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EFFECT OF PRE-RECORDED LECTURES INSTRUCTIONAL STRATEGY ON STUDENTS' ACHIEVEMENT AND RETENTION IN GENETICS IN ABUJA, NIGERIA

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Abstract

This study determined the “effects of the pre-recorded lecture instructional strategy on students' achievement and retention in genetics in Abuja, Nigeria.” The study adopted quasi-experimental research of pre-test, post-test, non-equivalent, non-randomized, control group design. The population for the study consists of 2,948 (1,300 males and 1,648 females) SS III students. Simple random sampling techniques was used to select a sample of 139 students (68 experimental and 79 control groups); students were selected for the study. Two instruments, namely Genetics Achievement Test (GAT) and Genetics Retention Test (GRT), were validated and found reliable for the study. Four research questions were asked, 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 the pre-recorded lectures Instructional strategy and their counterparts exposed to conventional method in favor of experimental group. Also, the findings revealed that there is no significant difference of male and female student's achievement and retention on Genetics using the pre-recorded lectures instructional strategy. Hence the researcher recommended that the use of pre-recorded lectures as an instructional strategy should be adopted for teaching Genetics concepts in the secondary schools, 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 pre-recorded lectures as an instructional strategy in teaching genetics concepts, among others.

Keyword: Pre-recorded Lectures Instructional Strategy, Achievement, Retention, Genetics

Introduction

Biology is one of the science subjects taught at senior secondary school level in Nigeria, it is a branch of natural science that studies living things and their interrelationship with the environment. It is the scientific study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. As a subject, biology plays a crucial role in helping students understand the natural world and their own place within it. Its inclusion in the curriculum is designed to equip students with a foundational understanding of the biological concepts that govern life processes, human health, ecosystems, and the environment. In Nigeria and many other countries, biology is considered a pivotal subject because of its interdisciplinary nature and its direct relevance to everyday life, health care, environmental conservation, and national development. The relevance of biology extends beyond the classroom; it helps foster awareness about important issues such as nutrition, disease prevention, personal hygiene, reproductive health, and the sustainable use of natural resources (Okebukola, 2021). These competencies are essential in an era where the world faces complex challenges such as global pandemics, climate change, and biodiversity loss.

In spite of the objective and importance of biology some of which are highlighted above, the achievements of students over the years have been observed to be low, revealing mass failure. The WAEC Chief Examiner's Reports (West Africa Examination Council, 2019-2023) has it that, students pass at credit level in Biology. Several studies, like that of Onu, Anyaegbunam & Uzoigwe (2020) also reported abysmally low levels of student interest and achievement in biology across secondary schools. These observations have become factors of major concern across all stakeholders involved in the biology educational process; teachers, parents, schools, government, curriculum developers and research bodies. Several factors based on research evidence (Usmadi, Hasanah & Ergusni, 2020; Niswah & Qohar, 2020; Ode & Tartenger, 2021; Tartenger, Omega & Enemarie, 2023) have been advanced for this incessant poor performance of students in biology. For instance, Niswah and Qohar (2020) attributed this to inadequate teacher's content knowledge of the subject. Jesulowo (2024) linked the poor achievement to perception of students that certain concepts in biology like genetics, central nervous systems and human physiology are very difficult to understand and comprehend. Other factors identified includes, methods of teaching, instructional materials, students' retentive ability and teachers content

knowledge. According to Obafemi (2022), the poor achievement often recorded in biology, is as a result of lack of adequate knowledge of the subject matter and incorrect interpretations of science concepts and ideas arising from students' prior knowledge. Obafemi (2022); Tartenger, Omega and Enemaria (2023) and Tartenger, Enemaria and Yusuf (2024) identified poor teaching method like lecture method as the major factor contributing to students' abysmal performance in mathematics and science among others.

A Pre-recorded lecture, unlike video conferencing, is an asynchronous learning style, whereby lessons are pre-recorded and made accessible to students. A pre-recorded lecture is a video or audio file created by an instructor and made available for students to watch at their convenience. Unlike a live lecture delivered in real-time, a pre-recorded lecture can be accessed asynchronously, meaning students can view it anytime, anywhere, and at their own pace. This format is a cornerstone of online and hybrid learning, offering high flexibility for both the instructor and the student. This method is characterized as

Asynchronous delivery: The instructor records the content ahead of time and distributes it through an online learning platform, such as YouTube, Vimeo, or a school's internal server.

Self-paced learning: Learners have full control over the pace. They can pause to take notes, rewind to review difficult concepts, or accelerate through familiar material.

Edited content: Instructors can edit the video before publishing to ensure it is focused, clear, and high-quality. This allows them to eliminate conversational fillers and interruptions that might occur in a live setting.

Content focus: Pre-recorded lectures are excellent for delivering core instructional content, such as factual information or foundational knowledge. Discussion-based learning, however, is better suited for live sessions.

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) viewed 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.

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.

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 (Fatma, 2015). Globally and in Nigeria, disparities in interest and achievement 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 pre-recorded instructional strategy can bridge

gender gaps in terms of students' achievement and retention in genetics in Abuja, Nigeria.

Statement of the Problem

Genetics is a major biology content of socioeconomic importance. Introduced in the school certificate biology syllabus in the mid-1970s, genetics covers core areas of social, agricultural, and medical concerns including heredity, variation, hybrids, sex determination, co-dominance, and mutation, among others. However, despite its relevance and judging by the abundance of empirical evidence on the achievement and retention gap, genetics has continued to feature as one of the most difficult biology topics. Evidence from WAEC (2019 - 2023) Chief Examiner's reports, among others, revealed that students' inability to demonstrate conceptual understanding and mastery of genetics has continued to cost them significant scores in examinations. It follows that students' inability to achieve meaningfully in genetics affects their overall interest and achievement in biology examinations. In ameliorating achievement and retention gap in genetics, researchers have come to deemphasize the persistent use of the traditional lecture method of instruction by biology teachers. They opined that although the traditional lecture method of instruction encourages larger content coverage among others, it has failed to enhance conceptual understanding and mastery which are basis for achievement

and retention optimization in genetics. Hence, they advocated for a shift to some novel strategies believed to be learner centered and which will help optimize interest and achievement through proactive learner engagement. However, despite these novel methods, achievement and retention in genetic is yet to improve. Perhaps, these methods concern more on improving interest and achievement through some hands-on, mind-on activities with no consideration that considerable learning occurs outside the classroom, where it is initiated and structured by students. Students' ability to initiate and structure learning outside the formal classroom and ahead of the real experience being a distinctiveness of the pre-recorded lectures instructional strategy may result in greater control over tasks. Hence, enhancing their achievement in the task and by extension improve their retention in genetics. Perhaps, by providing that biology students initiate and structure their learning of genetics outside the formal classroom and ahead of the real experience as obtained in pre-recorded lectures on their achievement in genetics may be enhanced and by extension improve their retention. It is on this assertion that the current study sought determined the effect of pre-recorded lectures instructional strategy on students' achievement and retention in genetics in Abuja, Nigeria.

Objective of the Study

This study investigated the effects of pre-recorded lectures instructional strategy on students' achievement and retention in genetics in Abuja, Nigeria.

Specifically, objectives of the study are to:

1. investigate the of achievement of students taught Genetics using pre-recorded lectures instructional strategy and Conventional method.
2. Find out the achievement of male and female students taught Genetics using pre-recorded lectures instructional strategy and Conventional method..
3. Determine the effect of retention of students taught Genetics using pre-recorded lectures instructional strategy and Conventional method.
4. Find out the retention of male and female students taught Genetics pre-recorded lectures instructional strategy and Conventional method.

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 pre-recorded lectures instructional strategy and those taught using Conventional Method?
2. What are the mean achievement scores of Male and female students

taught genetics using pre-recorded lectures instructional strategy?

3. What are the mean retention scores of students taught genetics using pre-recorded lectures instructional strategy and those taught using Conventional Method?
4. What are the mean retention scores of male and female students taught genetics using pre-recorded lectures instructional strategy?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

Ho₁: There is no significant difference in the mean achievement scores of students taught genetics using pre-recorded lectures instructional strategy and those exposed to conventional method.

Ho₂: There is no significant difference in the mean achievement scores of male and female students taught genetics using pre-recorded lectures instructional strategy.

Ho₃: There is no significant difference in the mean retention scores of students taught genetics using pre-recorded lectures instructional strategy and those exposed to conventional method.

Ho₄: There is no significant difference in the mean retention scores of male and

female students taught genetics using pre-recorded lectures 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. Simple random sampling techniques was used in selection of the 139 SS III students of which 60 for experimental group (12 male and 48 female) and 79 control group (27 male and 52 female) as sample for the study. Genetics achievement Test (GAT) and Genetics 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 experts and found reliable for the study with the reliability index of 0.78 for GAT and GRT respectively. A research assistant was trained on how to use pre-recorded lectures instructional strategy in teaching genetics. Pre-test, Post-test and Post Post-test was conducted and treatment lasted for 3 weeks for experimental and control groups simultaneously. The experimental group was taught genetics using pre-recorded lectures instructional strategy while the control group was taught using conventional method. 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 and Discussions

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 using Pre-recorded Lectures instructional strategy and conventional method?

Table 1: Mean and Standard Deviation of Achievement Scores of Students Taught Genetics Using Pre-Recorded Lectures Instructional Strategy and Conventional Method

Teaching Method	Type of Test	N	Mean	Std. Div.
Pre-recorded Lect.	Pre-test	60	14.20	3.11
	Post-test	60	27.03	1.41
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 pre-recorded lectures instructional strategy are (N= 60, M= 14.20, SD = 3.11) and (N= 60, M= 27.03, SD = 1.41) 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 on mean achievement scores of students taught genetics using Pre-recorded lectures instructional strategy 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 Pre-Recorded Lectures Instructional Strategy 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	1	3121.494	153.965	0.000	0.622
Error	2400.559	136	11.825			
Total	83326.000	139				
Corrected Total	8712.957	138				

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 pre-recorded lectures instructional strategy and Conventional Groups. The value of $F_{(2, 136)} = 153.965$ 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, pre-recorded lectures instructional strategies 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 pre-recorded lectures Instructional strategy and Conventional Group.

Research Question Two: What are the mean achievement scores of male and female students taught genetics using pre-recorded lectures instructional strategy?

Table 3: Mean and Standard Deviation on Achievement Scores of Male and Female Students' Taught Genetics Using Pre-recorded Lectures Instructional Strategy

Gender	Type of Test	N	Mean	Std. Div
Male	Pre-test	12	14.67	3.42
	Post-test	12	29.92	1.51
Female	Pre-test	48	14.08	3.06
	Post-test	48	27.06	1.41

Table 3 shows the results of pre-test and post-test mean and standard deviation of achievement scores of male students' taught genetics using Pre-recorded lectures instructional strategy (N = 12, M = 14.67, SD = 3.42) and (N = 12, M = 29.92, SD =

1.51), while pre-test and post-test mean and standard deviation of achievement scores of female students' taught genetics using pre-recorded lectures are (N = 48, M = 14.08, SD = 3.06) and (N = 48, M = 27.06, SD = 1.41) respectively.

Null Hypothesis Two: There is no significant difference in the mean achievement scores of male and female students taught using pre-recorded lectures instructional strategy.

Table 4: Results of ANCOVA on Achievement Scores of Male and Female Students 'Taught Genetics Using Pre-recorded Lectures Instructional Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	1.543 ^a	2	0.771	0.378	0.687	0.013	
Intercept	1967.456	1	1967.456	963.524	0.000	0.944	
Preprlachievement	1.339	1	1.339	0.656	0.421	0.011	
Gender	0.132	1	0.132	0.065	0.800	0.001	
Error	116.390	57	2.042				
Total	43966.000	60					
Corrected Total	117.933	59					

a. R Squared = 0.013 (Adjusted R Squared = -0.022)

Table 4 revealed that, there is no significant difference in the mean achievement scores of male and female students exposed to Pre-recorded lectures instructional strategy. The value of F (1, 57) = 0.065 was obtained with associated exact probability value of 0.800.

Since the associated probability value of 0.800 is greater than 0.05 level of significance, the null hypothesis is retained. This implies that, there was no significance difference in the achievement scores between male and female students taught genetics

using pre-recorded lectures instructional strategy.

Research Question Three: What are the mean retention scores of students taught genetics using Pre-recorded lectures instructional strategy and the 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 Pre-recorded Lectures Instructional Strategy and Conventional Method

Teaching Method	Type of Test	N	Mean	Std. Div.
Pre-Recorded Lect.	post-test	60	27.03	1.41
	Post-post-test	60	28.26	1.66
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 pre-conference lectures are (N= 60, M= 27.03, SD = 1.41) and (N= 60, M= 28.26 , SD = 1.66) 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 Pre-recorded lectures instructional strategy 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 Pre-Recorded Lectures 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
Postretention	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	136	12.421			
Total	87642.000	139				
Corrected Total	10347.314	138				

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 pre-recorded lectures and Conventional Groups. The value of $F_{(1, 136)} = 110.319$ 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 pre-recorded lectures teaching strategies produced a significant effect on the post-post-test retention scores of students' when covariate effect (post-test) is controlled.

Research Question Four: What are the mean retention scores of male and female students taught genetics using pre-recorded lectures instructional strategy?

Table 7: Mean and Standard Deviation on Retention Scores of Male and Female Students' Taught Genetics Using Pre-recorded Lectures

Gender	Type of Test	N	Mean	Std. Div
Male	post-test	12	26.92	1.51
	post-post-test	12	27.08	1.31
Female	post-test	48	27.06	1.41
	Post-post-test	48	28.56	1.61

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 pre-recorded lectures are (N

= 12, M = 26.92, SD = 1.51) and (N = 12, M = 27.08, SD = 1.31), while post-test and post-post-test mean and standard deviation of retention scores of female students'

taught genetics using pre-recorded lectures are (N = 48, M = 27.06, SD = 1.41) and (N = 48, M = 28.56, SD = 1.61) respectively.

Null Hypothesis Four: There is no significant difference in the mean retention scores of male and female students taught using pre-recorded lectures.

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 Pre-Recorded Lectures Instructional Strategy

Source	Type Sum of Squares	III df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	65.601 ^a	2	32.800	2.081	0.134	0.068
Intercept	92.922	1	92.922	5.896	0.018	0.094
Posttprlretention	0.497	1	0.497	0.032	0.860	0.001
Gender2	65.465	1	65.465	4.154	0.046	0.068
Error	898.399	57	15.761			
Total	38464.000	60				
Corrected Total	964.000	59				

a. R Squared = 0.068 (Adjusted R Squared = 0.035)

Table 8 reveals that, there is significant difference in the mean retention scores of male and female students exposed to pre-recorded lectures. The value of $F_{(1,57)} = 4.154$

is obtained with associated exact probability value of 0.046 is less than 0.05 level of significance, the null hypothesis is rejected.

Discussion of Findings

The findings of this study revealed that pre-recorded lectures instructional strategy has significant effects on students' interest in genetics unlike the conventional method, that did not improve students' interest in learning of genetics. This implies that, there is significant difference in the mean interest ratings of students exposed to pre-recorded lectures instructional strategy and

Conventional method in favor of pre-recorded lectures instructional strategy.

The results also revealed that, there is no significant difference in achievement and 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 and Pre-recorded lectures 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.

The findings of this research further revealed that teaching strategy has significant effects on achievement and retention, it showed that students taught genetics through pre-recorded lectures instructional strategy performed better in terms of achievement and retention than those exposed to the conventional method. The results also revealed that, there is no significant difference in achievement and 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 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 pre-recorded lectures instructional strategy.

Conclusion

This study concludes that, pre-recorded lectures instructional strategy enhanced and improved students' achievement and retention in genetics than the conventional method. pre-recorded lectures 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 pre-recorded lectures instructional strategy in teaching genetics in secondary schools in FCT Abuja
2. Biology teachers be trained on how to employ the use of pre-recorded lectures instructional strategy to teach genetics and Biology in general.
3. Biology teachers should be encouraged to use pre-recorded lectures 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-centered approaches like pre-recorded lectures instructional strategy in teaching and learning of certain concepts in biology.

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