



EFFECTS OF FLIPPED CLASSROOM STRATEGY ON RETENTION ABILITY OF SENIOR SECONDARY SCHOOL STUDENTS' IN ABSTRACT CONCEPTS IN BIOLOGY IN KWARA STATE, NIGERIA

BY

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Abstract

This study examined the effect of Flipped Classroom strategy on retention ability of senior secondary school students' in abstract concepts in Biology in Kwara State, Nigeria. The study adopted the pretest-posttest control group, quasi-experimental design. 150 SSII Biology students from two (2) co-educational schools in Irepodun Local Government Areas of Kwara State were randomly assigned to treatment group. The instruments used were Biology Student Retention Ability Test ($r=0.86$), Teachers Instructional guides on Fieldtrip strategy and lecture method and Evaluation Sheet for Assessing flipped classroom Strategy and Evaluation Sheet for Assessing Lecture method. The instruments were validated by two science educators and one expert in measurement and evaluation for both face and content validation. Two Research Questions and hypotheses guided the study. Descriptive statistics of means and standard deviation were used to answer the research questions and inferential



statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The effect of Flipped Classroom strategy on retention ability of senior secondary school students' in abstract concepts in Biology in Kwara State, Nigeria was significant ($F_{1,149} = 129.650, P > 0.000$). The results of the study showed that flipped classroom strategy enhanced students' performance in biology than lecturer method. This implies that flipped classroom strategy enhanced student's students' Retention ability in abstract concepts in Biology in Kwara State, Nigeria was significant. Based on the findings of this study, flipped classroom strategy should be adopted for teaching biology in the classroom in order to improve students' retention ability in abstract concepts in Biology.

Keywords: Flipped, classroom, strategy, abstract, concept, biology

Introduction

Biology is science of life that is concerned with the identification and functions of living organisms. Biology is one of important subject for science students in the curricula of senior secondary schools in Nigeria. Sallau, Abubarkar, and Sani (2018) described Biology as the science of life. Adewumi and Adeoye (2023) described biology as a unique captivating field of study that touches almost every aspect of human existence, for the advance in the field of biology have resulted in high standard of living in the field of food and health sectors. In addition, Ogundiwin and Olawale (2021) described biology as a broad field of science covering the minute workings of chemical machines in our cells, to broad-scale concepts of ecosystem and global climate. Biology as a branch of science lays a foundation in the studies of the structure, function, heredity, and evolution as well as anatomy and physiology of vertebrate and invertebrate animals, micro-organisms, fungi, plants, and animals that enable living things to trace their past, present and future events throughout their lifetime.

The importance of Biology cannot be overemphasized in terms of its relevance to Agriculture for the production and preservation of food; production of high yield and diseases resistance varieties; in health to understand personal hygiene among others; in medicine, it provides knowledge for the treatment of patients with various illnesses and in pharmacy for the production and administration of drugs; in chemistry to study the reaction of chemicals; in physics, it helps with the accuracy in measurements and technology which is the invention of useful things to solve problems. Knowledge of Biology is intrinsically connected to building a sustainable interaction between nature and human society. The specific aims to be achieved by the Biology curriculum, as specified in the National Policy on Education (NERDC, 2013) comprises the following: to understand certain vital biological concepts essential for positive living in a world of science and



technology; to illuminate the problems of sex, reproduction, growth, pollution, and health for the benefit of the society; to develop the ability to apply scientific knowledge to everyday life in the areas of personal and community health, as well as agriculture; to make room for technological advancement; to disperse superstitions beliefs in a technological method and to develop an awareness of the environment. Even though the Biology curriculum has a robust and consistent objective for Biology as a teaching subject, the students still find some Biological concepts difficult to understand such as vertebrate physiology which is how systems of the human body function.

Despite the fact, that the Biology curriculum includes robust and practical goals for the comprehension of biology as a teaching subject in senior secondary schools in Nigeria, students need help understanding some scientific concepts in biology, particularly abstract concepts such as molecular biology, cells, genetics, genes, and chromosomes. Secondary school pupils find topics such as genes, chromosomes, Mendelian genetics, and hormones challenging, as stated by Cimer (2012). The West Africa Examinations Council (WAEC) Chief Examiner's Reports from 2015 to 2018, as well as 2019 and 2022, provide data that confirm the prevalence of low academic performance among students in genetic concepts in biology. For example, the Chief Examiner's findings from WAEC from 2015 to 2018 revealed that many examinees could not provide needed definitions for terms such as gene, genotypes, gene mutation, and similar concepts. Furthermore, the WAEC Chief Examiner reports from 2019 to 2022 indicated that candidates struggled to define the term "chromosome," list transmittable qualities, draw genetic crosses accurately, and perform genetic diagrams correctly (Olagunju & Adewumi, 2021).

The inadequate teaching methods used by most biology teachers have been identified as the primary cause of the underperformance of students in biology. Previous studies have examined many teaching methods, including the gallery walk and mind mapping strategies proposed by Adewumi and Adeoye (2023), the Critical exploration strategy developed by Oloyede (2014), and the Puzzle-based Critical Thinking and Motivation tactics suggested by Ogundiwin (2013) and Gallery walk and Mind mapping (Adewumi 2021).

Despite implementing various strategies of teaching, students continue to face a significant prevalence of underperformance in the subject (biology). Researchers have taken notice of the flipped classroom strategy as one of the most effective teaching strategy. A Flipped Classroom strategy is a blended learning where students learn about the content given by the facilitator and introduces the contents and practice working through it



in and outside the classroom. Flipped classroom strategy is a mediator and a motivator for students to learn through the prepared materials before class time. Flipped classroom strategy is one of the new pedagogical methods based on active and group-based problem-solving activities in the classroom, with simultaneous video tutorials and homework exercises (Ezenwabachili and Okoli 2021)). Flipped classroom provides the opportunity for students to learn content according to their own pace based and their needs (Ugwayi, et al 2019). Therefore, flipped classroom instruction is a blended learning in which learners learn content online by listening to audio lectures or watching video lectures. Furthermore, mostly at their various home, assignment is solved together in the class with teachers. Flipping the classroom involves online learning and studying through a series of video lectures and this enhanced online method of learning is supported by face-to-face classroom discussions, interactions, and individual help. Though the flipped classroom is different from a purely online learning environment, this is because it involves the presence of a teacher in the classroom. Flipped classroom involves students learning the material by watching video lectures before class. Setren, Gambari et al (2016) revealed that flipped classrooms may take more time for students and will leave them without a foundational overview of the concepts if they do not watch the videos. Ezenwabachili and Okoli (2021) posited that the flipped classroom intentionally shifts instruction to a learner-centered model in which class time explores topics in greater depth and creates meaningful learning opportunities, while educational technologies such as online videos are used to 'deliver content' outside of the classroom. In a flipped classroom, 'content delivery' may take a variety of forms. Regularly, in Flipped classroom lessons video shall be prepared by the teacher or third parties to deliver content, although online collaborative discussions, creation of WhatsApp groups, digital research, and text readings may be used. Ezenwabachili and Okoli (2021) reported that teachers' interaction with students in a flipped classroom can be more personalised and less didactic. It is appropriate to highlight the benefits of Flipped Classroom Instruction to students and these include; it encourages the student to utilize digital content to explore knowledge beyond textbooks, it improves personalized learning and teaching methods and it gives rise to student-centered learning. Others include; it improves visualization and understanding capacity, smoothens student-teacher and student-student collaboration and interaction, enables students to learn at their own time and pace, provides a good platform for students to ask questions or seek extra help, encourages students to think out-of-the-box ideas and lastly, it encourages online tutorials and lectures because it supplies basic and essential knowledge and allows students to review the topics again and again as many times as possible.

In the course of concentrating on the students' performance, retention ability and gender usually suffice. Student's retention ability is one of the factors that might



affects student performance in biology. Retention ability can be referred to as the ability to retain whatever is learned during a process for future use. Ali, et al (2020) defined retention ability as recalling pieces of knowledge, processes, and skills that were learned earlier. Retention ability is the preservative factor of knowledge, attitude, and skills in the mind this corroborated. Ali et al (2020) described retention ability as what is left after learning has taken place over a given period. Retention can be the repeat of the performance of a task of learned behavior earlier gained. Concerning teaching and learning, retention means the act of remembering what has been learned in the classroom. Knowledge acquired during instruction is useful only when it is put up and retained, recovered, or created for usage in a new situation. It is believed that after some time it is a major part of the knowledge or skills that students will be able to keep or retain in their memory. Retention ability is an important aspect that must be pursued in learning because of its benefits to the teaching and learning situation. Ezenwabachili and Okoli (2021) suggested that Biology concepts need to be presented to the learners in a way or method that touches their sub consciousness and which can trigger quick recalling of the concept being taught or learned. When retention ability is high or strong learning is fast and easy, conversely when retention ability is low or weak, learning becomes a struggle and difficult for both male and female (gender). Gender has also remained an important issue which is relevant to the field of education because it has been linked with students' performance. Gender has been identified as one of the factors influencing students' performance in science. Female participation in science and related subjects has become a challenge for quite some time.

The belief among researchers varied relative to gender differences and intellectual abilities. That may be the reason Gambari et al (2016) concluded that findings on the effects of gender on students' achievement are inconclusive. The boys are less likely to fully engage with the school learning experience and more likely to receive sanctions such as expulsion. Aucejo and James (2019a) showed that there are large differences in behavior between males and females and these can explain much of the gender gap in schooling outcomes at all levels. The school outcomes of boys would likely be improved by moving away from continuous assessment and teacher-assigned scores toward greater use of standardized tests. Aucejo and James (2019b) argued that females tend to have much stronger verbal skills and evidence suggests that these types of skills are particularly valuable for educational attainment and can largely explain greater female enrolment in college. Also, as discussed earlier, for any given level of ability, boys tend to obtain lower teacher assessments than girls, likely due to worse classroom behavior, and this can lower their opportunity to progress successfully in the educational system. Danjuma (2015) posited that no statistically significant difference existed between the achievement of males and females in science, up till now gender differences in



science continue to exist. Etim, (2016) stated that the performance of female students is higher than that of male counterparts in English Language, Mathematics, and Biology. It is believed that Male teachers do not judge the academic performance of male students more favorably than that of girls, and female teachers do not show a preference for evaluating female students' performance more favorably than those of boys. It is on this note that Andrea, (2014) concluded that Gender differences in education are (and always) a social problem as they exist along with disadvantages within the labor market.

Many studies had been carried out on similar topic both at the national and international levels, focusing on the use of strategies to improve students' achievement. Works have been carried out on the strategy and gender separately on different subjects. However, not much has been done using the strategy and gender in the area of abstract concepts in Biology. It is this gap that this research work stands to fill. This research work seeks to find out the effect of that flipped classroom strategy will have on students retention ability in abstract concept in Biology. It also, examined the influence of students' gender on the abstract concepts in biology.

Statement of the Problem

Retention ability of students in senior secondary school in Biology has been fluctuating. This is inappropriate for a course that is not only popular with students in junior secondary schools but also useful to all Biology students in senior secondary schools. Prominent among the factors which have been identified as contributing to the fluctuating level of students' retention ability in Biology are the teaching methods adopted by their teachers. It would thus, be necessary to introduce more innovative and creative strategies suitable for improving teaching and learning outcomes in senior secondary schools biology abstract concepts. One of the innovative strategies is the adoption of online learning packages with little presence of the teacher, where the students themselves are involved in the processes. This would bridge the gap between suitable exposures to teaching strategy. Several innovative and creative pedagogy has been assessed by different researchers. However, the effects of activity-based, learner-centered pedagogy, such as flipped classroom strategy, on students' retention ability n biology is inconclusive. Therefore, there is a need, to explore the effects of Flipped Classroom strategy to find out whether they could meaningfully co ntribute to promoting retention ability of students in senior secondary schools abstract concepts in Biology. This study, therefore, determined the effects of Flipped Classroom strategy on students' retention ability in abstract concepts in Biology in Kwara State, Nigeria. The study further investigated the moderating effects of students' gender on the abstract concepts in biology.



Purpose of the Study

The purpose of this study was to investigate the effect of flipped classroom strategy on students' retention ability in abstract concepts in Biology in Kwara State. Specifically, the study sought to;

1. Examine the difference between the retention ability mean scores of students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.
2. Find out the difference between the retention ability mean scores of male and female students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

Research Questions

Two research questions were formulated to guide the study.

1. What are the difference between the retention ability mean scores of students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.
2. What are the difference between the retention ability mean scores of male and female students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

Research Hypotheses

To guide the study two null hypotheses were formulated and were tested at 0.05 level of significance:

H₀₁: There is no significant difference between the retention ability mean scores of students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

H₀₂: There is no significant difference between the retention ability mean scores of male and

Female students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

Methodology

This study adopted the pretest-posttest control group quasi-experimental research design. The population consisted of all senior school students in Irepodun Local Government Areas of Kwara State, Nigeria while the target population comprised senior school students in SSS II offering Biology. A sample of 150 students was randomly selected using balloting. Four instruments were used for data collection which are Abstract Concepts in Biology retention ability Test, the students' retention ability test consists of two sections,



A and B. Section A seeks personal information on the students while section B consists of the achievement test made up of 40 items. Originally, 55 questions were set on abstract concepts. The questions were given to four teachers teaching biology in senior secondary school and one experienced evaluator to establish the validity of the questions. This was carried out to ascertain whether the instrument was fit for the students. After their scrutiny, 45 questions were left. These 45 questions were the one that falls within the discriminating power of 4-7 as those that fall below 4 were considered too simple and those that fall above 7 were considered to be difficult for the students. The questions were trial-tested in a senior secondary school that was not nominated for the research study. Kr 20 was used in analyzing the data and 0.79 was obtained as the reliability coefficient. Teachers' Instructional guides on flipped classroom strategy and lecture method, and Evaluation Sheet for Assessing Teacher's Performance during Training. The draft of the Teacher's Guide on flipped classroom strategy and lecture method and evaluation sheet was given to five experienced Biology teachers in selected secondary schools. This was done to ensure the face, content and construct validity of the guide and evaluation sheet. These teachers are seasoned WAEC, NECO, and NABTEB examiners, and based on their comments and suggestions necessary amendments were made. The researchers administered the instruments {biology students' retention ability (BSRA)} as a pre-test and the student's scores were recorded. Thereafter, the researchers taught the experimental group (flipped classroom strategy) the abstract concepts using flipped classroom strategy, while the control group was taught with the lecture method. The abstract concepts that were selected for this study were related to evolution molecular Biology and genetics. The treatment lasted for six weeks. The data collected were analyzed using descriptive statistics, Analysis of Covariance, and Scheffe Posthoc test at 0.05 level of significance.

Results

Research Question One :What are the difference between the retention ability mean scores of students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

**Table 1**

Mean Retention Scores and Standard Deviation of students taught abstract concepts Using Flipped Classroom and Lecture Method.

Groups	N	Post-test		Retention	
		Mean	SD	Mean	SD
Flipped Classroom Strategy	55	35.39	3.159	36.27	2.88
Conventional Method	95	18.82	4.208	14.77	4.66

SD- Standard deviation

Table 1 displays increase in the students' retention ability scores of all the groups as compared to post -test scores descriptive statistics of the students' retention ability scores. The mean post-test scores for Flipped classroom strategy post-test mean score was 35.39 with standard deviation of 3.199 while Conventional method had pos-test mean scores of 18.82 with standard deviation of 14.208 mean retention ability scores for conventional method was 14.77 with standard deviation of 4.668.

Research Question Two: What are the difference between the retention ability mean scores of male and female students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

Table 2

Mean and Standard Deviation Associated with Male and Female Taught Abstract Concepts in Biology Using Flipped Classroom Strategy

Groups	N	Post-test		Retention	
		Mean	SD	Mean	SD
Flipped Classroom Strategy	21	35.56	3.386	36.59	3.027
Conventional Method	34	35.27	2.641	36.06	3.036

Table 2. Displays the descriptive statistics of the Flipped classroom group students' retention scores with gender. The mean Flipped classroom scores for male post-test was 35.56 with a standard deviation of 3.386 while the mean flipped classroom scores for female post-test was 35.27 with a standard deviation of 2.641. The mean students' retention ability score of male in Flipped classroom was 36.59 with a



standard deviation of 3.027 and the mean students' retention ability score of female in Flipped classroom was 36.06 with a standard deviation of 3.036.

Null Hypothesis One

H₀₁: There is no significant difference between the retention ability mean scores of students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

Table 3

Results of ANCOVA Test on Students' Retention Ability scores in abstract concepts in Biology Using Flipped Classroom Strategy and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	30948.171	2	10316.057	809.238	.000
Intercept	2021.170	1	2021.170	158.550	.000
Posttest	69.223	1	69.223	5.430	.021
*Method	3305.524	1	1652.762	129.650	.000
Error	3237.957	148	12.748		
Total	237299.000	150			
Corrected Total	34186.128	149			

$$F = 129.650; P = 0.000 < \alpha = 0.05$$

Table 3 revealed a significant difference in the retention ability of students who taught Biology using flipped classroom strategy and lecture method. F = ratio of 129.650 which is associated with an exact probability value of (0.000) is less than the benchmark probability value of 0.05 set as the level of significance, the null hypothesis was therefore rejected. This indicates that there was a significant difference in the mean retention ability scores of students in Biology using flipped classroom strategy enhanced and facilitated students' retention than lecture method. The result implies that students' retention ability with the use of Flipped Classroom Strategy was higher in Biology than when the lecture method was used. The hypothesis is rejected.

Null Hypothesis Two

H₀₂: There is no significant difference between the retention ability mean scores of male and female students' exposed to flipped classroom strategy in abstract concepts in biology and compare with their counterpart taught using the lecture method.

**Table 4**

Result of ANCOVA Test of students' Post-test Retention Ability Test Scores of Biology Using SBRAT on Gender and Flipped Classroom Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5.748	2	2.874	.341	.712
Intercept	862.651	1	862.651	102.365	.000
Post-test	.030	1	.030	.004	.953
Gender F	5.670	1	5.670	.673	.414
Error	691.029	52	8.427		
Total	112519.000	55			
Corrected Total	696.776	54			

Table 4 reveals the ANCOVA table on male and female students' retention ability Test in SBRT. The result reveals that the noted difference between male and female was not significant at 0.05 alpha level. F= ratio .673 and p=.414 which is greater than the benchmark probability of the value of 0.05 indicating that there was no significant difference in the mean retention ability scores of male and female students taught abstract concepts using Flipped classroom strategy. The null hypothesis was therefore accepted.

Discussion of Findings

The result revealed a significant difference in the mean retention ability scores of biology students' using flipped classroom strategy perform better than students' retention ability in lecture method. The result implies that the students' retention ability of students in Flipped Classroom strategy group was higher in abstract concepts than the students in the lecture method. This result is in line with the findings of Gambari, Bello, Agboola, and Adeoye (2016) who reported that the students taught the concept of the Mammalian skeletal system using flipped classroom instructional model out-performed their counterpart taught the same concept using the conventional lecture method in retention; and Ugwanyi, Nduji, Gana, Nwajiuba, Ene, Okeke, Eseadi, and Okeke (2019) who showed that flipped classroom instructional technology was effective in enhancing the retention of physics students at both post-test and follow-up. The result of this finding showed that Flipped Classroom strategy showed it flexibility and synchronous which enabled the students to retain high knowledge of what they learnt after the classroom activities and also enable them to make good of the knowledge gained and applied on other biological concepts.



The findings indicated that there was no significant difference in the mean student's retention ability scores of male and female students who taught abstract concepts using flipped classroom strategy. The finding of the study showed that the gender of the students has no role to play in the student retention ability in abstract concepts. Buttressing this is the finding of Ezema, Adejoh, Iji, and Ochu (2017) who posited a study that retention of Biology concepts was not enhanced by gender. Based on the findings of the differences between the flipped classroom strategy and lecture method and students, retention ability showed that the teachers motivated the biology students by making the learning flexible and this enabled them to learn in their comfort zones. Opportunities are given to the students to interact with different activities like; discussion forums, quizzes, and feedback in flipped classroom strategy to boost their confidence.

The findings indicated that there was no significant difference in the mean student's retention ability scores of male and female students who taught abstract concepts using Flipped classroom method. This finding is in agreement with Gambari, Bello, Agboola, and Adeoye (2016) established that both the male and female students who taught the concept of the Mammalian skeletal system using flipped classroom instructional model out-performed their counterparts taught the same concept using the conventional lecture method in retention and no significant difference was observed after the treatment. Gana, Nwajiuba, Ene, Okeke, Eseadi, and Okeke (2019), The result showed that flipped classroom strategy was effective in enhancing the students retention of abstract concepts. This may be attributed to the type of use. Flipped classroom strategy exposes the students to both inside and outside classroom exposure that leads to learning before the classroom intervention.

Conclusion

The findings of this study provided empirical evidence that the utilization of Flipped Classroom strategy enhance students' retention ability in abstract concepts in Biology. There is no significant difference in the retention of male and female students teachers taught abstract concepts in Biology using flipped classroom strategy. The implication of this study, therefore, centers on the development and use of more online/ blended learning means of teaching which are synchronous and asynchronous because they are more student-centered and their flexibility is second to none.

Recommendations

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

1. Biology teachers should adopt the use of flipped classroom strategy in teaching biology the students which will invariably lead to high retention ability in the subject.



2. Ministry of Education and Science Educators should organize workshops, seminars, and conferences from time to time for Biology teachers at the secondary schools. This is to prepare the lecturers on the effective use of Flipped Classroom Strategy in teaching Biological concepts to improve students' retention ability and also to make the lessons motivating.
3. Biology teachers should make Biology teaching and learning gender friendly by the Flipped Classroom Strategy activities flexible and learners friendly to enhance retention ability.

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