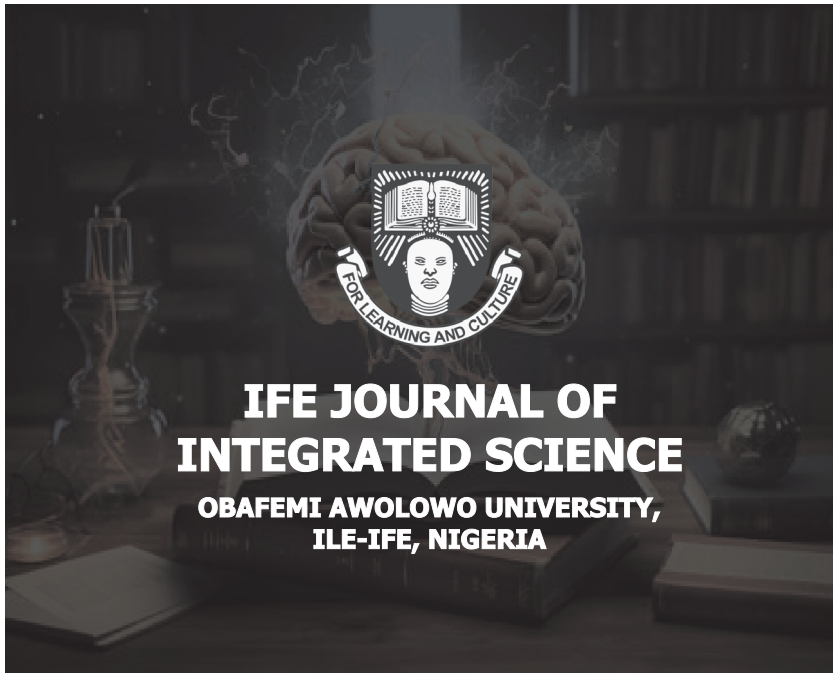

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EFFECTS OF FLIPPED AND BLENDED CLASSROOM LEARNING APPROACHES ON STUDENTS' RETENTION IN GENETICS CONCEPTS IN BIOLOGY IN EGOR LOCAL GOVERNMENT AREA OF EDO STATE

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Abstract
The study investigated the effect of flipped and blended classroom learning approaches on students' retention in genetics concepts in biology in Egor Local Government Area of Edo State. The study adopted the non-equivalent pretest-posttest control group research design. The population of this study comprised of 497 senior secondary school two (II) Biology students from the 11public co-educational schools in Egor Local Government Area of Edo State. The sample of the study is made up of 74 students comprised of 34 male and 40 female drawn from three intact classes. The study utilized the Biology Achievement Test on

Genetics (BATG) as instrument for data collection. The content, face, and structure validity of the instrument was ascertained by experts in science education. The reliability of the BATG was obtained using Kuder-Richardson Formulae 21 (KR-21) and a reliability coefficient index of 0.786 was obtained. Mean, standard deviation, and Analysis of Covariance (ANCOVA) were used to test the hypotheses. The findings of this study were that students exposed to the Blended learning approach were the most impacted, followed by the Traditional approach group while the Flipped classroom approach was the least impacted. The study concluded amongst others that Blended learning is the most impactful on students' achievement.
Keywords: Blended Learning, Flipped Learning, Traditional Learning Approaches, Gender, Retention

Introduction

Biology is a branch of natural science that deals with the study of living organisms; this includes their structures, functions, evolution, distribution and interrelationships. Biology is the science subject mostly preferred by many science students in secondary schools because it has less mathematical calculations as found in Physics and Chemistry which deal with non-living things. Due to this reason, Biology has higher enrolment of students in the external examination (Senior School Certificate Examinations) compared to Physics and Chemistry. Genetics as a topic is considered as one of the important topics in biological sciences. It is a fundamental part of biology that deals with heredity and variation in living organisms and knowledge of genetics is critical in understanding some other aspects of biology.

Genetics is the study of genes, genetic variation, and heredity in living organisms. It is an important branch in biology because heredity is vital to living organisms. Gregor Mendel a Moravian Augustinian friar working in the 19th century in Brno, was the first to study Genetics scientifically. The science of genetics began in the 1800s when Gregor Mendel figured out how traits are inherited by studying peas. Since scientists identified genes in the mid-1900s, the field of genetics has grown by leaps

and bounds. In the 1800s, Gregor Mendel discovered the rules of genetics. These rules govern inheritance, the law of Independent Assortment, Law of Dominance

Genetics methodologies provide powerful ways to investigate biological processes, and can ultimately reveal the underlying molecular mechanisms involved even when there is no knowledge at the outset of a study as to the mechanistic basis of a biological phenomenon. Branches of genetics include behavioural genetics, classical genetics, cytogenetics, molecular genetics, developmental genetics, and population genetics.

In the 19th century, it was observed that offspring resemble their parents but almost nothing was known about why this happened. Why did some children "take after" one parent, but not the other. Why could plants and animals have offspring that had traits seen in neither parent? Why did some species resemble each other more closely than others? In the 19th century, Gregor Mendel began examining inheritance in a systematic way by breeding pea plants. He tracked several traits of pea plants across several generations, recording what kinds of parents had what kinds off offspring. He successfully derived the mathematics behind dominant and recessive genes the first empirical evidence that traits really were passed down in some measurable way from parent to offspring.

Genetics concepts are abstract, several studies suggest genetics is difficult because it contains many abstract concepts (i.e., concepts that cannot be seen directly and are beyond our senses). Many abstract concepts exist at the molecular level, such as genes and DNA, this level includes invisible concepts.

Reasoning across levels of representation: Concepts in genetics exist on different levels of representation (macro, micro, molecular and symbolic) (Treagust & Tsui, 2013). For example, learning about inheritance involves ideas at the macroscopic level (e.g., phenotype), microscopic level (e.g. chromosomes), molecular level (e.g. gene mutations) and symbolic level (e.g. Punnett squares). Thus, learners of genetics need to reason between these levels.

Reasoning across ontological levels: Duncan and Reiser (2007) suggest that student's struggle to integrate knowledge about ontologically distinct entities in genetics, that is, entities that are distinct in their fundamental nature rather than with respect only to what are known about them. A gene is both a unit of information and a section of DNA. Thus, genes exist at both the informational level and the biophysical level, and students need to integrate this knowledge to understand genetics. According to Duncan and Reiser (2007), genetics is a hybrid of ontologically distinct levels.

Connecting concepts: Several studies suggest genetics is hard because students have difficulty connecting different concepts. Students not only have difficulty reasoning across levels of representation, multiple organizational levels and ontological levels, but also may struggle to connect concepts on the same level. Venville and Treagust (2002) found that high school students had difficulty connecting different concepts in genetics, such as genes with proteins, and DNA structure with protein syntheses, because lessons disconnected these concepts. Marbach-Ad (2001) also found that students had difficulties connecting concepts such as gene and trait to other concepts such as protein DNA and enzymes and therefore compartmentalise concepts. Marbach-Ad suggests this was a result of focusing on different areas of genetics in different lessons.

Domain-specific vocabulary: Knippels, Waarlo and Boersma (2005) argue that students find genetics difficult because genetics contains a lot of domain-specific vocabulary and terminology. For example, terms such as DNA, chromosomes, heterozygous, homozygous and codominance tend to be used solely within the context of genetics when students learn biology. Thus, students may not reinforce their understanding of genetics terms in other lessons.

Mbajiorgu et al. (2006) concluded in their report that without the use of special instrument the concept of genetics cannot be concretized for students understanding.

Retention is an individual's ability to hold information or

store learned materials for future use. Retention is a vital component in every learning process particularly in the science subjects. Poor retention has been identified as a common problem among secondary school students by stakeholders. This is because concepts learned tend to fade away with time when not put to use or not properly retained. This gravitates to forgetting and loss of knowledge. Retention in this context is an academic variable that emphasizes the recall of genetics concepts after a given period of teaching and learning experiences. It is also a measurable variable that would be ascertained from the level of success of a delayed posttest.

The concept of Retention can be said to mean students ability to remember or recall information, material and experiences learned over a given period of time. This acquired materials in the mind need to be preserved in form of images for knowledge to develop. Fakayode (2012) defines retention as individual ability to hold information or store learned material for future use. When simulating situation occurs, retained images are retrieved or produced (Douglas & Morris, 2012). Okoye (2012) opined that retention is the process of maintaining the availability new meanings or some part of them. Suggesting that the amount of original meaning that will be retained at any given point in time is a variable quantity, that active participation during instruction can increase learning and retention. Researches in science education have it that teachers can improve retention of concepts and information by explicitly creating memorable events involving visual or auditory images with projects, plays, simulation and other forms of active learning that can boost students' retention. Without retention, there cannot be a successful transfer of knowledge from one subject to another. If retention is not a top priority in the classroom, teachers will spend most of the class time reviewing and re-teaching concepts.

Forgetting as a word is the direct opposite of retention. It represents a decrement in the availability of an acquired meaning which describes the loss in availability that occurs between the original establishment of the meaning and its later reproduction.

Forgetting and fading away of concept learned tend to occur with time when is not put to use or not properly retained. Considering these two words, retention is the positive aspect of memory while forgetting is the negative aspect. Retention therefore is a vital component in learning process particularly in the science subject (Biology).

Teaching methods involve different activities of the teacher and the learner such as questioning, explanations, demonstration or direction. The activities can be referred to as skills or techniques.

Thus, teaching methods involves different techniques. The use of these techniques varies with different teaching methods and depend on many factors such as type of learning objectives, nature of subjects, age of students, number of students among others. Hence, there are different types of teaching methods: lecture/expository method, discussion, demonstration, recitation, lecture/discussion, game and simulations, engagement, flexible Fridays, spaced learning, blended learning, concept mapping, problem-solving, role-playing, scaffolding and inquiring learning. These different teaching methods have been grouped by some educator (Sawa, 2002; O'Bannon, 2002; Campbell, 2006; Stephens & Gray, 2023) into two main approaches: teacher-centered and student-centered.

The term teacher-centered approach therefore comes from the roles of the teacher in the traditional classroom as possessor of knowledge and decision maker and also decides the knowledge that will be transferred to learners in the teaching and learning process. Ibe (2004) noted that the traditional teaching methods stress transmission of knowledge in a manner that emphasize and encourage memorization. In line with the view of Guisti (2008) which describes that approach as one fact laden text consisting of assign, recite, test and then discuss the text procedure. From the foregoing it indicates that teacher-centered approach includes teaching methods that involves only unidirectional flow of information from teacher to students and does not give room for

exchange of ideas that makes teaching and learning process active.

Student-Centered Approach: Student-centered approach includes all teaching methods that underscore the teacher as a decision maker and problem solver in the classroom but rather see teacher as guide, facilitators, mentors, coach or consultants in the teaching and learning process. In the educational sector the term student-centered, child-centered or learner -centered are interchangeably used to refer to teaching methods that allow students to share some degree of responsibility and decision making in the classroom. The student-centered approach is opposed to the student-centered approach that characterizes the traditional teaching methods which rests classroom decision solely on the teachers.

Traditional classroom approach (Face-to-Face or lecture method) has been with us since Adam, and has been fulfilling the objective of imparting knowledge to our children. This learning approach largely comprises of classroom ambience which focuse on a variety of components, such as lectures, capstones, team projects, labs, and studios. Teaching is done synchronously in a physical learning environment, which means that the students are "traditionally" at the same place at the same time. This method of teaching is more teacher-centered, where the teacher lectures directly to the students, while they passively listen to the teacher. There is a Face-to-face interaction between student and teacher as well as amongst students. In traditional classroom learning approach students are evaluated exclusively by the teacher, who represents the main source of information, and the quality of learning is strongly dependent on the teacher alone.

The key asset of the traditional classroom is that students are motivated by both the teacher and their classmates. Numerous advantages have been credited to the traditional classroom approach instruction; both in the past and in the present dispensation that still make it very relevant. According to Miller (2020), in face-to-face learning, both teachers and students could use different intonations, facial expressions, body language

expressions, and other elements to transmit all kinds of emotions or feedback. Most of these features are not available in the modern system of learning. Regular attendance in classes helps students interact physically with their teachers and their peers.

The definition of the word flipped classroom was first given by Lage et. al (2000) "Inverting the classroom" which means that events that have traditionally taken place inside the classroom vice versa. "Invert" according to the authors means "turn inside out or upside down" which has the similar meaning with the word. Flipped classroom has been defined in numerous ways by different authors in the literature and a generally accepted definition does not exist. Flipped classroom is an approach to teaching and learning activities where students watch a video lesson outside the class through distance learning and have hands on activities in the class. Flipped learning is also been referred to as inverted classroom. According to Bishop and Verleger (2013), flipped classroom is an educational technique that consists of two parts, interactive group learning activities inside the classroom and direct computer-based individual instruction outside the classroom. Mull (2012) defined flipped classroom as a model that allows student prepare themselves for the lessons by watching videos, listening to podcast and reading articles. Also, Milman (2012) expressed that flipped classroom approach aims at the efficiency of lesson by transferring knowledge to student via video and podcast as well as by discussion, group works and application during course. Zen and Syamsuar (2019) explained further that flipped classroom consists of students studying learning materials through a video at home or before coming to class, while class activities will be more of group discussions, questions and answers. Halili and Zainuddin (2015) argued that flipped classroom is a reverse classroom, that it is an element of blended learning which integrates both face to face learning in the class through group discussion and distance learning outside the class by watching asynchronous video lesson and online collaboration. Blended learning simply means the activity of teaching and learning which combines face to face physical activities with online learning (Lean, moizes & Newbery, 2014).

Hamdam et.al (2013) added that flipped classroom is not a defined model instead it is a model that teachers use as a compensation for the demands of students by using different equipment.

Blended learning is considered a supportive learning environment (Miyazoe & Anderson, 2010). It is also mentioned that blended learning decreased dropout rate and increased examination pass rates compared to fully online courses (Lopez-Perez et. al., 2011). This view is in consonance with an earlier report by (Ho, lu and Thurmaler 2006) that students withdrawal rates were reduced in blended learning course.

Graetz and Goliber (2002), explain that blended learning can bring teachers and students closer together. Aspen and Helm (2004) also explored student engagement and interaction with students in the context of a blended learning situation and argue that blended learning can help bring teachers and students together by making appropriate use of a mix of technologies students can feel increased connectivity with both their fellow students and teachers. Furthermore, Garrison and Anderson (2003) argued that access to information is an important part of learning, however student's learning are largely achieved through engagement and interactions with other students, Chen and Loci (2007) indicated that online discussion contains more opportunities for the practice of in-depth clarification and inference skills. Blended learning environments can provide access to online learning materials for different styles of students learning and engage learners interactively (Sharpe 2006). Motteran (2006) found out that blended learning approach enhanced the learning experience as the course structure enables students to deal with topics in their own time and to organize themselves better around the tasks. In addition, blended learning courses can support students and has been proved to be very useful in improving teacher's abilities to respond to a wide range of students need.

The continuous use of instructional approaches that are not student centered and non-participatory are not suitable to address the present situation. Maybe the utilization and deployment of student-centred and technology driven

instructional approaches like the blended learning and flipped classroom instructional approaches could bring about improvement in achievement and students grasp of genetic concepts in Biology. Several studies have been carried out by science scholars to ascertain the efficacy of the flipped classroom and blended learning approaches in Nigeria and beyond (Maccoun 2016; Duygu & Ali 2018; Efiuwere&Fomsi 2019) but none of them have been carried out in Egor Local Government Area of Edo State. Also, none of these studies highlighted to the best of the researcher's knowledge have taken into consideration the variables of flipped classroom, blended learning, sex, retention and achievement in a single study. For instance, Duygu & Ali, (2018) work considered flipped classroom model, academic achievement and attitude in Turkey, Efiuwere & Fomsi, (2019) work looked at flipped classroom, achievement and interest in Rivers state while Maccoun (2016) work looked at blended learning, achievement and retention in Baghdad. It is on the strength of this that this study investigated the effect of flipped, blended and traditional classroom learning approaches on students' retention in genetics.

Purpose of the Study

The purpose of this study is to:

a. determine if there is a difference in the mean retention scores of students taught genetics using flipped classroom, blended learning and traditional classroom approaches.
b. investigate the interacting effect of flipped classroom, blended-tearing and traditional classroom approaches.

Research Questions

1. What is the difference in the mean retention scores of students taught genetics concept using Flipped classroom, Blended learning and Traditional approaches at post and delayed post-test?
2. What is the interaction effect of Flipped classroom, Blended learning and Traditional classroom approaches and gender on students' retention in genetics?

Hypothesis

$H_0$1: There is no significant difference in the mean retention scores of students taught genetics concept using flipped classroom, blended learning and traditional classroom approaches at posttest and delayed posttest.

Methodology

The non-equivalent pretest-posttest control group design structured into the 3 x 2 factorial research design was utilized for this study. The population of the study consisted of the 497 senior secondary school Two (II) Biology students from the 11 public co-educational senior secondary schools in Egor Local Government Area of Edo State. A total of 74 students comprising 34 males and 40 females from three intact classes formed the sample of the study. Simple random sampling technique was then used to obtain three schools from the remaining seven (7) schools that met the criteria. These three schools were randomly assigned to experimental groups A, B and control group C using ballot. The instrument for data collection was Biology Achievement Test on Genetic (BATG). The face and content validity were ascertained by experts in the Department of Curriculum and Instructional Technology. The reliability of the instrument was ascertained using the Kuder-Richardson formula 21 to obtain a reliability coefficient of 0.786**.**Mean, standard deviation, and Analysis of Covariance (ANCOVA) were used to answer the research questions and test the hypotheses at .05 level of significance.

Research Question One: What is the difference in the mean retention scores of students taught genetics using Flipped classroom, Blended learning and Traditional approaches at pretest and posttest?

Table 1: Mean and Standard Deviation of Post and Delayed Posttests Retention Scores of Students Taught Genetics Concepts

Groups	N	Pretest Mean ($\bar{X}$)	SD	Delayed Posttest Mean ($\bar{X}$)	SD	Mean Gain
Flipped Classroom	27	10.41	4.35	8.81	3.38	-1.60
Blended Learning	24	10.92	3.40	11.33	3.34	0.41
Traditional classroom	23	9.87	3.02	9.61	3.85	-0.26

The data in Table 1 shows the mean and standard deviation of retention scores of students taught genetics concepts using Flipped classroom, Blended learning and Traditional approaches. The data revealed that Flipped classroom group got a mean score of 10.41 and a standard deviation of 4.35 in the posttest and a mean score of 8.81 and a standard deviation of 3.38 in the delayed posttest making a mean gain of -1.60. The Table also shows that students taught using Blended learning got a mean score of 10.92, a standard deviation of 3.40 at posttest, while in the delayed posttest, the students got a mean of 11.33 and a standard deviation of 3.34 giving a mean gain of 0.41. In the Control group, data shows that the students got a mean score of 9.87 and a standard deviation of 3.05 at posttest, while at delayed posttest a mean score of 9.61 and a standard deviation of 3.85, making a post and delayed posttests mean gain of -0.26. Table 1 further shows that students exposed to the Blended learning approach got the highest mean gain, followed by the Traditional approach group while the Flipped classroom approach got the least mean gain.

Hypotheses

$H_0$1: There is no significant difference in the mean retention scores of students taught genetics concepts using Flipped classroom, Blended learning and Traditional classroom approaches at posttest.

Table 2: Analysis of Covariance (ANCOVA) of Students' Retention Taught Genetics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	340.113[a]	3	113.371	13.100	.000
Intercept	162.823	1	162.823	18.814	.000
Pretest (Covariate)	257.093	1	257.093	29.707	.000
Retention	64.387	2	32.194	3.720	.029
Error	605.793	70	8.654		
Total	8167.000	74			
Corrected Total	945.905	73			

a. R Squared = .360 (Adjusted R Squared = .332)

Table 2 shows the ANCOVA analysis of the mean retention scores of students taught genetics using Flipped, Blended and Traditional classroom approaches. The data shows that $F_{(2, 70)} = 3.720$, $p = .029 < 0.05$. Since p – value is less than the alpha level, the null hypothesis is rejected. This means that there is a significant difference in retention of students. Therefore, the null hypothesis of no significant difference in the mean retention scores of students taught genetics concept using flipped classroom, blended learning and traditional approaches is rejected.

$H_0$2: There is no significant interaction effect of Flipped classroom, Blended learning and Traditional classroom approaches gender on students' achievement in genetics.

Table 3: Analysis of Covariance (ANCOVA) of Students' Retention Taught Genetics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	340.113[a]	3	113.371	13.100	.000
Intercept	162.823	1	162.823	18.814	.000

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Discussion of Results

This study found that participants exposed to the Blended learning approach got the highest mean gain, followed by the Traditional approach group while the Flipped classroom approach got the least mean gain. The present result is in agreement with that of Gambari et.al (2017) findings that the use of blended learning approach improves students' academic performance, retention and inspire positive attitude towards learning. The study also found a significant difference in the mean retention scores of students taught genetics concept using flipped classroom, blended learning and traditional approaches. This finding further agrees with the finding of Ezenwabachili and Okoli (2021) in Enugu state who found that students taught using flipped classroom had significantly higher retention scores than those taught using think-pair-share and the conventional methods.

Conclusion

This study concluded that the Blended learning approach is the most impactful, followed by the Traditional approach group while the Flipped classroom approach made the least impact. Also it was concluded that flipped classroom and blended learning approaches significantly interacted with gender on students' retention in genetics concepts.

Recommendations

Based on the findings of this study, it was recommended that:

1. Biology teachers should be encouraged to change from traditional instructional approach and adopt innovative and technology-based learning approaches like blended learning and flipped classroom in the teaching of topics that are more practical
2. Curriculum planners and other educational authorities should organize themes in biology and emphasize the use of technology in the classroom instructional process.

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