



IJIS

Journal of the Institute of Education
Obafemi Awolowo University, Ile-Ife, Nigeria

ISSN: 3043-6400

Vol. 2, No. 1, 2025



CALL FOR PAPERS
IFE JOURNAL OF INTEGRATED SCIENCE (IJIS)

NOTE TO CONTRIBUTOR

Ife Journal of Integrated Science, (IJIS) is a Bi-annual publication of Institute of Education, Obafemi Awolowo University, Ile-Ife (Integrated Science Unit). The Journal aims at improving the quality of academic and research manuscripts submitted by scholars and researchers, through peer review process, and disseminate the publications through open access to practitioners, educators, educationists, academia, researchers, curriculum planners and policy makers. The manuscripts can have different approaches which are quantitative as well as qualitative.

IJIS is an annual and peer - reviewed Journal.

Manuscript submitted to IJIS should:

1. have a strong introduction that clearly states the organizing points of the study, acquaints the readers to what is ahead, and makes a direct link between theory, questions and research design
2. have focused literature review that clearly establishes why the topic /problem warrants discussion
3. be prepared according to the style prescribed by the 6th or 7th edition of publication manual of American Psychological Association.

Guidelines for Paper Submission

- * Articles should not be longer than 15 A4 - sized pages using Times New Roman, font size of 12. Longer articles will attract additional publication fee.
- * Reference style should conform to the American Psychological Association format (6th or 7th Edition). This should be arranged in alphabetical order according to the surname of the author.
- * Footnotes are not allowed.
- * Manuscripts' cover should include the title of the paper, author(s) name(s), institution affiliation, contact and E-mail address (es).
- * Abstract should not be more than 250 words.
- * Articles can be submitted electronically via e-mail to ijisn.2023@gmail.com
- * Assessment fee of ₦6,000 shall be paid before any paper shall be reviewed.
- * Publication fee of ₦35,000, is a condition for publication that a manuscript submitted to Ife Journal of Integrated Science (IJIS) has not been published and will not be simultaneously submitted or published elsewhere.

All fees must be paid into Ife Journal of Integrated Science Account.

Bank Name: Polaris Bank

Account Name: Ife Journal of Integrated Science (IJIS)

Account Number: 1140280175

- * Submissions are published at the editor's exclusive discretion. Submission that does not conform to these guidelines may not be considered for publication.

EDITORIAL BOARD

Prof. P. O. Jegede
Editor - in - Chief

Prof. T. O. Bello
Managing Editor

Editors

Prof. O. S. Agboola
Dr. S. O. Olajide

EDITORIAL CONSULTANTS

- Prof. A. Akinlua - Dept of Chemistry, Obafemi Awolowo University, Ile-Ife.
Prof. O. A. Ogunfowokan - Dept of Chemistry, Obafemi Awolowo University, Ile – Ife.
Prof. T. O. O. Oladipupo - Dept. of Botany, Obafemi Awolowo University, Ile – Ife
Prof. J. G. Adewale - Institute of Education, University of Ibadan, Ibadan
Prof. M. A. Eleruja - Dept. of Physics, Obafemi Awolowo University, Ile -Ife.
Prof. M. A. Adeleke - Dept. of Science and Technology Education,
Obafemi Awolowo University, Ile – Ife.
Prof. O. A. Sofowora - Dept. of Educational Technology and Library Studies,
Obafemi Awolowo University, Ile – Ife
Prof. I. A. Olaosun - Dept. of English, Obafemi Awolowo University, Ile – Ife
Prof. D. Okunoye - Dept. of English, Obafemi Awolowo University, Ile – Ife.
Prof. E. T. O. Babalola - Dept. of English, Obafemi Awolowo University, Ile – Ife.
Prof. M. A. Ajayi - Dept. of Human Kinetics and Health Education,
University of Ibadan, Ibadan.
Prof. J. B. Bilesanmi - Dept. of Curriculum Studies and Instructional Technology,
Olabisi Onabanjo University, Awoderu Ago-Iwoye
Prof. A. T. Akande - Dept. of English, Obafemi Awolowo University, Ile – Ife
Prof. E. F. Bamidele - Dept. of Science and Technology Education,
Obafemi Awolowo University, Ile-Ife.
Prof. R. O. Ogunlusi - Dept. of Chemistry, Obafemi Awolowo University, Ile-Ife
Dr. A. Tella - Dept. of Science and Technology Education,
University of Ibadan, Ibadan
Dr. A. S. Adelokun - Department of Educational Management
Dr. K. A. Aderounmu - Department of Kinesiology and Human Recreation,
Obafemi Awolowo University, Ile-Ife.
Dr. T. A. Adebisi - Dept. of Science & Technology Education, Faculty of
Education, Obafemi Awolowo University, Ile-Ife.
Dr. A. A. Adetunji - Dept. of Science and Technology Education,
Obafemi Awolowo University, Ile-Ife.
Dr. V. O. Animola - Dept. of Integrated Science, Federal College of Education,
Iwo, Osun State.
Dr. O. O. Bakare - Institute of Education, Obafemi Awolowo University, Ile-Ife
Dr. M. O. Omiyefa - Institute of Education, Obafemi Awolowo University, Ile-Ife
Dr. V. B. Olanipekun - Bamidele Olumilua University of Education, Science and
Technology, Ikere, Ekiti State.

TABLE OF CONTENTS

INFLUENCE OF TEACHERS' QUALIFICATION ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN IFE-EAST LOCAL GOVERNMENT AREA OF OSUN STATE, NIGERIA Timilehin Christianah ADEDEJI	1-18
ASSESSMENT OF CHEMISTRY CURRICULUM IMPLEMENTATION IN SENIOR SECONDARY SCHOOLS IN IFE CENTRAL LOCAL GOVERNMENT AREA OF OSUN STATE Elijah Oluwatobi ADEWUYI	19-41
LOCUS OF CONTROL AND SELF-EFFICACY AS PREDICTORS OF SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN IFE CENTRAL LOCAL GOVERNMENT AREA, OSUN STATE, NIGERIA Olamide Rofiat TIJANI	42-60
EFFICACY OF SELF-DIRECTED AND COLLABORATIVE CONSTRUCTIVISM INSTRUCTIONAL STRATEGIES ON JUNIOR SECONDARY SCHOOL STUDENTS' ENGAGEMENT IN BASIC SCIENCE AND TECHNOLOGY IN ADAMAWA STATE Samuel Akinola OGUNDARE, Ph.D, & Ahmed IBRAHIM, Ph.D	61-75
EFFECTS OF JIGSAW COOPERATIVE INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL STUDENTS' ACQUISITION AND RETENTION OF MATHEMATICS PROCESS SKILLS Lucy ERAIKHUEMEN, Peter Akpojehih Agbarogi & Festus Osadebamwen Idehen	76-93

EFFECTIVENESS OF FLIPPED AND BLENDED CLASSROOM LEARNING APPROACHES ON STUDENTS' ACHIEVEMENT IN GENETICS CONCEPTS IN BIOLOGY Blessing Izehiuwa EDOKPOLOR, C. N. OMOIFO, Ph.D & L. ERAIKHUEMEN, Ph.D	94-111
EFFECTS OF FLIPPED AND BLENDED CLASSROOM LEARNING APPROACHES ON STUDENTS' RETENTION IN GENETICS CONCEPTS IN BIOLOGY IN EGOR LOCAL GOVERNMENT AREA OF EDO STATE L. ERAIKHUEMEN, Ph.D, C. N. OMOIFO, Ph.D & Blessing Izehiuwa EDOKPOLOR	112-130
SUSTAINABLE STEM EDUCATION IN THE IOT ERA: BALANCING THE PARADOX OF APPLICATIONS, BENEFITS, AND CHALLENGES FOR BETTER PROSPECT Ezekiel Adedayo ADEOLA	131-157
TEACHERS' TEACHING METHOD PREFERENCES AND RESOURCES UTILISATION AS PREDICTORS OF SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN OSUN STATE, NIGERIA Damilola Monsurat ELUYERA & Omowunmi Sola AGBOOLA, Ph.D	158-188
ENVIRONMENTAL LITERACY AMONG OSUN STATE CLASSROOM TEACHERS Omowunmi Sola AGBOOLA, Ph.D, Simeon Olayinka OLAJIDE, Ph.D, Olusegun Ojo BAKARE, Ph.D & Muraina Olugbenga OMIYEFA, Ph.D	189-207
EFFECTS OF BI-MODAL SCHOOL YARD PEDAGOGY AND GENDER ON SCIENCE PROCESS SKILLS OF PRESCHOOLERS IN OYO STATE, NIGERIA Florence Taiwo. OGUNYEMI, Ph.D. & Fatimah ZAKARIYYAH	208-226

STUDY HABIT AS PREDICTOR OF JUNIOR
SECONDARY SCHOOL STUDENTS' INTEREST IN
BASIC SCIENCE IN IFE CENTRAL LOCAL
GOVERNMENT AREA, OSUN STATE

Oluwaseun Newton AJEWOLE

227-234

ROLE OF SCHOOL FARMS IN DEVELOPING
ENTREPRENEURIAL SKILLS AMONG
SECONDARY SCHOOL STUDENTS IN IFE
CENTRAL LOCAL GOVERNMENT AREA, OSUN
STATE, NIGERIA

**Oluyemisi Dolapo ADISA & Ibironke Ibiwumi
IDOWU**

235-248

TEACHERS' SELF- EFFICACY AND JUNIOR
SECONDARY SCHOOL STUDENTS' LEARNING
OUTCOMES IN BASIC SCIENCE IN
SOUTHWESTERN NIGERIA

**Abosede Adenike OYAGBILE, Ph.D. & Theodora
Olufunke BELLO, Ph.D.**

249-262

**EFFECTIVENESS OF FLIPPED AND BLENDED
CLASSROOM LEARNING APPROACHES ON
STUDENTS' ACHIEVEMENT IN GENETICS
CONCEPTS IN BIOLOGY**

Blessing Izehiuwa EDOKPOLOR,
Curriculum & Instructional Technology
Faculty of Education
University of Benin, Edo State
E-mail: blessynedokpolo@yahoo.com

C. N. OMOIFO, Ph.D
Curriculum & Instructional Technology
Faculty of Education
University of Benin, Edo State
E-mail: cnomoifo@yahoo.co.uk

&

L. ERAIKHUEMEN, Ph.D
Curriculum & Instructional Technology
Faculty of Education
University of Benin, Edo State

Abstract

The study determines the difference in the mean achievement scores of students taught genetics using flipped classroom, blended learning and traditional classroom approaches and investigated the interacting effect of learning approaches and gender on students achievements. The study adopted the non equivalent pretest-posttest control group research design which is a type of quasi-experimental research design. Three (3) research questions were raised, hypothesized and tested at 0.05 level of significant. The population of this study comprised 497 senior secondary school two (II) Biology students from the 11 public co-educational schools in Egor Local Government Area of Edo State.

The sample of the study is made up of 74 students comprising 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, Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA) were used to test the hypotheses. The findings of this study were there is no significant difference in mean posttest achievement scores of students taught genetics concepts using Flipped classroom, Blended learning and Traditional learning approaches. However the participants in the blended learning group achieved the most, followed by those in the flipped learning and the traditional learning approach got the least achievement. The results also showed that there is a significant difference in male and female students' achievement scores taught genetics concepts in favour of the male. The study concluded amongst others that blended learning is the most impactful on students' achievement.

Keywords: Blended Learning, Flipped Learning, Traditional Learning Approaches, Gender, Achievement

Introduction

Biology occupies a unique position in the secondary school education curriculum because of its importance as a life science. In Nigeria, the secondary school Biology curriculum is designed to enable students investigate natural phenomena, deepen their understanding and interest in biological sciences. Biology also encourages students to apply scientific knowledge to their day-to-day life in matters of personal, community, health and agriculture. The knowledge of Biology has been crystallized into concepts, empirical laws and theories which form the basis of human comfort. Biology stands as the bedrock for other science related courses (Careers) like Medicine, Pharmacy, Nursing, Biochemistry, Genetics, and Agriculture which are of great

economic importance to any country.

In spite of the popularity of Biology among students and the importance of genetics to humans, achievement in Biology at Senior Secondary School Certificate Examination (S.S.C.E) has not been encouraging (Abannikannda, 2020). Researchers in science education have expressed concern about this trend and several efforts to identify major causal factors with the aim of addressing them are being made daily. This poor achievement in Biology has been attributed to many factors among which are the ineffective instructional approaches employed by Biology teachers (Auwal, 2013 & Joda, 2018). Instructional approaches which do not give students room for active participation in the classroom, allow students take responsibility for their own learning, encourage higher order learning and collaboration among biology students. Could this be the reason for students' poor academic achievement in Biology in external examinations such as National Examinations Council and West Africa Senior School Certificate Examination?

Instructional approaches have been identified to play a significant role in the teaching and learning process. In Nigeria secondary schools, the traditional classroom method of teaching is still the dominant teaching approach (Joda, 2018).

Understanding genetics is very important for both students and teachers of Biology. For example, an understanding in genetics allows biology students to get firsthand information about contemporary scientific issues such as genetic screening and genetically modified foods (Duncan et al., 2011) and also allows biology students to understand fundamental ideas about biological inheritance and evolution. Again, understanding of genetics plays a substantial role in academic achievement of Biology students as an average of five to eight questions is been dedicated to genetics concept every year in the West Africa Senior School Certificate Examination. Thus, it is therefore important to understand genetics concepts. However, studies suggest genetics is difficult to learn (Duncan & Reiser, 2007; Osman, BouJaoude & Hamdan, 2017). Over several decades, researchers have

identified, across many age ranges reasons why genetics is difficult to learn for students (Venville, Gribble & Donovan, 2005; Smith & Knight, 2012).

Teacher -Centered Approach: Teacher-centered approach includes all the teaching methods that the teacher dominates in the lesson procedure and takes the lead in coordinating the classroom activities as regards to what to be done. O'Bannon (2002) stated that teacher-centered approach includes all the teaching methods grounded in behaviorism such as lecture demonstration, discussion and recitation etc. Teacher-centered classroom is thus rigidly structured and only factual information is conveyed to learners. For instance, in a lecture method, the instructor presents fact and principles orally. In view of this, the lecture method has been criticized to be a poor method of teaching hands-on skills in science including biology although it provides for the effective use of time and manpower especially in presenting ideas to a large group of people.

Considering other teacher-centered approaches O'Bannon (2002) described demonstration as a teaching method that involves the teacher showing students a process or procedure involved in a learning process. The demonstration method has some advantages over the lecture method in skill acquisition, the disadvantage remains that the learners follow the rigidly prescribed probed procedure by the teacher and this makes it not effective for science teaching. Then the discussion method among other teacher-centered approach is a more advanced teacher-centered approach in which an issue in the learning content is posed as a question by the teacher and each of the students' chips in their different ideas etc. The discussion method also has its pros and cons with some degrees of students-centeredness as the teacher decides what is to be discussed. However, all the mentioned teaching methods the teacher determines the content and the question and takes upper control in the flow of information or knowledge hence they are considered as teacher-centered approach to teaching.

This approach allows teachers to directly know their

students and evaluate their strengths and weaknesses better. Traditional classroom approach is more suitable for young children, teenagers, and young adolescents, who are yet to join the workforce (De, 2018).

The traditional classroom approach has been with us since ages and has been applauded for its instructional effectiveness. Despite all its praises, the same learning approach has been criticized by several researchers for its inefficiency in meeting the demands of the present learners. Listed below are some of the shortcomings of the traditional classroom approach as declared by some scholars. Harmon (2017) declared that teachers at the elementary level often deliver the course content through lecture (i.e. chalk and talk) method without employing other vigorous teaching methodologies to improve the conceptual understanding of the students in their academia, thereby students take handouts from the whiteboard without getting the main theme of the topic, which eventually promotes cramming among the students. The traditional classroom approach (lecture method) is predominantly teacher-centered, which gives a prominent role to teachers, whereas the students gain maximum knowledge in a limited time. This approach is devoid of the conceptual understanding and critical thinking potentials of students are not developed as desired (Ullah & Iqbal, 2020). There is less flexibility but rigidity in class scheduling. Less cost effective that is students must travel to and from class irrespective of the distance. The lecture is usually passive as students/learners sit and listen and rarely ask questions.

According to O'Bannon (2002) student-centered approach is grounded in constructivism, with the epistemological view that learners are the architects of their own idiosyncratic meaning of concepts and natural phenomena. In view of this student-centered approach is based on constructivist principles and ideas. However, Campbell (2006) posited that the cognitive learning theory also advocated for student-centered idea. Thus, student-centered approach is based on the constructivists as well as cognitive theories with the educational applications linked to the works of Dewey and Piaget among others. In discussing student-centered

teaching methods, such term like constructivism, inquiry discovery, and learning is often interchangeably used. Kirshner et.al (2006) noted although these terms share some commonalities experts in each field but observed some important differences.

Nevertheless, in today's educational discussions the term student-centered approach is a broad term that includes all innovative teaching methods that are usually activity oriented, where learners are expected to observe, analyze, synthesize and evaluates ideas or phenomena using materials or previous knowledge. Teaching methods emphasizing this approach include discovery, constructivism related method (concept mapping, co-operative learning), problem solving, graphic organizers, anointed diagrams, role playing, simulations, blended learning, inquiry method, games and know what to learn etc. Educational Broadcasting Corporation (2004) also noted that the principles of student-centered approach are linked to the philosophy of Rousseau' work 'Emile' which stressed on the intuition nature of children to investigation and learning naturally from the environmental experience.

The student-centered approach is relevant to Biology teaching because in Biology teaching creating an environment that will encourage students to interact with materials and specimens enables students to construct meaningful knowledge and learn Biology first hand. In view of the relevance of student-centered approach to teaching and learning of biology many researchers in biology education, Ibe and Nwosu, 2003; Ibe, 2004; Nwagbo, 2006 and Opara (2011) recommended for a shift from the use of traditional teaching methods (teacher-centered approach) of teaching Biology to a modern/innovative teaching method (student-centered approach).

In 2000, American scholars Lage, Platt and Michael introduced the great teaching efforts through flipped classroom when they were teaching Introduction of Economy in Miami University. They put the conclusion in their thesis inverting the classroom: A Gateway for creating an inclusive learning Environment. However, they did not put forward the term: flipped

classroom model or flipped teaching. Still in 2000, another scholar Baker published a thesis titled the classroom Flip using web course management tools to become a guide by the side in the 11th international Teaching conference. These scholars only put forward the term flipped classroom theoretically. In 2007 two chemistry teachers from woodland park high school named SamAaron and Bergmann Jonathan, started to record live lesson and presentations, using video software with voice in Colorado. They uploaded the videos to internet to help those students who missed lessons. Before long, they started a more innovative attempt to let all the students gradually watch videos and listen to lectures at home. While in class, teachers mainly provide help for the students having difficulties in experiments. As the development of internet gain limelight, the flipped classroom became more popular in North America.

Heinze and Procter, (2004) described Blended learning as a term concerned with transmitting knowledge, that it is learning that is facilitated by the effective combination of different modes of delivery, models of teaching and style of learning which is based on transparent communication amongst all parties involved within the course. Graham (2006) Proposed that Blended learning systems combine face-to-face instruction with computer-mediated instruction, then Graham and Dziuban, (2008) stated that Blended learning is an instructional approach that combines online digital media with traditional classroom method.

Krasnova (2014) posited that blended learning is a method of teaching that combines the most effective face-to-face teaching techniques and online interactive collaboration, both constituting a system that functions in constant correction and forms a single whole. Other theorist and practitioners also offered different definitions, which are similar to those of Graham and Dziuban (2008). For Staker and Horn (2015), blended learning is a formal education program in which a student learns at least part through online delivery of content and instruction with some element of student control over time, place, path, and /or pace and at least in part at a supervised brick-and-mortar location away from home. Their definitions emphasized more on content and instruction that must be delivered online, meaning that a traditional face-to-face

course in which students are encouraged to use the internet for research does not qualify as blended learning.

Balentyne and Varga (2017) viewed Blended Learning as an instructional strategy that involves a thoughtful combination of traditional face-to-face instruction and online instruction. The concept of Blended learning broadly refers to the integration “blending” of e-learning tools and techniques with face-to-face traditional method of teaching. As described above, there are many varieties in defining blended learning and different institutions implement blended learning approaches in different way this is because blended learning isn't one size fits all. The term blended learning has been interchangeably used in the literature to mean hybrid learning, technology-mediated instruction, web-enhanced instruction, mixed-mode instruction, flexible learning, e-learning and distance learning. It can be concluded that blended learning approach requires the physical presence of both teachers and students, with some elements of students control over time, place, path or pace, while students attend brick-and-mortar schools with a teacher present. The conventional classroom practices are combined with computer-mediated activities regarding content and delivery while the teacher acts as a facilitator. In the article “Blending traditional learning with online learning in teacher education” Bhatia (2007) enumerated the following as advantages of blended learning approach when incorporated into teaching and learning practice: greater flexibility of time freedom for students to decide when each online lesson will be learned; greater efficiencies with group sizes; lack of dependence on the time constraints of the teacher (Lock 2006); wide access to digital resources, shared tools, and information systems; time of reflection; freedom for students to express thought and ask questions without limitation (Chamberlin & Moon 2005).

Researches in science education have shown that the teaching and learning of Biology as a science subject suffer so many challenges. Auwal (2013) and Joda (2018) attributed some of these challenges to ineffective instructional approaches employed by Biology teachers.

The WASSCE Chief Examiners Report (2009) indicated that students are not favorably disposed towards genetics concepts. Specifically in 2017, the report advised that “teachers should ensure they complete the syllabus, schools should provide teaching aids and teachers should employ instructional approaches that can help students understand Biological concepts and spell technical terms correctly”. This situation of poor grasp of genetics concepts in Biology and dwindling performance could be attributed to the continuous and persistent use of the traditional instructional approach that is teacher-centred dominated and makes students to be passive recipients of information and note takers. Could the dwindling performance be an indication of student's inability to retain biological concept (genetics concepts)? 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. It is on the strength of this that this study investigated the effect of flipped and blended classroom learning approaches on students' achievement and retention in genetics.

Objectives of the Study

The objectives of this study are to:

1. determine if there is a difference in the mean achievement scores of students taught genetics using Flipped classroom, Blended learning and Traditional classroom approaches.
2. investigate the interaction effect of learning approaches and gender on students' achievement

Hypotheses

- H₀1: There is no significant difference in the mean achievement scores of students taught genetics concepts using Flipped classroom, Blended learning and Traditional classroom approaches at posttest.
- H₀2: There is no significant interaction effect of Flipped classroom, Blended learning and Traditional classroom approaches gender on students' achievement in genetics.

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 of 34 males and 40 females from three intact classes formed the sample of the study. Purposive sampling technique was employed to select schools with not more than 40 Biology students in the class from the 11 co-educational schools in Egor L.G.A. Schools with large class sizes were eliminated from 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.

Table 1: Mean and Standard Deviation of Pretest and Posttest Achievement Scores of Students Taught Genetics Concepts

Groups	N	Pretest Mean ($\bar{X}$)	SD	Posttest Mean ($\bar{X}$)	SD	Mean Gain
Flipped Classroom	27	7.37	2.90	10.41	4.25	3.04
Blended Learning	24	7.42	2.59	10.92	3.40	3.50
Traditional classroom	23	7.26	1.96	9.87	3.02	2.61

The data in Table 1 shows that students taught genetics concepts using Flipped classroom got a mean score of 7.37 and a standard

deviation of 2.90 in the pretest and a mean score of 10.41 and a standard deviation of 4.25 in the posttest making a pretest-posttest mean gain of 3.04. The Table also shows that students taught using Blended learning got a mean score of 7.42, a standard deviation of 2.59 at pretest and a mean gain of 3.50, while those taught using Traditional learning approach got a mean score of 7.26 and a standard deviation of 1.96 at pretest and a mean score of 9.87 and a standard deviation 3.02 at posttest making a mean gain of 2.61. The Table further shows that students exposed to the Blended learning approach got the highest mean gain followed by the Flipped classroom approach and the Traditional approach (Control) got the least mean gain.

Hypotheses

H₀1: There is no significant difference in the mean achievement scores of students taught genetics concepts using Flipped classroom, Blended learning and Traditional classroom approaches at posttest.

Table 2: One-Way Analysis of Variance (ANOVA) of Posttests Students' Achievement Scores on Genetics

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.877	2	6.439	.477	.623
Within Groups	958.961	71	13.506		
Total	971.838	73			

Table 2 shows the ANOVA analysis of posttest students' achievement scores taught genetics using Flipped classroom, Blended learning and Traditional learning approaches. The result indicates that $F_{(2,71)} = .477$, $p = .623$ which is not significant at 0.05 alpha level. This means that there is no significant difference in the posttest mean achievement scores of genetics. Therefore, the null hypothesis of no significant difference in mean posttest achievement scores of students taught genetic-concepts using Flipped classroom, Blended learning and Traditional learning approaches is not rejected.

H₀2: 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) Showing Interaction of Learning Approaches and Gender on Students' Achievement in Genetics Concepts

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	227.341 ^a	5	45.468	4.153	.002
Intercept	7801.291	1	7801.291	712.546	.000
Approaches	33.384	2	16.692	1.525	.225
Gender	8.457	1	8.457	.772	.383
Gender *	210.747	2	105.373	9.624	.000
Approaches					
Error	744.497	68	10.948		
Total	8984.000	74			
Corrected Total	971.838	73			

a. R Squared = .234 (Adjusted R Squared = .178)

Table 3 shows the ANCOVA analysis of interaction effect of learning approaches and gender on students' achievement in genetics concepts. The result indicates that $F_{(2, 68)} = 9.624$, $p = .000$ which is significant at 0.05 alpha level. This means that there is a significant interaction effect of learning approaches and gender on students' achievement in genetics concepts. Therefore, the null hypothesis of no significant interaction effect of instructional approaches and gender on students' achievement in genetics is rejected.

Discussion of Results

This study found that participants in the blended learning group achieved the most, followed by those in the flipped learning

group while the traditional learning group recorded the least achievement. This finding agrees with the findings of Ellan and Hamaidi (2018) who concluded in Amman in Jordan that students taught using flipped learning strategy got higher scores in academic achievement test than students who were taught using the traditional method. The study also found no significant difference in mean posttest achievement scores of students taught genetic-concepts using Flipped classroom, Blended learning and Traditional learning approaches. This finding corroborates that of Didem and Ozdemic (2018) in Turkey who concluded that there is no significant difference in achievement between those taught with flipped approach and those using the blended learning methods. It was also found that there is no significant interaction effect of instructional approaches and gender on students' achievement in genetics. This finding contradicts the finding of Edem and Anari (2021) that there is no significant interaction effect of strategy and gender on students' achievement and retention in Chemistry.

Conclusion

This study concludes that flipped classroom and the traditional learning approach got the least achievement in posttest and that flipped classroom impacted males more than females in terms of achievement and retention. It was further concluded that blended learning is the most impactful on students' retention, followed by the traditional classroom approach and the flipped classroom made the least impact. Also it was concluded that flipped classroom and blended learning approaches significantly interacted with gender on students' achievement and 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.

References

- Abanikannda, M. O. (2020). Influence of flipped Learning strategy on high school students learning outcomes in Biology in Osun state. *Frameless*. 3 (30). 1 – 12.
- Auwal, A. (2013). Effect of teaching methods on retention of agricultural science knowledge in senior secondary schools of Bauchi local government area, *International Journal of science and Technology Education Research*, Nigeria, 4(4), 63-69.
- Baker, J. W. (2000). Faculty Member of the Year. 32. Cedarville University, https://digitalcommons.cedarville.edu/faculty_member_award/32
- Balentyna, P. & Varga, M.A.(2017). Attitude and Achievement in a self-passed Blended mathematics Course. *Journal of online learning research*. 3(1), 55-72.
- Bergmann, J. & Sams, A. (2012). Flip your classroom: *Reach Every student in-Every Day*. International society for Technology in Education.
- Bhatia, R. (2007). Blending traditional learning with online learning in teacher education. *International Conference*. Delhi University
- Campbell, M. A. (2006). The Effects of 5^E Learning cycle model on students Understanding of force and motion concepts. *Unpublished M.Ed. Thesis* University of central Florida Orlando: Florida.
- Chamberlin, S. & Moon, S. (2005). Model Eliciting Activities: An Introduction to Gifted Education. *Journal of Secondary*

- Gifted Education*, 17(1), 37-47.
- De, B. (2018). Traditional Learning Vs. Online Learning. Retrieved 13 July, 2022 from.
- Duncan, R. G.& Reiser, B. J. (2007). Reasoning across ontologically distinct levels: students' understandings of molecular genetics. *Journal of Research in Science Teaching*, 44(7), 938–959.
- Duncan, R. G., Freidenreich, H. B., Chinn, C. A. and Bausch, A. (2011). Promoting middle school students' understandings of molecular genetics. *Research in Science Education*, 41(2), 147–167.
- Duygu, S. & Ali, A. (2018). The effect of flipped classroom on the Academic Achievement and Attitude of Higher Education students. *World Journal of Education*, 8(4), 170-176.
- Educational Broadcasting Corporation (2004). Constructivism as a Paradigm for Teaching and Learning (30th ed.). Retrieved on 12 May 2008 from <http://www.13.org/edonline/concept2class/constructivism/index.html>
- Efiuvwere, R. A. & Fomsi, E.F (2019). Flipping the mathematics classroom to enhance senior secondary student's interest. *International Journal of mathematics Trends and Technology*, 65 (2) 95-101.
- Graham, C.R. (2006). Blended learning systems: Definition, current trends, and future Directions. The Hand Book of Blended learning Global perspective, Local Designs. (Ed : C.J. Bonk; C.R. Graham)
- Graham, Ch. R., Borup, J. Short, C. R. & Archambault, L. (2019). K-12 Blended Teaching: A guide to personalized learning and online integration, 11-12. [http:// edtechbooks.org/k12 blended](http://edtechbooks.org/k12blended).
- Graham, C.R & Dziuban, C.D. (2008). Core research and issues related to blended learning environments. In J.M. Spector, M.D. Merrill, J.J.G Van merrienboes, & M.P, Driscoll Eds., *Handbook of Research On Education communication And Technology* (3rd Ed.) Mahwah, N.J: Lawrence Earlbaum Associates.

- Harmon, L. (2017). How elementary pre-service teachers acquire pedagogical language knowledge for supporting English learners' academic language development (Doctoral dissertation, University of California, Santa Barbara).
- Heinze A. & Procter, C. (2004). 'Reflections on the use of Blended learning: Education in a changing Environment' Conference proceedings university of salford, Education Development unit.
- Ibe, E. & Nwosu, A.A (2003). Effects of Guided-inquiry and Demonstration on science Process skills Acquisition among secondary school Biology students. *Journal of the Science Teachers Association of Nigeria*.38(1 and 2) 58-63.
- Ibe, E. (2004). Effects of Guided inquiry demonstration and Conventional Methods of teaching Science on acquisition of science process skills Among Senior Secondary Students. *Anunpublished M.Ed. Thesis, Department of science Education, University of Nigeria, Nsuka*.
- Joda, F.M. (2018). Effect of concept mapping teaching approach on senior secondary school Biology students Achievement in Biology in Adamawa state, Nigeria. *Jigawa Journal of multi-disciplinary studies (JJMS)*1(1), 140-147.
- Kirshner, P.A., Sweller, J. & Clark, R.E. (2006). “Why minimal guidance During Instruction doesn't work: An analyst of the failure of constructivist, Discovery, problem-based, experimental and inquiry-based teaching. *Educational Psychologist*41(2) 75-86. <http://www.cogtech.use.edu/Publication/kirshner-Sweller-clark.pdf>
- Krasnova, T.A. (2014). Paradigm shift Blended learning integration in Russian Higher Education. *Procedia-Social and Behavioral Sciences*, 2015 (166), 399-403.
- Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education*, (31) 30-43.
- Lock, J. V. (2006). A new image: Online communities to facilitate teacher professional development. *Journal of secondary Gifted Education*, 17 (1), 37-47.

- Maccoun, H. S. (2016). The Effect of using Blended learning on the Achievement of students and Information Retention of fifth Graders in the Biology course. *Faculty of Education Journal*, 22(95), 209-240.
- Nwagbo, C. R. (2006). Effects of two Teaching methods on the Achievement in and Attitude to Biology of students of different levels of scientific Literacy *International Journal of Educational Research* 45: 216-229
- O'Bannon, B. Webster, (2002). Planning for instruction. (Instructional methods) (Online) Available @<http://ife.Uk/rbonannon/in-strategies-html>.
- Opara, J. A. (2011). Inquiry method and students' Academic Achievement in Biology lessons and policy implications: *American-Eurasian Journal of Scientific Research*, 6(1), 28-31.
- Osman, E., BouJaoude, S. & Hamdan, H. (2017). An investigation of Lebanese G7–12 students' misconceptions and difficulties in genetics and their genetics literacy. *International Journal of Science and Mathematics Education*, 15(7), 1257–1280.
- Smith, M.K. & Knight, J. K. (2012). Using the Genetics Concept Assessment to Document Persistent Conceptual Difficulties in Undergraduate Genetics Courses. *Genetics Education*, 191, 21–32.
- Staker, H. & Horn, M. (2015). Blended: Using disruptive innovation to improve schools. San Francisco; JosseyBass Retrieved from <http://canvas.harvard.edu/courses/18482/files/3017564/download>
- Ullah, O., & Iqbal, M. (2020). Comparison of Impact of Traditional and Modern Teaching Methods on Students' Performance at Elementary School Level. *Global Regional Review*, V(I), 386395. doi:10.31703/grr.2020(V-I).42. URL: [http://dx.doi.org/10.31703/grr.2020\(V-I\).42](http://dx.doi.org/10.31703/grr.2020(V-I).42)

- Venville, G., Gribble, S. J.& Donovan, J. (2005). An exploration of young children's understandings of genetics concepts from ontological and epistemological perspectives. *Science Education*, 89(4), 614–633.
- West African Examination Council (2017;2018;2019). *Biology Chief Examiners Reports, Nigeria*.