

Effect of Two Modes of Flipped Classroom on Students' Interest in Biology in Colleges of Education in South-East, Nigeria

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Abstract

Interest is an educational concept that determines some aspects of students' affective domain which is very important in the teaching and learning process. It has been hypothesized that the use of child-centered approach will stimulate students' interest in any learning situation. Flipped classroom strategy is one of such child-centered approaches. This study was therefore undertaken to explore the use of standard inverted and group-based flipped classroom in stimulating the interest of students to learn Biology. Three research questions and three null hypotheses guided the study. The design of the study was quasi-experimental factorial design, specifically, the design was 2x2 pretest-posttest, non-equivalent factorial research design. The sample for this study consists of 147 Biology students of two colleges of education in South-East, Nigeria. Biology Interest Scale (BIS) was used as instrument for data collection. Two experts from Biology unit and one from measurement and evaluation unit, department of science education, University of Nigeria Nsukka validated the instrument. The Interest scale has an internal consistency reliability of 0.84 established using Cronbach alpha. Mean and standard deviations were used to analyze the data to provide answers for the research questions. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). Result of the study showed that the use of standard inverted and group-based flipped classroom was both effective in enhancing students' interest in Biology. The increase in interest score is not gender dependent as there is no significant difference in the mean interest of male and female students in Biology, $F_{(1, 138)} = .832$, $P < .363$. The educational implications of the findings were highlighted and the recommendations proffered which includes: In-service training, seminars, workshops and conferences should be organized by school administrators in colleges of education and other tertiary institutions to train Biology teachers on the use of innovative pedagogical strategies like standard inverted and group-based flipped classroom to facilitate students' involvement and interest in Biology.

Keywords: Biology, Biology Education, student centered approach, standard inverted flipped classroom, group-based flipped classroom, interest and gender

Introduction

Considering Biology as a major prerequisite for the study of science related courses in tertiary institutions such as Medicine, Pharmacy, Biochemistry, Nursing. It is expected that the student performance in the subject will be satisfactory but this is not the case owing to the reports of students' poor performance in the subject in both secondary and tertiary institutions that made the students to lose interest in the subject. Many stake holders in the

educational system have tried to proffer solution to the problem yet it still persists, this study therefore investigated the efficacy of two modes of flipped classroom in stimulating students' interest in Biology in colleges of education in South East, Nigeria.

Biology is a natural science that deals with the study of living organisms, plants and animals. It is central to many science-related courses such as

Medicine, Pharmacy, Agriculture, Nursing and Biochemistry. As a field of science, Biology helps us to understand the living things and the ways many species function, evolve and interact. Since Biology occupies a unique position in the school curriculum. It is imperative that teachers of Biology in secondary school possess both the content, pedagogical and technological knowledge and skills to carry out this professional task. This can be achieved through Biology education in higher institutions of learning in Nigeria, particularly colleges of education.

Biology education is a programme in colleges of education in Nigeria that is run through the National Certificate of Education (NCE) and Bachelor in Education (B. ED.). According to Okenyi (2012) Biology education is the act of teaching and learning in order to inculcate or transfer the knowledge of Biology to the students. While Okenyi (2015) explains that Biology education is the application of principles of education in teaching and learning of Biology. Thus, Biology education is the act of training future Biology teachers in the principles and techniques of Biology. From this explanation Biology education is expected to produce knowledgeable, highly motivated, professional and effective teachers who will be able to develop in students an appreciation and understanding of biological processes and principles. Therefore, studying Biology in colleges of education is an avenue to develop confidence in Biology teachers, which will enhance their ability to adapt to the changing situation in science- and technological-oriented society.

Considering the huge importance placed in producing teachers in Biology with high expertise in the content, technology and pedagogical skills, who can sustain Biology teachers in secondary schools and higher levels of education, there is need to stimulate students' interest offering Biology education in colleges of education through the use of innovative instructional approaches that are student-centered, so that learners will be actively involved in the learning process.

Student-centered approach includes all teaching methods that underscore the teacher as a decision maker and problem solver in the classroom but rather see teachers as facilitators, mentors, coach or consultants in the teaching and learning process. In the educational sector, the term student-centered refers to teaching methods that allow students to share some degree of responsibility and decision making in the classroom. According to Egara and Mosimoge (2024), student centered approach is a method of teaching that focuses on students' needs, interest and abilities, and involve them in the learning process as

active participants. While Tang, (2023) refers student centered approach as a pedagogical strategy that puts the student at the center of the learning process, emphasizing their unique experiences, perspectives and contributions. grounded in constructivism which sees learners as the architects of their own learning. Flipped classroom is one of these strategies.

Flipped classroom is the reversal of learning activities in the conventional classroom. Flipped classroom is a pedagogical strategy that requires students to study content material outside of classroom, typically through pre-recorded videos, readings, or online activities and utilizes classroom time for hands-on activities, discussions and collaborative learning to deepen understanding and application of the material, with the teacher acting as a facilitator or guide to enhance student learning. Hamdan, McKnight, McKnight, Arftstorm and Arftstorm (2013) sees flipped classroom as a pedagogical strategy that reverses the traditional lecture-homework format, delivering instruction at home and moving homework to the classroom. The concept of flipped classroom has been around since the year 2000. The learning is student-directed in terms of time, pace, path, and place. It provides a learning experience that is appealing and that delivers successful learning outcomes. Flipped classroom strategy involves applying more than one, strategy or technique in education, technology is combined with face-to-face learning in different ways to motivate students and enhance learning.

Classroom can be flipped in different ways according to varieties of study materials, use of class time or type of students. These different ways of flipping the classroom are called modes of flipped classroom. Modes of flipped classroom include: Standard inverted or traditional flipped classroom, micro-flipped, discussion- oriented, demonstration-based flipped, faux-flipped, group-based flipped, virtual flipped and role-reversed flipped classroom (Arya, 2020). Considering the nature of flipped classroom, the modes of flipped classroom that may be more facilitative for Biology instruction in Nigeria include standard inverted flipped classroom and group-based flipped classroom. Standard inverted flipped classroom is the classic flipped classroom. In this model learners are asked to go through the lecture videos and other study material that are prerequisites for the next class. The class time is reserved for practicing the concepts studied at home and to improve the students' understanding in various ways using a one-to-one interaction with the teacher. Standard inverted flipped classroom according to Bergmann and Sams (2012) is a type of flipped classroom that traditional lecture-format is reversed,

with students, learning the course materials through pre-recorded videos, textual readings or reading online before attending the class for hands-on activities, discussions and personalized instruction via one-on-one interaction with the teacher, whose role is to guide the students in their area of need. This model involves students engaging with pre-recorded lectures or readings before the class session, allowing classroom time to be dedicated to active learning activities. This model of flipped classroom is designed to improve students' motivation through its attribute of competence and independence. Galindo-Dominguez (2021) noted that the standard inverted flipped classroom provides students with the opportunity to self-pace their learning and fosters instructor-student interaction during in-class session. The second mode of flipped classroom investigated in this study is group-based flipped classroom.

The group-based flipped classroom model focuses on group learning. After the students have studied the materials provided to them at home, they work together on assignments during the classroom time, the students learn by explaining concepts to each other, which improves interest and enhances retention. Hamdan et al. (2013) define group-based as a type of flipped classroom that combines the flipped model with collaborative learning, where the students learn the course material at home through pre-recorded video or readings and then work in groups in the classroom to apply, analyze and solve problems related to the course materials under the guidance of the teacher. Similarly, Hao (2016) sees group-based flipped classroom as a type of flipped classroom that emphasizes group work and collaboration, where students work in small groups to complete activities, solve problems and complete projects through the guidance of the teacher who also offers immediate feedback to students. This model adds a new element which is to help students learn from each other. The class starts the same way others do, with lecture videos and other resources shared before class. The shift happens when students come to class, teaming up to work together on that day's assignment. This model encourages students to learn from one another and helps students to not only learn what the right answers are but also how to actually explain to a peer why those answers are right. In this model, students collaborate in groups, discuss concepts, and solve problems together during class time. Chen, Hwang and Lai (2020) reported that the group-based flipped classroom promotes peer learning, improves critical thinking and problem-solving skills among students. The findings of these research (Adhe, & Mujahhidin, 2024; Seery, Donnelly & O'Regon, 2015) shows that flipped classroom significantly increases students'

engagement in the learning process and has a positive impact on their academic achievement. However, there is no evidence as to how standard inverted and group-based modes are compared in terms of their effectiveness in stimulating interest in Biology instruction. This study therefore examined the mode of flipped classroom that effectively enhance students' interest in learning Biology

Interest is an educational concept that determines some aspects of students' affective domain which is very important in the teaching and learning process. It is a feeling, desire and act of developing affection towards something. In education, interest is characterized by increased attention and concentration in classroom and academic activities. Ezeiruaku (2024) states that interest is the attention shown by students in learning. It is a motivational variable and emotionally oriented trait which determines the vigour of the learner in tackling educational activities. Onu, Anyadiegwu and Uzoigwe (2020) observed that students who are interested in certain field pay special attention to it, observing carefully and thinking actively. Interest guides and encourages students to think critically and to keep trying until success is achieved. Interest and achievement correlate in teaching and learning process and have intra influence on each other, high interest improves students' achievement while high achievement promotes interest, and in other hand low interest retards learning and results to poor achievement. Interest is positively correlated with achievement. Ibenegbu, Nzewi and Aniakwu (2018) stated that interest has been a positive predictor of achievement in various domains, including mathematics, science and reading. Hamdan et al. (2013), Omile, Uloh-bethels, Ugwuanyi, Obiezu, Osigwe, & Ezeife, (2021) indicated that students' interest can be influenced by innovative teaching methods. Researchers like (Hao, 2016; Asiksoy & Ozdamli, 2016; Okebukola, 2022) are of the opinion that in flipped classroom strategy, students' interest and self-efficacies are important variables that impact student willingness to learn and their confidence towards learning which are likely to affect their application process. A study conducted by Onu, Anyadiegwu and Uzoigwe (2020) revealed that students taught Biology using collaborative instructional strategy posted better achievement scores and interest ratings than their counterparts taught using conventional method. Enebechi (2016) noted that the use of appropriate instructional approach in teaching and learning of Biology promote students' interest in the subject. Studies by Ezeudu and Gbendu (2020) recorded enhanced interest of students in Geography when exposed to flipped

classroom. Based on poor interest of students in Biology as observed by the researcher during preliminary studies conducted on plant anatomy an aspect of Biology. This study was carried out to find out which mode of flipped classroom (standard inverted or group-based) led to better interest among Biology students in colleges of education. Ibenegbu, Nzewi and Aniaku (2018) showed that the students learning Biology using the blended teaching approach had a significant increase in their interest scores, the increase in interest score is not gender dependent as both boys and girls had enhanced interest score. Thus, effect of standard inverted and group-based flipped classroom on students' interests in Biology were investigated along gender lines.

Gender is the role ascribed to male and female in the society. Isaak, Kleiner and Wilde (2022) defined gender as the socio-cultural constructed characteristics and roles which are ascribed to male and female in the society. According to Godpower-Echie (2017), as one grows, he/she is socialized by the society to fit into the masculine or feminine mould that particular society has constructed. Gender behaviour, belief, values and roles unlike sex are learned through socialization. Females are noted to under achieve in science and technology disciplines (Njoku & Nzewi, 2010). The under achievement of females in the science and technology discipline has been brought about by several interrelated socio-cultural and school factors which depress interests, enrolment, participation and achievement in science subjects at various levels of Nigeria education system. Some of the factors according to Odagboyi (2017) include, male chauvinism, stereotype about women, negative attitude of some parents to women education, gender bias in curriculum, the pedagogical sustenance of academic competition adopted by science teachers which usually go against the female academic interest. However, it is observed that Biology is popular to both female and male students.

In spite of this, there are contradictory findings on how gender influenced interest of students in Biology. Some studies such as Godpower-Echie (2017) has shown no significant difference in interest of male and female students in Biology while others like Ahmad, Sultana and Jamil (2022) indicated the superiority of one gender over the other. Gender issues and its effects on students' interest in science subject (Biology) has been persisted over the years with contradicting results and stands out as a controversial issue in science education due to varying reports from different researcher. This study was geared towards investigating how the effect of standard inverted flipped classroom and group-based flipped classroom which is an innovative and learner

centered strategy will help in stimulating students' interest in Biology.

The following research questions and hypotheses were formulated to guide this study:

1. What is the mean interest ratings of students when taught Biology using standard inverted flipped classroom and group based flipped classroom?
2. What is the influence of gender on students mean interest rating scores in Biology?
3. What is the interaction effect of mode of flipped classroom and gender on students mean interest rating scores in Biology?

The null hypotheses were tested at 0.05 level of significance.

- Ho₁ There is no significant difference in the mean interest ratings of students when taught Biology using standard inverted flipped classroom and group based flipped classroom
- Ho₂ There is no significant difference in the mean interest rating scores of male and female students in Biology.
- Ho₁ There is no significant interaction effect of mode of flipped classroom and gender on students' mean interest rating scores in Biology.

Method

The study adopts a quasi-experimental factorial research design. A quasi- experimental factorial design is one that combines quasi-experiment and factorial design to investigate both main and interactive effects of independent variables on dependent variables (Fraenkel & Walten, 2023; Miller, Smith & Pugatch, 2020). The design has been used successfully in many studies such as Ibenegbu (2013). Specifically, the design was 2x2 pretest-posttest, non-equivalent factorial research design. Two levels of flipped classroom namely: standard inverted flipped classroom (X₁) and group- based flipped classroom (X₂) and two levels of gender, male (Y₁) and female (Y₂), were involved in the study. The sample for the study consisted of 147 students, 13 males and 134 females from colleges of Education in South East Nigeria. Purposive sampling and simple sampling techniques were employed for drawing the sample of study. Purposive sampling technique was used to select three colleges of education out of 6 public colleges of Education. The criteria for inclusion were (1) It must offer B.Sc. Biology Education (2) the lecturers must possess minimum of M.Sc./M.Ed. in Biology (3) the college should have

Biology laboratory and (4) the college has been offering the programme for at least four years. Simple random sampling was used to select two colleges of education from 3 colleges that met the criteria to be included in the study. The researcher used Biology Interest Scale (BIS) as instrument for data collection. This instrument was developed by the researcher to ascertain the students' level of interest in learning of Biology. Two (2) experts from Biology unit and one (1) from measurement and evaluation unit, department of science education University of Nigeria Nsukka validated the instrument, after which it was used to establish the reliability by administering them to 25 Biology students. The

scores obtained from the BIS was analysed using Cronbach alpha formula and it yielded internal consistency reliability index of 0.84. Mean and standard deviations were used to analyze the data to provide answers for the research questions. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The decision rule for testing the hypotheses was thus; reject the null hypotheses (H_0) if the probability value associated with the test statistics is less than or equal to 0.05 ($p \leq 0.05$), otherwise do not reject. To control extraneous variables intact classes were used for the experiment.

Results

Table 1. Mean analysis of the achievement scores of students with different interest rating scores in Biology.

Mode of flipped Classroom	N	Pretest		Posttest		Adjusted Mean
		\bar{x}	SD	\bar{x}	SD	
Group-based	92	76.67	9.85	78.42	7.96	79.04
Standard Inverted	55	73.23	8.51	77.26	9.33	79.27

The data in table 1 revealed that students who were taught Biology using group-based flipped classroom strategy had posttest of 78.42 and adjusted mean score of 79.04. Similarly, the students who were taught Biology using standard inverted flipped classroom strategy had posttest of 77.26 and adjusted

mean score of 79.27. These results indicated that students who were exposed to standard inverted flipped classroom had a slightly higher posttest mean interest rating score than those exposed to group-based flipped classroom.

Table 2: Analysis of covariance of students' interest scores in Biology due to mode of flipped classroom.

Source	Type III Sum of Square	df	Mean Square	F	Sig.	Partial Eta Squd
Corrected Model	881.254 ^a	8	110.57	1.621	.124	.086
Intercept	6751.892	1	6751.892	99.328	.000	.419
Pretest	594.958	1	594.958	8.753	.004	.060
Mode	.405	1	.405	.006	.939	.000
Gender	56.583	1	56.583	.832	.363	.006
Mode * Gender	.189	1	.189	.003	.958	.000
Error	9380.624	138	67.976			
Total	909296.000	147				
Corrected Total	10261.878	146				

a R Squared = .311 (Adjusted R Squared = .271)

Table 2 reveals that there is no significant difference between the mean interest rating scores of students taught Biology using group-based flipped classroom and those taught using standard inverted flipped classroom, $F_{(1, 138)} = .006, p \leq .939$. The null

hypothesis was not rejected. This means that both group-based flipped classroom and standard inverted flipped classroom improves students' mean interest in Biology.

Table 3: Mean influence of gender on interest rating scores of students.

Gender	N	Pretest		Posttest		Adjusted Mean
		\bar{x}	SD	\bar{x}	SD	
Male	13	73.69	9.30	80.08	7.08	80.48
Female	134	77.49	9.82	78.02	8.50	77.

Data in Table 3 revealed mean interest rating scores 73.69 at pretest and 80.08 at posttest for male Biology students, while female Biology students had mean interest rating scores of 77.49 at pretest and 78.02 at posttest. The adjusted mean scores of 80.48 and 77.83 for the male and female students respectively, shows that the male students had a higher posttest mean interest rating score than their female counterparts in Biology.

Table 2 also shows ANCOVA analysis of the influence of gender on the mean interest rating score of students in Biology. The result reveals that, there is no significant difference in the mean interest scores of male and female students in Biology, $F_{(1, 138)} = .832, p \leq .363$. Thus, the null hypothesis is not rejected. This means that gender does not significantly influence students' interest in Biology.

Table 4: Interaction effect of modes of flipped classroom and gender on interest rating scores of students in Biology

Mode of flipped classroom	Gender	Pretest		Posttest		Adjusted Mean	
		N	\bar{x}	SD	\bar{x}	SD	
Group-based	Male	4	78.75	13.22	81.50	5.32	80.28
	Female	88	79.72	9.77	78.42	8.06	77.80
Standard inverted	Male	9	71.44	6.77	79.44	7.94	80.67
	Female	46	74.12	8.51	77.26	9.33	77.87

Result in Table 3 shows that male students exposed to group-based flipped classroom strategy had adjusted mean score of 80.28 and their female counterpart had adjusted mean score of 77.80. The result also revealed that male students exposed to standard inverted flipped classroom strategy had adjusted mean score of 80.67 and their female counterpart had adjusted mean score of 77.87. This showed that at all levels of gender male students had higher adjusted mean score than their female counterparts in Biology. The result showed that there is no interaction effect of gender and modes of flipped classroom on mean interest scores in Biology.

Table 2 similarly, shows that the interaction effect of mode and gender on the mean interest rating score of students in Biology is not statistically significant, $F_{(1, 138)} = .003, p \leq .958$. This is because the associated probability (Sig) value of .958 is greater than 0.05 level of significance at which the result is being tested. On this note, the null hypothesis which stated that there is no significant interaction effect of mode of flipped classroom and gender on the mean interest rating score of students in Biology was therefore not rejected.

Discussion

The findings revealed that students who were exposed to standard inverted flipped classroom had slightly higher posttest mean interest rating score than those exposed to group-based flipped classroom. It was however revealed that there is no significant difference in the mean interest scores of students taught Biology using group-based flipped classroom and those taught using standard inverted flipped classroom. This means that the two modes were effective in improving students' interest in Biology.

The result of this finding agrees with the study conducted by Ezeudu and Gbendu (2020) that reveals that flipped classroom promotes students' engagement and motivation. Also, Ugwoke, Edeh and Ezemma (2018) revealed that flipped classroom has the capacity of increasing students' interest while Onu, Anyaegbunam and Uzoigwe (2020) revealed that student taught Biology using collaborative strategies had better interest ratings than those taught with lecture method. The outcome of this study may be as a result that both standard inverted and group-based flipped classroom uses pre-recorded video to deliver instructional materials to student during out of class section. This pre-recorded video makes student to be highly engaged and motivated. Both modes

promote active learning through one-one interaction and via group collaboration. Similarly, both modes were student centered approach focusing on students needs and interest which led to similar levels of engagement and motivation.

The finding revealed that male students had a higher posttest mean interest rating score than female students. It was however. Revealed that there is no significant difference in the mean interest scores of male and female students in Biology. This may be due to the fact that flipped classroom increases students' engagement through interactive hands-on activities, discussion and group work in the class, reducing gender-based differences. The study agrees with the finding of Ibenegbu, Nzewi and Aniaku (2018) which reveals that students learning Biology using the blended teaching approach had a significant increase in their interest scores, the increase in interest score is not gender dependent as both boys and girls had enhanced interest score. This shows that both standard inverted and group-based flipped classroom strategies can be effective in promoting interest in Biology among both male and female students.

This finding agrees with that of Emaikwu, Iji and Abari (2015) and Ebuo (2011) which revealed that both gender showed similar interest towards statistics and biology respectively while Usman (2018) and Godpower-Echie (2017) showed that gender is a significant factor in students' interest in integrated science and mathematics respectively in favour of males.

The study also reveals that both modes stimulate students' interest in Biology, without worrying about gender differences. The reason for this may be due to the fact that boys and girls disciplined themselves to watch the instructional video at home. They were motivated equally and enjoyed the interactive activities in class, this made a lot of difference that is why gender probably did not interact significantly with flipped classroom.

This finding is consistent with Ugwuoke, Edeh and Ezemma (2018) which revealed no statistically significant interaction effects of method and gender on mean interest score of students in accounting. This also agreed with the result of a study by Abdullahi and Umeano (2020) which revealed no significant interaction effect of strategy and gender on students' interest in reading comprehension, The study also agrees with Ezeudu and Gbendu (2020) that reveals no interaction effect of flipped classroom and gender. Lack of gender difference in this study may be attributed to the fact that both strategies emphasize active learning, collaboration, and student-centered instruction which can appeal to a wide range

of learning styles and preferences regardless of gender

Recommendations

1. Teachers should strive to use standard inverted and group-based flipped classroom as innovative instructional approach in teaching biology as this will help to concretize learning and enhance interest of the students.
2. Teachers should be equipped with computer and other ICT facilities to enable them use them effectively.
3. In-service training, seminars, workshops and conferences should be organized by school administrators to train teachers on the use of innovative pedagogical strategies like standard inverted and group-based flipped classroom.

Conclusion

This study has shown that the use of standard inverted and group-based flipped classroom was both effective in enhancing students' interest in Biology. Teachers should be given more training through workshops and conferences on the student-centered innovative approaches to employ in teaching science subjects especially Biology using group-based and standard inverted flipped classroom that enhances students interest in learning sciences.

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