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# Effects of Flipped Learning and Peer Tutoring on Learning Outcome in Biology in Ibadan

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## Abstract
*The academic achievement of learners in Biology based on previous observations has not been encouraging over the years. This could be as a result of inactive participation of learners during teaching and learning process in a conventional/traditional classroom where teachers frequently employ the traditional method. In other to avoid persistent poor academic achievement of learners, every effort must be made to fully engage the learners in teaching/learning process. Therefore, a flipped learning and peer tutoring pedagogical approaches were used. A pretest-posttest-control approach was used in a quasi-experimental design. Out of the four educational zones in Ibadan, one was chosen by random sampling for this study and purposive sampling was used in selecting three schools and from each school, an arm of SS2 science intact class was used totalling114 learners. Five instruments were used: Achievement test in Biology (ATB) (r = .81), flipped learning guide, peer tutoring guide, flipped learning – peer tutoring and lecture method guide. At p = 0.05, two hypotheses were evaluated. The method of data analysis used was Analysis of Co -variance. The result revealed that there was a significant effect of treatments (flipped learning, peer tutoring and flipped learning – peer tutoring) on learners' academic achievement [$F_{(3, 105)} = 126.497$, p=.000]. Additionally, it was shown that there was no discernible connection between treatment and learners' gender and academic achievement [$F_{(3, 105)} = 0.456$, p=.714]. It was recommended that flipped learning, peer tutoring and flipped learning – peer tutoring should be encouraged and adopted during teaching/learning of Biology.*

**Keywords**: Flipped learning group, Peer tutoring, Lecture Method group and Academic Achievement

## Introduction
Biology is a science subject that is helpful in explaining the various phenomena both around and within us. The various phenomena of Biology apply to our life such as where we reside, what we consume and what activities we engaged in. Based on its usefulness to life there is need for learners to improve on the academic achievement in other to avoid continuous decline in the academic achievement of learners that had always been recorded in previous years. According to evidence, the percentage of students who passed Biology at the credit level was extremely low when compared to the total number of students who applied. In 2014, 2015, 2016, and 2018, 33.9 percent, 28.6 percent, 33.9 percent, and 28 percent of learners were at the credit level correspondingly (WAEC, 2013 – 2018). Learners' academic achievement was always less than half of the total number of students. As vital as biology knowledge is to humans, it appears that students' academic achievement in biology is slipping behind that of other science disciplines in high school as revealed by the above stated WAEC result analysis.

The contributory factors which might have been affecting the academic achievement of learners are numerous such as teaching method used by teachers popularly known as the traditional/conventional method, learners' gender among others. In facilitating the transfer of knowledge, teachers should employ the teaching strategies that are most appropriate for the particular objectives and level exit outcomes. This unhealthy development in the disposition of learners towards science has sparked the search for the development of alternative methods of teaching and learning which can stimulate students' interest and guarantee an educational system that offers equal opportunities for all sexes. (Ajaja, 2013). Thus, the field of study of science education is in

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dire need of methods to recommend to science teachers that have traits like lesson clarity, self-activity promotion, self-development promotion, stimulation of interest and curiosity, and reliance on the psychological process of teaching and learning. The approaches should promote better science education and learning than what is now practiced (Ajaja, 2013). Learners' gender is also an important factor. Blackwood (2020) reported in her write up stated that male participate actively in subject areas such as sciences, mathematics among others whereas female have lower perceptions of scientific abilities and are aware of gender identity. In testing for the efficacy of flipped learning and peer tutoring, this study focused on flipped learning and peer tutoring and learners' gender if it might improve the academic achievement of learners.

In flipped learning, direct instruction is moved from the group learning environment to the individual learning environment, and the resulting group learning environment is transformed into a dynamic, interactive learning environment where the educator guides learners as they apply concepts and engage creatively in the subject matter. When a teacher uses "flipped learning" in the teaching/learning process, they can give students different learning options based on how they learn best, such as reading a textbook, watching videos, listening to audio files, or using any other kind of material they can find or make that covers a particular topic. In a traditional classroom, the teacher serves as the wise man on stage, but in a flipped classroom, the teacher serves as a guide on the side while students watch lessons at home at their own pace, engage in online discussions with peers and teachers, or read textbooks, and engage with concepts in the classroom with the teacher's assistance. According to Wright (2011) in Edudemic Connecting Education & Technology claims that the flipped classroom is a more evolved version of the student-centred classroom. It all comes down to shifting from passive to active learning.

Flipping the classroom entails fundamentally rethinking how you've been doing things for years. Here are some of the advantages of doing so:

1. Flipped learning keeps learners more engaged: Students' interest is usually maintained through discussion and hands-on activities.
2. The flipped classroom style allows teachers to spend more time working with pupils one-on-one. As a result, they can easily spot when a student is struggling with a concept and work with them one-on-one to help them understand it. Teachers will be able to obtain a better understanding of their students' diverse learning styles as a result of increased engagement in the classroom, allowing them to personalize their instruction to their individual requirements.
3. Learners are able to complete their work at their own leisure. Learners have the option of watching it again if they believe they need it to better understand the idea. They have greater control over how and when they study and learn.

Peer tutoring is a general name for a strategy in which students support other students in the learning process. While the act of initial instruction in any skill or topics should be done by the teacher, students can be successful in providing support, reinforce or modelling for a variety of academic topics. It allows for different types of students' pairings. Some models pair peers of similar abilities while other model pair a higher – performing students with a lower – performing student for a target skill (Calderwood, 2021). AbdulRaheem, Yusuf & Odutayo (2017) revealed that students in peer tutoring group obtained higher Economics Performance Test (EPT) scores than students in the conventional group.

**Theoretical Background**

This study's two underlying ideas are psychological theories. These theories are cognitive and behaviourist which comprises Cognitive Theory, Dual Coding Theory (DCT), Social constructivism Theory and Generative Theory of Multimedia Instruction The interaction between individuals and groups in the classroom will improve the students'

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knowledge of scientific concepts when peer tutoring is appropriately supervised by a teacher.

The Cognitive Theory of Jean Piaget recognized four phases of cognitive development, the last stage which is stage of formal operation (11 years and above) is relevant to this study, the students are more logical, divergent and or convergent in thinking and can make justifiable generalization. The students are as well mentally prepared to exploit the features of human relationship and multimedia instruction which will captivate their attention and affect learning.

Secondly, Dual Coding Theory (DCT) emphasise that students have preferred representation styles. Some students retain knowledge and acquire it more easily when it is presented visually, while others do so when it is spoken to them. Paivio, (1971), in his Dual Coding Theory, proposes that information is encoded and processed in two separate channels, namely verbal system units and visual system units. And that learning experiences that exposes the learner to both verbal and visual units, may likely be more effective than learning experiences that exposes the learner to one of the units. According to Kozma (1994) in Audu (2018), we must evaluate the interaction between the medium's properties and students' cognitive processes in order to grasp the relationship between media and learning.

Thirdly, Vygosky theory of cognitive constructivism called social constructivism places a strong emphasis on the collaborative nature of learning. The thesis holds that knowledge is co-formed and not only constructed. The zone of proximal development, a notion introduced by Vygotsky, serves as the foundation for the social constructivism peer-tutoring learning technique. The zone of proximal development is the space between the level of actual development as determined by independent problem-solving and the level of prospective development as defined by problem-solving under adult supervision or in cooperation with more advanced peers (ZPD).

The learner's present level of development is the moment at which they have advanced to the point where they can solve issues independently. The degree of development that a learner is capable of obtaining with the assistance of teachers or by working with peers is known as the learner's potential development (zone of proximal development). The student is capable of understanding and solving problems at this level that they are unable to do at their current degree of advancement. The amount of learning depends on the level of prospective development. It consists of cognitive structures that are still developing, but they can only do so via collaboration or assistance from others. The zone of proximal development, according to Vygotsky (1978), refers to functions that have not yet fully developed but are in the process of doing so; functions that will fully develop tomorrow but are currently in the embryonic stage.

When a child is engaged in an activity that they could not do on their own but can complete with the assistance of a peer or an adult, according to Vygotsky, they are working within their zone of proximal development.

The idea of Vygotsky (1978) applies to pupils in this study because it can raise students' achievement. Vygotsky believed that peer learning groups led by teachers may help students develop intellectually to their full capacity while also inspiring them to learn more about the subject.

Lastly, Mayer proposed a generative theory of multimedia instruction (1997) in Mayer (2001). The hypothesis assumes that using a multimodal method of delivery (texts, images, audio, video, and animation) has an impact on how much learners use cognitive processes to study. Thus, the learner is placed in the centre of the learning process, acting as a knowledge constructor by choosing and tying together visual and spoken knowledge. According to Mayer (2001), meaningful learning occurs when a person chooses the knowledge that is most significant, organizes it into a logical mental picture, and combines the new information with the preexisting information. Mayer reported that mixed mode of delivery is suggested, according

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to the fact that data is encoded in the memory by two independent, non-conflicting channels, one Visual and the other Verbal. In other words, a picture would be encoded by a visual encoding mechanism and a word encoded by a verbal mechanism. However, information that contain images and words is encoded and processed twice in the memory and therefore could be retained more in the cognition.

**Hypotheses**

1) There is no significant main effect of treatment on learners' academic achievement.
2) There is no significant interaction effect of treatment and gender of the learners and their academic achievement.

**Method**

Pretest, Posttest, Control Group, Quasi Experimental Design was employed in the study. The schematized layout is shown below;

$O_1 X_1 O_2$ is Experimental group 1
$O_1 X_2 O_2$ is Experimental group 2
$O_1 X_3 O_2$ is Experimental group 3
$O_1 X_4 O_2$ is Control group
$O_1$ denotes pre-achievement test
$O_2$ denotes post-achievement test
$X_1$ = Flipped learning
$X_2$ = Peer tutoring
$X_3$ = combination of flipped learning and peer tutoring
$X_4$ = Lecture method

**Participants:** The schools in Ibadan were clustered along four educational zones, three local government areas were chosen at random from each zone totalling 12 local government areas. In order to choose the participants, a purposeful sampling strategy was adopted one private school from each of the selected local government area. Private schools were used because of the availability of the materials needed for the study. In each school an arm of SS 2 intact class was used, totalling 114 students (Male 57 and Female 57).

**Instrument:**

The instrument used for this comprised;

1) Achievement Test on Biology (ATB)
2) Flipped Learning Guide (FLG)
3) Peer – Tutoring Guide (PTG)
4) Flipped Learning - Peer – Tutoring Guide (FLPTG)
5) Lecture Method Guide (LMG)

**Achievement Test on Biology (ATB)**

Thirty multiple-choice questions with four answer choices made up the test (A, B, C and D). The questions were derived from six themes in the SS 1 and SS 2 Biology curriculum, with a total of 60 items pilot examined. The researcher created the instrument using a table of specifications that included cognitive areas such as remembering, understanding, and applying. The reliability coefficient of the Achievement Test on Biology was determined using the Kuder – Richardson 20 (KR – 20) method. The item difficulty indices were between 0.41 and 0.63 with discriminating indices between 0.33 and 0.47. The 30 items were selected from the pools of items trial tested. The table of specification shows the final selected items for the multiple-choice test. The reliability coefficient was 0.81. Table 1 displays the analysis of the questions.

The multiple-choice test's specification table indicates that forty – percent tested remembering, thirty per cent tested understanding and thirty per cent tested applying. The right answer received a score of 1, while the wrong answer received a value of 0. The maximum mark obtainable for the multiple – choice was 30 marks.

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**Table 1: Table of Specification for Achievement Test on Biology**

| Topics/Objectives | Remembering 40% | Understanding 30% | Applying 30% | Total 100% |
|---|---|---|---|---|
| Meaning of Ecology and Ecological Concepts | 2 | 2 | 1 | 5 |
| Population Studies | 2 | 2 | 1 | 5 |
| Food chain, Food web and Trophic Level | 2 | 2 | 1 | 5 |
| Skeleton, Forms and Components | 2 | 1 | 2 | 5 |
| Types of Skeleton | 2 | 1 | 2 | 5 |
| Joints – Definition, Types, Location and Examples | 2 | 1 | 2 | 5 |
| Total | 12 | 9 | 9 | 30 |

**Flipped Learning Guide (FLP)**

The instructional guide was prepared by the researcher to show the various steps the teacher followed. The following steps were followed;

1) Step 1 – The teacher uses educational video to teach the content by using a 5 – minute video
2) Step 2 – The teacher makes decision on the video service to use for the students
3) Step 3 – The teacher makes videos by setting some limits. Five minutes is the maximum allowed for video duration, and no more than three movies can be assigned every day or night. Videos should only be seen before school in the morning in case someone forgot or does not have access to technology at home.
4) Step 4 – The teacher gives the students notes quizzes or hiding pictures, words or phrase in the videos (assignment) to check that they did and understood them in order to make them accountable for watching the videos.

**Peer – Tutoring Guide (PTG)**

The instructional guide was prepared by the researcher to show the various steps the teacher followed. The following steps were followed;

1. Step 1 – The teacher paired mixed ability students (Ability of students was determined using the previous continuous assessments recorded by the teacher)
2. Step 2 – The teacher defines tutor and tutee roles
3. Step 3 - The tutor fills in the gaps in the tutee's knowledge by explaining and demonstrating how to arrive at a certain solution.
4. Step 4 – The tutor asks tutee guiding and probing questions
5. Step 5 - The tutor asks for positive feedback. This act as encouragement

**Flipped Learning - Peer – Tutoring Guide (FLPTG)**

The instructional guide is prepared to show teacher's various steps to follow using Flipped Learning and Peer – tutoring

1) Step 1 – The teacher uses educational video to teach the content by using a 5 – minute video
2) Step 2 – The teacher make decision on the educational video service to use for the students
3) Step 3 – The teacher makes videos by setting some limits. Five minutes is the maximum allowed for video duration, and no more than three movies can be assigned every day or night. Videos should only be seen before school in the morning in case someone forgot or does not have access to technology at home.
4) Step 4 – The teacher gives the students notes quizzes or hiding pictures, words or phrase in the videos (assignment) to check that they did and understood them in order to make them accountable for watching the videos.

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5) Step 5 – The teacher paired mixed ability students
6) Step 6 – The teacher defines tutor and tutee roles
7) Step 7 - The tutor fills in the gaps in the tutee's knowledge by explaining and demonstrating how to arrive at a certain solution.
8) Step 8 – The tutor asks tutee guiding and probing questions
9) Step 9 - The tutor asks for positive feedback. This act as encouragement

**Lecture Method Guide (LMG)**

The instructional guide was prepared by the researcher to show the various steps the teacher followed. The following steps were followed;

1. Step 1 – The teacher asks questions on previous topic taught
2. Step 2 – The teacher defines and explain the concepts
3. Step 3 – The teacher asks questions on the topic taught
4. Step 4 – The teacher writes the note on the topic taught on the chalkboard
5. Step 5 – The teacher checks the students' notebook
6. Step 6 – The teacher marks the students' note

**Data Collection**

The study enlisted the help of six qualified Biology teachers. For one week, the researcher instructed the biology teachers on how to implement the pedagogical approaches. In the first week, a pre-test of achievement was given. The treatments lasted for six weeks, thereafter, biology achievement test was administered on the participants as post – test. There were three different treatment groups. These were flipped learning, peer tutoring and flipped learning and peer tutoring. In flipped learning group, N = 27 learners. The treatment in this group involved teaching the learners for 40 minutes for each contact totalling 10 contacts. In peer tutoring group, N = 31. The treatment in this group involved teaching the learners for 40 minutes for each contacts totalling 10 contacts likewise in flipped learning – peer tutoring group, N = 28 and conventional teaching method group, N = 28.

**Data Analysis:**

The analysis was carried out using inferential statistics – Analysis of Covariance (ANCOVA) - treatment: four groups.

**Results**

**Table 2 ANCOVA of Learners' Academic Achievement in Biology**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Corrected Model | 2193.778[a] | 8 | 274.222 | 74.755 | .000 |
| Intercept | 345.521 | 1 | 345.521 | 94.192 | .000 |
| Pre-Test | 502.099 | 1 | 502.099 | 136.876 | .000 |
| Lnrs' Gend | 2.533 | 1 | 2.533 | .690 | .408 |
| Trmt | 1392.074 | 3 | 464.025 | 126.497 | .000 |
| Lnrs'Gend*Trmt | 5.017 | 3 | 1.672 | .456 | .714 |
| Error | 385.169 | 105 | 3.668 | | |
| Total | 44650.000 | 114 | | | |
| Corrected Total | 2578.947 | 113 | | | |

a. R Squared = .851 (Adjusted R Squared = .839)* = sig at p < .05

**KEY: Trmt** – Treatment, **Lnrs' Gend** – Learners' Gender

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**Table 3: Scheffe Post Hoc Homogenous Test showing the Means in Learners' Academic Achievement in the Treatment Groups**

| Treatment | N | Subset for alpha = 0.05 1 | 2 |
|---|---|---|---|
| Conventional Teaching Method | 28 | 12.5357 | |
| Flipped Learning – Peer – Tutoring | 28 | | 20.8929 |
| Peer - Tutoring | 31 | | 21.6129 |
| Flipped Learning | 27 | | 21.6296 |
| Sig. | | 1.000 | .819 |

$H_{O1:}$ There is insignificant main effect of treatment on learners' academic achievement.
Table 2 indicates that there is significant main effect of treatment on learners' academic achievement [F $(_{3,\ 105})$ = 126.497), p = .000] therefore, null hypothesis is rejected.

Table 3 also shows the result of Scheffe Post Hoc Multiple Comparison with differences in mean scores in four treatment groups. Flipped Learning group, Peer – Tutoring group and Flipped Learning - Peer – Tutoring group had the following mean scores 21.6296, 21.6129 and 20.8929 respectively with high mean score but slight differences among the three groups while Lecture Method group had low mean score of 12.5357

$H_{O2}$: There is no significant interaction effect of treatment and gender of the learners and their academic achievement.

Table 2 displays a summary of result of effect of treatment (flipped learning, peer tutoring, flipped learning with peer tutoring and lecture method) as well as the learners' gender on their academic in biology. It reveals that there is no significant interaction effect of treatment and gender of the learners and their academic achievement [F $(_{3,\ 105})$ = 0.456, p =.714] after controlling for covariate. The null hypothesis is therefore accepted.

**Discussion**

The post hoc analysis indicates that all the students taught with flipped learning, peer tutoring, and flipped learning-peer tutoring outscore lecture method group. Ullah, Rabia and Tabassum (2018) found that mean score of the experimental group was significantly better than that of the control group (Lecture Demonstration Method). Olulowo, Ige & Ugwoke (2020) affirmed that peer – tutoring instructional strategy is more effective in improving students' academic achievement in financial accounting concepts than the conventional method. The study also shows that the experimental strategy was not sensitive gender. Abdulallahi (2017) found that students taught with peer – tutoring strategy performed better than those taught with conventional teaching method and gender has no effect on their mathematics achievement scores. Karadag (2017) found that "Flipped Learning" approach positively affect students' academic achievement in mathematics. Adunola (2011) in Audu (2018) claims that teachers must be familiar with a range of teaching philosophies that reflect the gravity of the subjects they are expected to teach. Ayeni (2011) defines teaching as a process that comprises causing desired changes in learners in order to achieve specific goals. The results imply that adopting instructional strategies improves learners' academic achievement.

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In addition, Okeke (2018) on interaction effect of gender and treatment (Teaching Strategy) using Mend Mapping Teaching Strategy (MMTS) and Conventional Teaching Method (CTM) was in tandem with this study while the finding of this study is disagreeing with the result of finding of Papama, Sive & Rose (2022) in mathematics on interaction effects and teaching strategy.

## Conclusion

Flipped Learning, Peer – Tutoring and Flipped Learning – Peer -Tutoring positively influenced learners' academic achievement in biology. It could be concluded that when appropriate pedagogical approaches are used, the learners' learning outcome could be improved.

## Recommendations

The following are recommended:

(i) Biology teachers should employ learner – centred pedagogical approaches as supplement to the regular conventional method in other to improve learners' learning outcomes.

(ii) The Biology curriculum should be revised to make adequate provisions for the use learner - centred pedagogical approaches.

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