International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 8 Issue 12 December - 2024, Pages: 121-126

Improving Junior Secondary School Students' Achievement in Basic Science in Ogun State, Nigeria: A Quantitative Investigation of Efficacy of Flipped Learning Strategy

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Abstract: *This study investigated the effects of flipped learning strategy on junior secondary school students' achievement in Basic science. The study employed a quasi- experimental design. The sample consisted of 80 students for experiment and the control group. Students with personal computer, and internet access at home were randomly assigned into an experimental group of 46 students (34 males, 12 female) and control group of 34 students (20 male, 14 female) The instruments used for data collection during the pre-test and post-test consisted of Basic science achievement test (BAT) and students' engagement scale (SES), The BAT was validated by specialists in Basic science and measurement and evaluation using table of specifications constructed for the multiple choice test items. The reliabilities of the multiple choice test items of BAT, and SES, were established using the coefficient of internal consistency based on R software. The reliability coefficients for the BAT and SES were 0.78 and 0.75 respectively. The data collected from the pre-test and post-test were analysed using ANCOVA at 0.05 level of significance. The findings showed that, flipped learning strategy was more effective than the traditional method in improving students' academic achievement in Basic science,* $F_{(1,420)} = 70.1$, $p < 0.05$. *The result also shows reveal the mean differences between the achievement of male and female students from the experimental group, males mean was 24.00 while females was 22.00 mean, also there was no significant interaction effects of treatment and gender on students' achievement. It was recommended among others that curriculum planners and educational policy makers should consider a review of the curriculum to incorporate flipped classroom strategy into junior secondary school curriculum, and government should provide enough technology and internet facilities in schools.*

Keywords—internet facilities; flipped learning; attitude; students' engagement; achievement

1. INTRODUCTION

The spread of digital technologies in education has opened up new avenues for learning, creating dynamic web-based environments that offer students unprecedented opportunities for interactive learning and access to diverse resources. This rapid expansion of interactive technologies has sparked innovative teaching methods in junior classes of education, fostering collaborative learning, exploration, and research within online networks. Consequently, alternative approaches to traditional teacher-centered instruction have gained traction in lower education classes. Moreover, the evolution of student-centered approaches has prompted educators to reconsider educational processes, shifting the emphasis from teachers to students. This shift aims to enhance student' engagement, foster critical thinking skills, and promote digital literacy which be achieved through flipped learning.

Flipped learning is an instructional strategy where traditional classroom activities are reversed or "flipped." In a flipped learning environment, students typically engage with instructional content, such as lectures or readings, outside of class, often through videos or online materials. Then, class time is used for active learning activities, such as discussions, asking questions, answering questions, problem-solving, group work, where students apply and deepen their understanding of the content with the guidance of the teacher [1].

The idea is that students gain exposure to new material at their own pace outside of class, allowing for more personalized learning experiences. This approach according to [2] can increase engagement, promote deeper understanding, and allow teachers to provide more individualized support to students during interactions in class. Flipped learning typically involves preparation of content, teachers create instructional materials, such as videos, readings, or interactive online modules that the students need to learn. Also, it involves pre-class engagement where students engage with the preparatory materials before coming to class. This may involve watching videos, reading texts, or completing interactive online activities. It also involves in-class activities where class time is used for active learning activities that allows students apply and deepen their understanding of the content. The teacher facilitates these activities, providing guidance, support, and feedback as needed [3] Moreover, formative assessment techniques is used by teacher to measure students' understanding of the content before, during, and after class. This helps to give instruction and identify areas where students may need additional support or

clarification [4]. Flipped learning allows for flexibility in pacing and differentiation of instruction. Students can engage with the preparatory materials at their own pace, and teachers can provide additional support or extension activities based on individual student needs [5]. Technology often plays a central role in flipped learning, as it enables the delivery of instructional materials outside of class and facilitates interactive activities and collaboration during class time. This may include the use of learning management systems, video hosting platforms, online discussion forums, and interactive multimedia resources [6]. Flipped learning shifts the focus of classroom time from teacher-centered instruction to student-centered learning, promoting active engagement, collaboration, and deeper understanding of the content [7].

In flipped learning, several variables can influence the effectiveness and implementation of the approach, like. Content delivery which includes how instructional content is delivered to students outside of class, sometimes through video lectures, readings, interactive online modules, or other resources, and this format and quality of content delivery can impact students' engagement and comprehension. According to [1], the degree to which students engage with preparatory materials before class is a critical variable. Factors influencing student engagement may include the relevance and clarity of the materials, students' motivation, and the expectations set by the teacher. The nature of the activities conducted during class time is another variable that influence the effectiveness. This includes the types of active learning exercises, discussions, problem-solving tasks, or projects that students participate in to deepen their understanding of the content. The effectiveness of these activities depends on their alignment with learning objectives and the support provided by the teacher [8]; [9].

The role of the teacher in facilitating learning during class is a significant variable. This includes the teacher's ability to guide discussions, provide feedback, address misconceptions, and support students' learning needs. Effective teacher facilitation is essential for maximizing the benefits of flipped learning, assessment practices and feedback mechanisms are also crucial for monitoring student progress and adjusting instruction accordingly [8]. Formative assessment strategies, feedback loops, and opportunities for reflection are all factors that can impact learning outcomes in a flipped classroom. The extent to which technology is integrated into the flipped learning environment is very important and this includes the use of learning management systems that is the level of engagement of the students in the classroom activities after video hosting platforms, interactive multimedia resources, and other digital tools to deliver content and facilitate learning activities. Students' readiness and support for flipped learning and the support provided to them can influence their success. This includes factors such as students' prior knowledge, digital literacy skills, access to technology, and the availability of resources and support from the teacher or peers. By understanding and effectively managing these variables, educators can optimize the implementation of flipped learning to enhance student engagement, understanding, and achievement [10].

Flipped learning is a pedagogical approach where direct instruction moves outside the classroom through technology and the internet (e.g., videos, podcasts, online blogs, or available online materials), while class time is dedicated to practice and collaborative activities that encourage active learning [10]. This method reallocates passive learning tasks to outside school hours, allowing for more interactive learning experiences during face-to-face sessions .In flipped learning, students prepare by studying textbook chapters and other materials before class, using class time for problem-solving, in-class exercises, and receiving additional guidance from teachers. [11] describes the flipped classroom model as a reversal of traditional teaching, where activities typically done in class are exchanged with those usually done outside class. Instead of attending lectures in class and then completing assigned problems at home, students review course content independently and engage in teacher-guided problem-solving, analysis, and discussions during class time. Research in the field indicates that videos are commonly employed for out-of-class instruction, while interactive tasks that engage students actively are typically used within classroom settings. The use of videos effectively can foster active participation and student-centered learning by capturing and maintaining students' focus on the subject matter in the classroom [12]; [13].

In the classroom, students are encouraged to participate in the classroom learning activities, which is their level of engagement, with guidance from their teachers or peers. Expected of them is active interaction with both the instructor and classmates, practical application of theoretical knowledge, and utilization of available opportunities to enhance learning performance and foster higher-order thinking skills [14]. Essentially, instructors must implement active learning strategies that empower learners to take ownership of their responsibilities, self-regulation, and learning journey [13]. The flipped learning model emphasizes enhancing students' understanding and solidifying content learned outside the classroom through guided instruction inside it [14]. By watching video content independently, students then internalize and apply it practically, engaging directly with teachers during classroom interactions [1].

The study examines the effect of flipped learning on junior secondary school students' achievement in Basic science. Regarding the experience of the researcher in the field of teaching science, it is noted that junior secondary school science classrooms, which is traditional classroom, often seems to be boring, mathematical aspect and some topics involve formula seems to be difficult to teach by some teachers and difficult to understand by many students, and this affect the result of the students in Basic Education certificate Examination (BECE), both state and federal. So it was notable by the researcher that, there is a need to conduct a

research study that would contribute to raising the achievement level of the students in Basic science for future sustainable development.

To address these challenges, and improve the educational process, the researcher proposes adopting modern instructional technology concepts. Specifically, the suggestion is to implementing a flipped instructional strategy where students watch lesson content in video format before class. This approach aims to enhance classroom interactions, cater to individual learning differences, and make learning more enjoyable for students. By leveraging technology in this way, teachers can potentially elevate their students' academic performance while ensuring they stay abreast of technological advancements in Ogun state.

2. HYPOTHESES

i. There is no significant main effect of treatment on academic achievement of the students in basic science.
ii. There is no significant main effect of gender on academic achievement of the students in basic science?
iii. There is no significant main effect of level of engagement on academic achievement of students in basic science.
iv. There is no interaction effect of treatment, gender, level of engagement and academic achievement of students in basic science.

3. METHODOLGY

This study employed pre-test-post-test quasi-experimental design to investigate the impact of flipped learning on the academic achievement of junior secondary school students in Basic Science, comparing it with the traditional teaching method. A total of eighty (80) students, all equipped with computers and internet access at home, were randomly divided into two equal groups. The control group received instruction through the traditional teaching method, while the experimental group was instructed using the flipped learning model. Both groups took the Basic Science Achievement Test (BAT) at pretest and posttest stages to measure their learning outcomes. The diagram below illustrates the study's design:

3.1 DIAGRAMATIC REPRESENTATION OF STUDY DESIGN

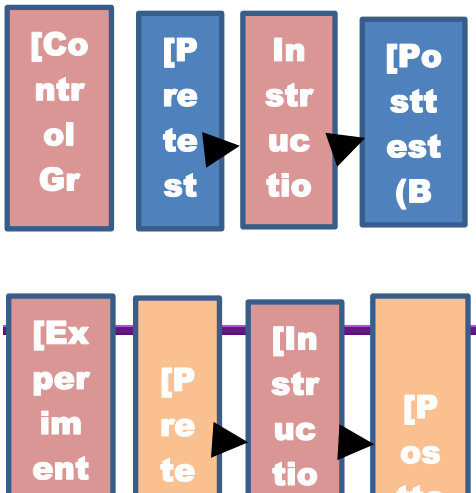

Figure 1: **By the reseachers**

This design allows for a comparative analysis of the effectiveness of flipped learning versus traditional teaching in enhancing students' understanding and performance in Basic Science. Two instruments were used for the study. They are: the Basic science Achievement test (BAT) and which was used for the pre-test and the post-test and Students' Engagement Scale (SES). Data collected were analysed using ANCOVA.

4. RESULTS

Table 1: Mean differences of treatments, Gender and Level of engagement

Treatment	Mean	N	Std. Deviation
Flipped	30.45	40	6.575
traditional	10.43	40	2.763
Total	20.02	80	11.253

Gender	Mean	N	Std. Deviation
male	23.17	30	12.704
female	18.80	50	10.067
Total	20.44	80	11.253

There was mean differences between Treatment (Flipped learning) and Control of 20.02. This call for testing for significant level using ANCOVA.

H01. What is the significant main effect of treatment on academic achievement of the JSS students in Basic science?

Table 2: Analysis of covariance (ANCOVA) of students' post–test achievement scores in Basic science by treatment

Table 2 shows the summary of analysis of covariance (ANCOVA) of students' post–test achievement scores in Basic science by treatment (flipped learning) and control group, level of engagement and gender. It was revealed that there was significant effect of treatment on the students' achievement in Basic science using flipped learning strategy

and traditional method. After adjusting for the covariance, (pre- test score in Basic science), $F_{(1,420)} = 70.1$, $p < 0.05$.

H02. What is the significant effect of gender on academic achievement of the students in basic science?
Table 1 revealed that there was no significant effect of gender on the students' achievement in Basic science, $F_{(1,420)} = 4.917$, $p > 0.05$. Meanwhile, there was mean difference between the performance of female and males' students participated in the experiment using flipped learning. The males had higher mean of 24.00 over female with 22.00 mean.This is revealed in fig 1.

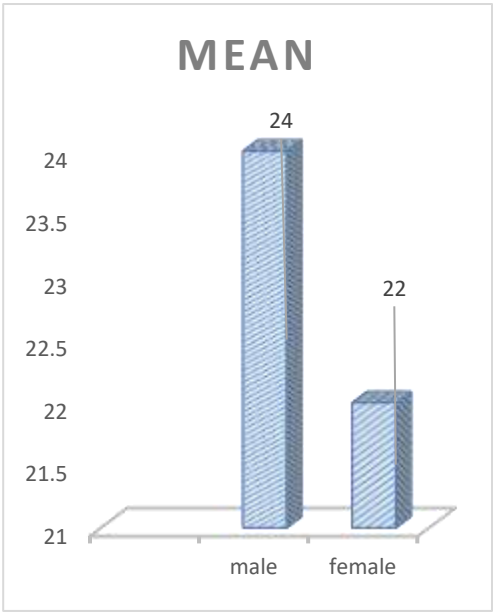

Fig. 1 mean difference of gender (Male and Female)

Fig. 1 reveal means difference of male and female students' Achievement in Basic science using flipped learning. It was revealed that male have higher mean of 24.00 while females have 22.00

HYP 3. What is the significant main effect of level of engagement on academic achievement of students in basic science?
Table 1 revealed that there was significant main effect of level of engagement on the students 'achievement in Basic science, $F_{(1,420)} = 8.399$, $p < 0.05$.
HYP 4. What is the interaction effect, of treatment, gender, level of engagement and academic achievement of students in basic science?
Table 1 revealed that there was significant that there was interaction effect of treatment, gender and level of engagement by the students on their achievement. The P value is less than 0.05.

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9583.571	27	354.947	43.934	.000	.958
Intercept	16247.217	1	16247.217	2011.002	.000	.975
treatment * Gender	50.017	1	50.017	6.191	.016	.106
treatment * levelofengage	.503	1	.503	.062	.804	.001
treatment * Gender * levelofengage	227.584	9	25.287	3.130	.004	.351
Treatment	566.704	1	566.704	70.144	.000	.574
Gender	39.721	1	39.721	4.917	.061	.086
levelofengage	950.011	14	67.858	8.399	.000	.693
Error	420.117	52	8.079			
Total	43419.000	80				
Corrected Total	10003.688	79				

a. R Squared = .958 (Adjusted R Squared = .936)

5. Discussion

The study revealed that, students taught Basic science with flipped classroom strategy obtained higher achievement scores than those of their counterparts taught the same topics with traditional method. This is attributed to the individualized learning experiences through the use of instructional videos, pictures, and the classroom activities which engaged students and teachers interaction that were provided in the flipped classroom group. This finding is similar to the findings of the study about the positive impact of flipped learning on students' success by [1]. The result of [8], [15] also in line with the positive effect of flipped learning in their study of integration flipped learning into senior secondary schoo*l for improvement of academic achievement and attitude to leaning.
The study also showed that male students had improved mean achievement scores than their female counterparts in the

flipped learning class but no difference in control class. The higher mean score of male over female students may due to the openness of the male student learning through videos at home rather playing ball or doing other thing and the female busy with mummy or doing house chores or the phobia of female student to the use of computers caused the lower achievement scores. This findings is in line with studies of [16], [8] where they explained the idea of gender differentiation in ability.

The study also revealed the significant effect of level of engagement of students to the good performance of students in Basic science. The higher the level of interaction and contribution in asking questions, explained concept of topics watched in the video, answering questions in the flipped learning class the higher the achievement scores. This buttress the finding of [5], [3], [17]**,** they explained that flipped learning helped increase students' participation, have them be prepared for the lesson, help them understand the content better and improved their performance. [2], [1] findings goes along with the findings, that the higher the level of students level of engagement in classroom the higher the academic achievement. Also, it showed that there was interaction effect of treatment, gender and students level of engagement.

6. CONCLUSION AND RECOMMENDATIONS

Based on the findings and discussions, it was determined that the flipped learning strategy significantly enhanced students' achievement in Basic Science. Although there was no notable gender effect on overall Basic Science scores, male students achieved higher mean scores than female students when utilizing the flipped learning strategy. Thus, the use of flipped learning (Treatment) was identified as the factor contributing to the significant improvement in students' academic performance in this study.

In light of these results and existing literature, flipped learning proves to be highly effective and efficient in boosting students' academic performance in Basic Science and fostering a positive interest in the subject. This suggests that integrating innovative teaching methods into the learning process could enhance students' enthusiasm for science classes in senior secondary school. Additionally, it could lead to more streamlined and effective lessons, equipping students with strong scientific skills that promote independence in future endeavors.

Furthermore, the findings suggest that flipped learning is a suitable and beneficial approach for simplifying science education in classrooms.

Based on the study's findings, the following recommendations are proposed:

1. Junior secondary school teachers are encouraged to adopt the flipped learning approach for teaching Basic Science and integrate it into their instructional methods.
2. Curriculum planners and educational policymakers should consider reviewing the curriculum to incorporate flipped learning methodologies effectively.
3. Federal and State Governments, in collaboration with Ministries of Education, should organize and sponsor regular training workshops and conferences to educate teachers on implementing flipped learning strategies in science classes.
4. Pre-service teachers should receive comprehensive training in utilizing flipped learning techniques during their teacher preparation programs.
5. Adequate ICT facilities and resources should be provided by the Federal and State governments through the Ministry of Education to support the implementation of flipped learning strategies in secondary schools across Nigeria.

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