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Effects of Flipped Instructional Strategy on Academic Performance and Gender Differences in Sciences among Undergraduate Students in Zamfara State, Nigeria.

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Abstract

The academic performance of undergraduate science students in Zamfara State, Nigeria, has been declining in recent years. Despite the availability of modern technology, teaching methods remain largely dependent on traditional lecture-based instruction. Lecturers and their students use different applications and software for their personal purposes, but using these technologies for educational purposes was very low. This study investigates the effects of the Flipped Instructional Strategy (FIS) on the academic performance and gender differences of undergraduate students in science disciplines. A quasi-experimental design was employed, involving 160 students from two universities in Zamfara State. The instrument used for data collection was Science Courses Achievement Test (SSPT) with reliability coefficients of 0.819. The instrument was duly validated by experts. Mean and standard deviation were used to answer the research question, while ANCOVA was used to test the hypotheses at 0.05 level of significance. Results showed a significant improvement in students' performance when taught using FIS compared to enhanced lecture methods. There were no significant gender differences in performance. The study recommends training science lecturers in FIS to enhance student learning outcomes.

Keywords: Flipped Instructional Strategy, Academic Performance, Sciences.

Introduction

Research on teaching and learning constantly endeavour to examine the extent to which different teaching methods enhance growth in students' learning. Quite remarkably, poor academic performance by the students, majority is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners. Substantial research on effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievement of learners. The relationship between teaching methods and students' academic performance especially when it comes to applications in the context of 21st century shows that there is something in teaching that opens the gate of learning (Abbas, 2023). According to Tan et al. (2020), asserted that effective instruction requires a merging of technological, pedagogical and content knowledge functioning as a single construct instead of viewing them as independent entities. Active-learning approaches seem to have a positive impact on student learning and achievement in science. Matazu and Isma'il (2023) recommended the use of Flipped Instructional

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Strategy with recent developments in active-learning pedagogical approaches with advances in instructional design and technology.

Flipped Instructional Strategy (FIS) is used to describe a pedagogical approach in which the conventional way of classroom-based learning is inverted (Abbas, 2023). It is an educational technique that consists of two parts: direct individual instruction outside the classroom where students learn by using means of technology and interactive group learning activities inside the classroom where the teachers guide the students to digest what was learned at home. Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic interactive-learning environment where the educator guides students as they apply concepts and engage creatively with the subject matter (Emine, 2018). Flipping the classroom employs easy-to-use technology to free class time from traditional lecture allowing for more active learning.

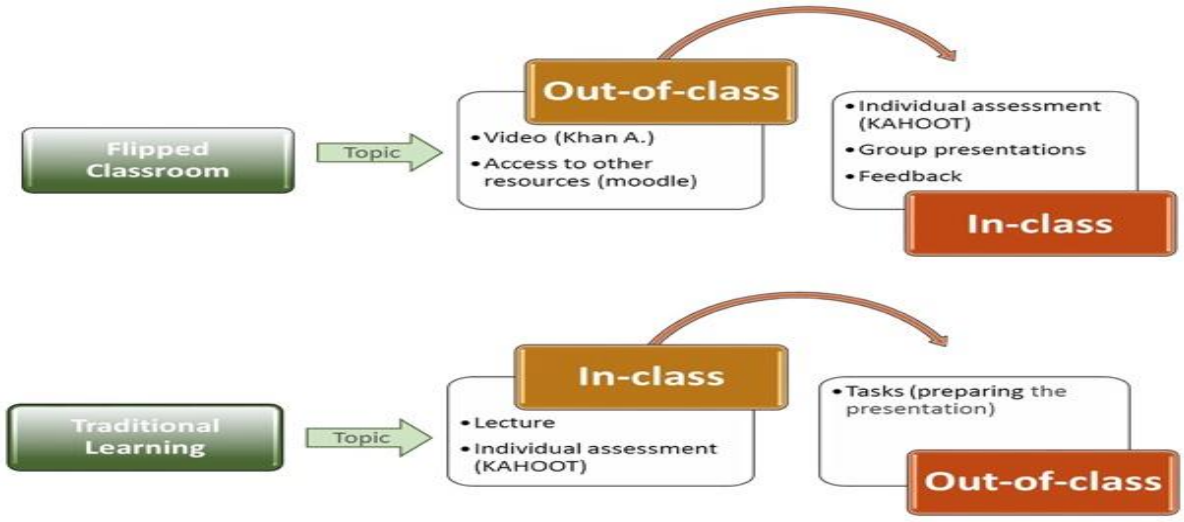

Figure 1: Features of learning environments for experimental group (FIS) and control group (Emine, 2018).

According to Abbas and Idris (2024) as well as Matazu and Iisma;il (2023), flipped instructional strategy improved students' academic performance irrespective of gender and therefore it should be employed as the best strategy for teaching science concepts. Thus, this research used Flipped Instructional Strategy in teaching science concepts and investigated its effect on academic performance.

Several studies have investigated the effectiveness of the Flipped Instructional Strategy approach in enhancing students' learning in Biology. In Nigeria, using Quasi experimental design, Matazu and Isma'il (2023) conducted a study to investigate the effect of flipped classroom instruction and enhanced lecture method on academic performance in genetics among students with VAK learning styles in Gusau, Zamfara State, Nigeria. The study found that visual learning style (40.76%) was the most preferred by the SS 3 students, followed by auditory (31.52%) and

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kinesthetic (27.72%) styles. The study also found that flipped classroom instruction and enhanced lecture methods improved academic performance in genetics compared to traditional lecture methods, regardless of students' VAK learning styles. In a similar trend, Abbas and Idris (2024) examined the effects of flipped classroom learning on academic achievement in genetics concepts among secondary school students in Gusau, Zamfara State, Nigeria. The research design employed was quasi-experimental; specifically, pre-test, post-test, non-equivalent control group design. Results showed a significant improvement in students' performance when taught using Flipped Classroom Learning in genetic concepts than those exposed to lecture method. The findings equally indicated the insignificant difference between the academic achievement of male and female students exposed to Flipped Classroom Learning.

Academic performance is standardized test scores, grades, and overall academic ability and achievement outcomes which have to do with the aspects of the students' academic setting, such as the interactions with peers and teachers, and other student influences within the school (Badmus, 2021). It is individual or group effort which is highly important for an organization such as school as a whole and for the individuals learning process. The success of any educational institution is measured by the performance of its students in both academic and non-academic tests. Abbas and Idris, (2024) emphasizes that for effective instruction, a science teacher must be able to use several science teaching methods and to implement them where they are applicable and most effective. Therefore, the teacher being the important agent and the methods he uses in teaching and learning process exerts influence upon the students' academic performance. For this reason, this study therefore, will investigate on the Effects of Flipped Instructional Strategy on Academic Performance in Sciences among Undergraduate Students taking gender differences in to consideration.

Gender refers to the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women. It emphasizes that masculinity and femininity are products of social, cultural and psychological factors and are acquired by an individual in the process of becoming a man or woman. Gender differentiation is an old controversial issue in education; it could be a factor that influences students' perception of concepts. In this regards, gender differences have gradually become a common discuss in educational cycles (Armah et al., 2021). Many researches has been done in gender, some studies revealed males' and females differences in achievement (Worman and Hyder, 2020; Armah et al., 2021). Some studies on the other hand disclosed that there was no significant gender difference in the students' academic performance in various science subjects such as Mathematics, Physics, Chemistry and Biology (Musa et.al., 2024; Abbas and Idris, 2024; Matazu and Isma'il, 2023). Upon this background, this study therefore, investigated the Effects of Flipped Instructional Strategy on Academic Performance in Sciences among Undergraduate Students in Zamfara State, Nigeria.

Statement of the Problem

The study was prompted by poor academic performance in sciences among undergraduate students in Zamfara State higher institutions of learning especially at their first year of study.

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Results of 100 level undergraduate students in 2020/2021 & 2021/2022 shows poor academic performance in single honour courses of Biology, Chemistry and Physics among undergraduate university students in Zamfara State. Despite the new technology tools that surround students and lecturers, for example the social networks applications are used regularly as one of the most important communication ways among the daily life of students and lecturers. However, the teaching and learning processes still depend exclusively on lecture method. Lecturers use different applications and software for the personal purposes, but using these technologies for educational purposes was very low. In an attempt to encourage learning in sciences, the problems of mastery of subject matter, skills, and interest in scientific concepts could be addressed through the use of appropriate teaching method (Musa et al., 2024). Therefore, there is a big gap between modern teaching methods that followed by lecturers and learning methods that their students need based on their abilities and interests which needs to be addresses timely.

Some of the reasons of undergraduate students' failure in utilising modern technologies to learn were attributed to the methods of teaching adopted by the lecturers in teaching sciences, which is mostly lecture method, where the lecture method is not recommended for teaching sciences (Abbas, 2023). This leads to find out new approaches to develop and update teaching processes which focus on the role of learner and make him/her the center of learning process. there is limited research on the flipped instructional strategy in Nigerian universities, especially regarding gender differences in academic performance in science subjects.

This work will therefore concern with the use of more effective approaches to enhance students' academic performance in sciences. One of such modern methods and strategies is the flipped instructional strategy. Most of the studies on FIS were carried out in secondary school and no studies have specifically addressed flipped learning at tertiary institutions considering gender differences in Zamfara State, making this study a unique contribution. Therefore, there is need to carry out this research and find out the effects of flipped instructional strategy on academic performance and whether gender differences influence outcomes in undergraduate science students.

Research Questions

Based on the objectives of the study, the specific questions to be addressed are:

1. What is the effect of flipped instructional strategy on the academic performance of undergraduate science students in Zamfara State?
2. Is there a significant difference in performance between male and female students using the flipped instructional strategy?

Research Hypothesis

The following null hypotheses were formulated at 0.05 alpha level of significance.

$H0_1$: There is no significant difference in the academic performance of undergraduate science students taught using the flipped instructional strategy versus the enhanced lecture method.

$H0_2$: There is no significant difference in the academic performance between male and female students taught using the flipped instructional strategy.

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Methodology

This study employed quasi-experimental research design (pre-test and post-test experimental control group design). The experimental groups were taught using Flipped Classroom Learning Strategy while the control groups were taught using enhanced lecture method of teaching. The population of this study consisted of all first-year undergraduate sciences students offering single honour courses of Biology, Chemistry and Physics from two universities in Zamfara State i.e. Federal University Gusau and Zamfara State University Talata Mafara. The sample size of the study consisted of one hundred and sixty (160) UG I sciences students selected through stratified sampling of gender which comprised of eighty (80) males and eighty (80) females, then a simple random sampling techniques was used to assigned them into experimental and control groups.

The treatment for the study was teaching of general sciences courses of Biology, Chemistry and Physics for UG I. The experimental group were taught these general courses using FIS guided by the Lesson Plan designed by the researchers for a period of four weeks. In delivering the actual experiment a flow chart of the steps involved in FIS as designed by Karanicolas et al., (2018) was strictly adhered to. The flow chart of the Flipped Classroom Learning by Karanicolas et al., (2018) is presented in the figure:

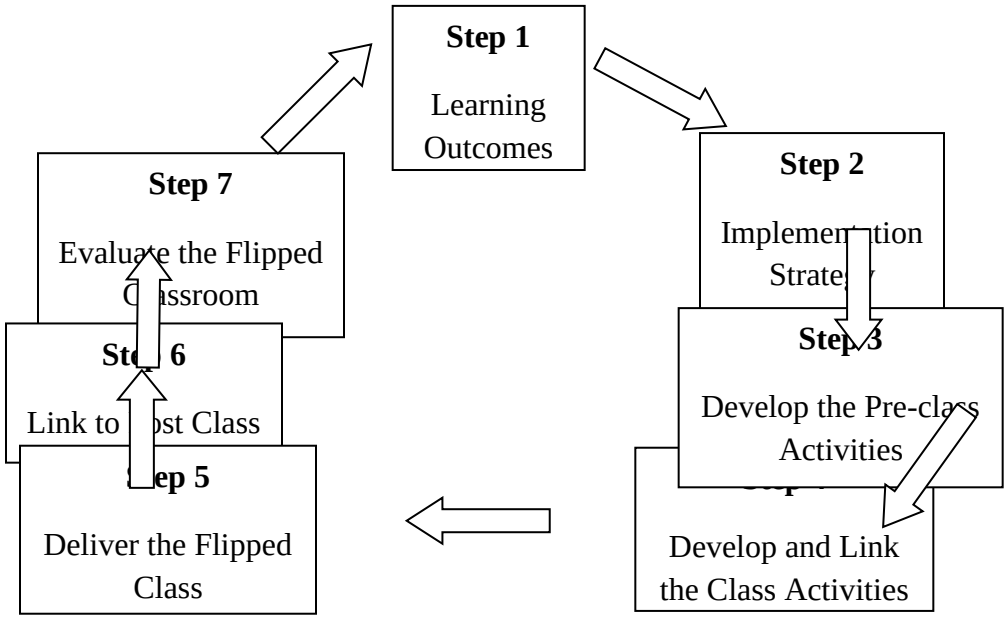

Figure 1: Steps in Developing Flipped Model (Karanicolas et al., 2018)

Step 1: Learning Outcomes
Step 2: Plan Your Implementation Strategy
Step 3: Develop the Pre-Class Learning Activities
Step 4: Develop and Link the Class Activities

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Step 5: Deliver the Flipped Class
Step 6: Link to the Post Class Activities
Step 7: Evaluate the Flipped Classroom

The students in the control group were taught the same concepts using enhanced lecture method of teaching which involved lecture-based instruction with the use of diagrams and illustrations related to concepts being treated to enhance participants' engagement and participation. The researchers ensured that the lesson plan designed for this purpose was strictly followed and lecture notes were given by the researchers.

Science Students Performance Test (SSPT) served as an instrument for data collection, it was face and content validated by experts in the field with reliability coefficients found to be 0.819. Mean and standard deviation were used in answering the research question, while analysis of covariance (ANCOVA) was used for testing the hypotheses at 0.05 level of significance using statistical product and services solution (SPSS) version 20.0.

Results

Research Question 1: What is the effect of flipped instructional strategy on the academic performance of undergraduate science students in Zamfara State?

To answer this research question, mean and standard deviation were used. Data on Post-test scores of undergraduate science students taught using Flipped Instructional Strategy and those taught using enhanced lecture method were computed and presented in Table 1.

Table 1: Mean and Standard Deviation of Post-test for Experimental and Control Groups

Group	N	Mean	SD	Mean Diff
Experimental	80	16.9875	3.53820	5.962
Control	80	11.0250	2.40240	

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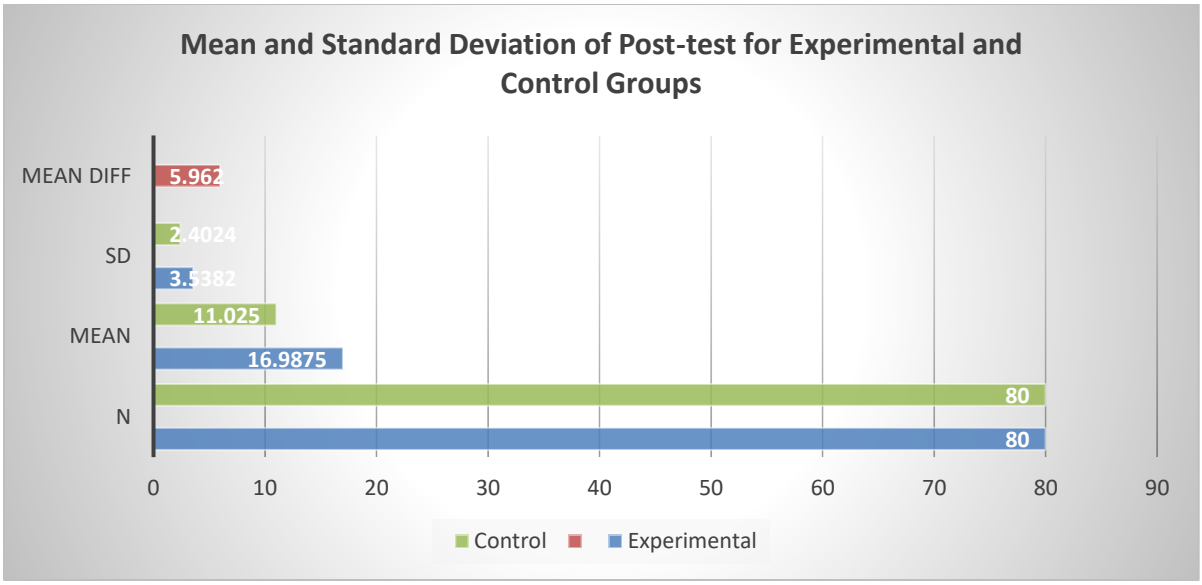

The results show that there is a significant effect of flipped instructional strategy on academic performance in sciences as indicated by the means and standard deviations of experimental group 16.99 and 3.54 and that of control group 11.03 and 2.40 respectively. The mean difference was found to be 5.96 in favour of the experimental group. This shows that the experimental group had performed better as a result of exposure to flipped instructional strategy. To find out if the difference in the mean was statistically significant, the corresponding hypothesis one was therefore tested.

$H0_1$: There is no significant difference in the academic performance of undergraduate science students taught using the flipped instructional strategy versus the enhanced lecture method.

To test this hypothesis, the post-test scores of undergraduate science students in the experimental and control groups were compared using ANCOVA statistics. Table 2 shows the result obtained.

Table 2: ANCOVA Analysis on the Mean Academic Performance of Experimental and Control Groups

Performance	Sum of Squares	df	Mean Square	F	Sig.	Decision
Between Groups	1422.056	1	1422.056	155.498	.000	Rejected
Within Groups	1444.938	158	9.145			
Total	2866.994	159				

* Significant, $P \leq 0.05$

Results presented in Table 2 shows that the significant (2-tailed) value is 0.000 which is less than $P \leq 0.05$. Therefore, there is significant difference in the mean scores of experimental and control groups.

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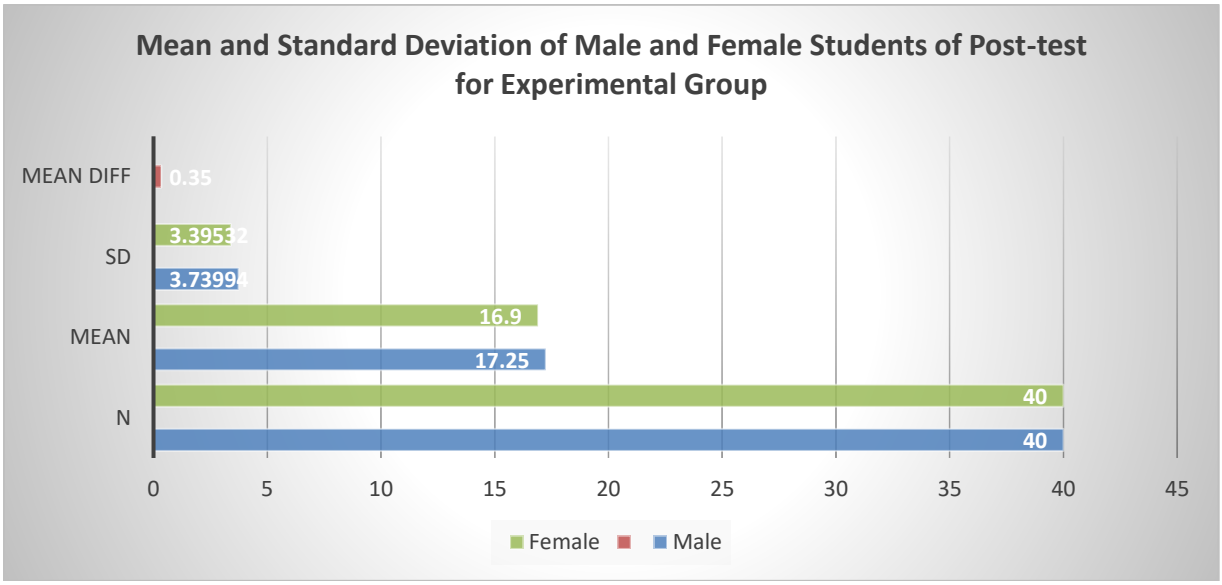
Research Question 2: Is there a significant difference in performance between male and female students using the flipped instructional strategy?

To answer this research question, mean and standard deviation were used. The post-test mean scores of experimental group were subjected to descriptive statistics based on gender (i.e. male and female). Mean and standard deviation were computed and presented in Table 3.

Table 3: Mean and Standard Deviation of Male and Female Students of Post-test for Experimental Group

Group	N	Mean	SD	Mean Diff
Male	40	17.2500	3.73994	0.35
Female	40	16.9000	3.39532	



The results show that there is slight difference of male and female academic performance scores when taught using flipped classroom learning strategy, with the means and standard deviations of male students in the experimental group 17.25 and 3.749 and that of female students are 16.90 and 3.395 respectively. The mean difference was found to be 0.35 in favour of males. To find out if the difference in mean is statistically significant, the corresponding hypothesis (HO_2) was therefore tested.

$H0_2$: There is no significant difference in the academic performance between male and female students taught using the flipped instructional strategy.

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To test this hypothesis, the post-test scores of the male and female students in the experimental group were compared using ANCOVA statistics.

Table 4: ANCOVA Analysis on the mean academic achievement of Male and Female Students in the Experimental Group

Gender	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Between Groups	2.450	1	2.450	.192	.662	Accepted
Within Groups	995.100	78	12.758			
Total	997.550	79				

** Not Significant, P > 0.05

Results presented in Table 4 show that the significant (2-tailed) value is 0.66 which was more than P ≤0.05. Therefore, there is no significant difference in the mean scores of male and female students taught general science courses using FIS.

Discussion of the Findings

The study investigated the Effects of Flipped Instructional Strategy on Academic Performance and Gender Differences in Sciences among Undergraduate Students in Zamfara State, Nigeria.

The finding from the Research Question 1 and Research Hypothesis 1 as contained in Table 1 and 2 revealed that there is significant difference in the mean academic performance of students taught sciences using FIS and enhanced lecture method with mean difference found to be 5.96 in favour of the experimental group. This implies that the experimental group performed significantly better than their counterparts in the control group. The reason for the significant difference between the experimental and control group in this study resulted from active participation of students in their learning. The work of Yusif (2023) proved that when students had access to improved learning materials it improves student's learning. Unlike the lecture method where the teacher assumes the position of one who knows all, he delivered the knowledge while students remain at the receiving end. The teacher does most of the activities and presented the topic. This finding agrees with several other studies, such as that of Abbas (2023) and Abbas & Idris (2024) who concluded that there is significant difference in the performance of students taught science subjects using Flipped Classroom Learning and those taught using lecture method. The finding also supports Ezenwabachili and Okoli (2021) who shows the effectiveness of FIS in promoting students' learning and academic performance in science subjects. Contrary, the findings of Matazu and Isma'il (2023) showed that there is no statistically significant difference between FIS and enhanced lecture method, but only with traditional lecture method. Also, the findings of Emine (2018) showed that the use of the FC Model does not yield significant impacts on increasing the students' academic achievement.

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The result of Research Question 2 and Research Hypothesis 2 in Table 3 and 4 shows that there is no significant difference in the mean academic achievement of male and female students taught sciences FIS. This shows that when science lecturers employ teaching method that helps in delivering instruction in a manner that appeals to different learners, allows practice and active learning, it improves students' academic performance regardless of gender, and this means that FIS is effective in improving academic achievement of both male and female. This finding is in conformity with many findings reported by researchers such as Musa et.al. (2024) who disclosed that there is no significant gender difference in the students' academic performance science subjects. The finding is also in line with that of Matazu and Isma'il, (2023) and Abbas and Idris, (2024) who revealed that gender has no significant influence on academic performance of students when taught with flipped classroom learning strategy. But the findings opposed that of Workman and Heyder (2020) who opined that females seem to do better than males in language and the arts, as well in the natural sciences, despite the latter being a traditional area of male dominance. Also, Armah et al. (2021) shows that males outperform females especially in mathematics and science subjects.

Conclusions

The findings of the study concludes that students exposed to FIS performed better than those taught sciences concepts by means of enhanced lecture method. This implies that FIS enhanced students' performance in learning science concepts and therefore should be use the main teaching strategy in order to improve the teaching and learning of sciences in tertiary institutions. The restriction of the study to specific sciences courses of Biology, Chemistry and Physics is fairly narrow for the generalization of the study, as such similar study may be needed for other courses and other levels of education to see if similar results can be obtained.

The results also show that there is no significant difference between the performance of male and female students who learnt sciences by means of FIS; hence gender does not affect learning when students are taught using FIS. Therefore, science lecturers should use FIS in teaching both males and females students.

Recommendations

The following recommendations are made:

1. The use of FIS improved the academic performance of students in the present study. Therefore, science lecturers should use FIS and other active learning strategies as the main teaching strategy in order to improve the teaching and learning of sciences in tertiary institutions.

2. Science lecturers should be trained by stakeholders on effective procedures for implementing FIS in their lecture rooms by organizing training on FIS Model and other active learning strategies. This is because FIS helps in improving students' academic performance.

3. There should be a continuous evaluation and feedback mechanisms by education stakeholders for implementing FIS.

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4. The federal and state government through ministry of education and other educational agencies should provide universities with learning materials based on modern technologies that meet the students' requirements. These include computers, projectors, video conference rooms, e-library and available wireless network in schools.

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