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FLIPPED CLASSROOM AND ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN PORT HARCOURT METROPOLIS, RIVERS STATE

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Abstract: This study examined flipped classroom and academic performance among physics students in secondary schools in the Rivers State Metropolis of Port Harcourt. This study was guided by four research questions and four hypotheses. Quasi-experimental pretest-posttest experimental and control group design was used in the study. The study population consists of 17,780 senior secondary school students in 45 public secondary schools in Port Harcourt Metropolis, Rivers State. By simple random sampling, four (4) coeducational schools located strategically in the study area were chosen for the study. A non-randomized sample size of 209 students offering Physics in SS 2 class, comprising 114 male and 95 female students, was selected for the study. An instrument titled Physics Performance Test (PPT) was used by the researcher for data collection, which yielded a reliability coefficient of 0.86 using Spearman-Brown formula. The mean and standard deviation were used to answer the research questions, while the hypotheses were tested at the 0.05 level of significance using analysis of covariance (ANCOVA). The analysis results revealed a significant difference between the mean performance scores of students taught physics using the flipped classroom and those taught using the demonstration method. There was a significant difference between the mean performance scores of male and female students taught physics using the flipped classroom. There was no significant difference between the mean performance scores of male and female students taught physics using the demonstration method. There was a significant interaction effect of instructional methods (flipped classroom and demonstration method) and gender on students' academic performance in physics. The study concluded that a flipped classroom is effective for improving the academic performance of students in Physics. The combination of instructional methods and gender has a significant impact on the academic performance of students in Physics. In view of the findings, recommendations were made that conferences, seminars, and workshops should be organized by school administrators and other educational stakeholders to prepare teachers on how to include and use flipped classrooms, especially for teaching physics.

Keywords: Academic performance, Demonstration Method, Flipped Classroom, Physics.

Introduction

Education is an instrument for national development and social change. According to Asuzu andOkoli (2019), it is the process of facilitating learning and acquiring knowledge, skills, values, morals, beliefs, and habits. Educational methods include storytelling, demonstration, discussion, and problem-solving. Educational systems

are established to facilitate teaching and learning and empower students with the necessary knowledge and skills to effectively contribute to the solutions of societal problems. Classroom learning is expected to be transferred into solving problems in real-life situations.

Science refers to the pursuit and application of knowledge and understanding of the natural and social world through a systematic procedure anchored in evidence. It is an intellectual and social endeavor (Akpan, 2024). People are more likely to react thoughtfully to scientific claims and less likely to reject them out of hand or accept them uncritically when they understand how scientists go about their work and reach conclusions, as well as the limitations of such conclusions. Unfortunately, the images that many people have of science and how it works are often distorted. The myths and stereotypes that young people have about science are not dispelledwhen science teaching focuses on the laws, concepts, and theories of science. Therefore, the study of science as a way of knowing must be made explicit in the curriculum (Akpan, 2017a, 2017b,2019).

Science subjects in secondary schools have been categorized as Physics, Chemistry, Biology, Agricultural Science, and Computer Science (FRN, 2014). According to Nnaji (2021), physics is one of the science subjects at the secondary school level and deals with the study of laws thatdetermine the structure of the universe with reference to matter and energy in the universe. Ilo (2022) described it as the soul of science and technology creation because its principles, laws, and theories are the root of technology advancement. Therefore, it can be said that almost everything in the universe has a direct or indirect relationship to physics

Therefore, it is one of the major requirements for those who want to study a science and technology. Related course -in higher institutions in Nigeria. The objectives of teaching physics in senior secondary school are to: provide basic literacy in physics for a fundamental living society, acquire basic concepts of physics as preparation for further studies, acquire essential scientific skills and attitudes as a preparation for the technological application of physics, and stimulate creativity (FRN, 2014). These objectives are of great advantage to mankind and society at large if they are achieved and achieved above average.

However, the actualization of the above objectives of teaching physics in senior secondary school has been a mirage as there has been a steady decline in students' performance in physics as observed by science education researchers (Nnaji, 2021; Ilo, 2022). Evidence in the statistics of students' academic performance in the West African Senior School Certificate Examination in physics purports poor students' performance in the subject as compared to other science subjects. The observed poor performance is believed to be due to the teaching methods and the overuse of the conventional teaching method employed by physics teachers (Ilo, 2022). Nnaji (2021) observed a serious disconnection between the ways of learning and the methods of teaching in physics, and most teachers use the conventional methods they were taughtwith for today's teaching, thereby resulting in half-baked knowledge imparted to students in physics. Nnaji (2021) asserted that the most common conventional methods, which are often teacher-centered, were lecture, expository, and teacher-demonstration methods of teaching.

The demonstration teaching method revolves around the expert teacher conveying knowledge to novice students. This approach assumes that the teacher directs and provides the students with new information. It tends to emphasize passive learning because it primarily involves the transferof information from the teacher to the students without fostering active engagement. This method does not adequately support pedagogical techniques that promote effective science learning. In this approach, the teacher struggles to incorporate the life experiences and

positive values of students into the lessons. Instead, students mostly watch and listen while the teacher talks, resulting in limited interaction.

This method has proven inadequate for developing a deep understanding of the material in the context of physics instruction. The traditional approach restricts student interaction, requiring themto accept the teacher's knowledge and ideas as definitive. The teacher's control over learning

Flipped instruction or a flipped classroom is a form of blended learning in which students learn new content online by watching video lectures, usually at home, and what used to be homework (assigned problems) is now done in class with teachers offering more personalized guidance and interaction with students, instead of lecturing. This method is also known as backwards classroom, flippedclassroom, reverse teaching, and the Thayer method (Christopher et al., 2016). The flipped classroom model is a promising approach to such courses, as it has been shown to help prevent the development of inert knowledge (Schwichow, 2021; Fidan, 2023). The flipped classroom is an alternative educational approach that emphasizes the student-centered teaching method while keeping the traditional classroom environment as a reserve. It also captures interests widely and is acceptedin high education levels. As a student-centered learning method, the flipped classroom includes several theories and methods of constructivism and active learning with education peers' help (Chien-Yuan, 2018).

The implementation of the model expected that science learning at school, especially Physics, not only focuses on the product and delivery of content scientific learning but also can be more focused on the process of science outcomes, for example, through demonstration about science and technology in the environment. Therefore, students can improve their critical thinking skills and deepen their understanding of science and technology so that they can develop scientific literacy. It is against this background that the researcher is interested in examining the flipped classroom and academic performance of secondary school students in physics in Port Harcourt Metropolis, Rivers State.

Statement of the problem

At the introductory level, science students often find it difficult to understand some science concepts. Effective teaching and learning of physics in Nigerian secondary schools has become animportant issue that requires urgent attention. It has been observed that teaching negatively affects the performance of students in both internal and external examinations. The development ofa sound basis for scientific and reflective thinking, as demanded by the National Policy on Education(NPE), can only be achieved when science is taught appropriately and properly. Despite the importance of physics among Nigerian students, performance at the senior secondary school level has been poor (Bunkure 2014).

The conventional method of teaching physics in secondary schools has been criticized for being passive, as students tend to absorb information rather than actively engage in their learning. This method may fail to effectively involve students or cultivate the critical thinking and problem-solving abilities necessary for achieving success in physics and other STEM fields. In recent years, there has been an increasing interest in alternative teaching methods designed to boost student engagement and enhance academic performance, example of this method is the flipped classroom.

Research in Physics indicates that traditional teaching methods are becoming less effective in classrooms in the 21st century. Consequently, contemporary methods, such as the flipped classroom, are becoming increasingly

valuable for fostering problem-solving skills in students. This suggests that enhancing physics education in the 21st century using conventional methods is no longer possible; therefore, adopting modern teaching strategies is essential.

This study attempted to fill this gap by ensuring that physics education is provided to students using the right and modern approach while also instilling the problem-solving skills required in the 21st-century workplace. It also intends to provide some possible solutions to the persistently low performance in the subject among secondary school II (two) physics students. Specifically, this study examined the flipped classroom and academic performance of secondary school students in physics in Port Harcourt Metropolis, Rivers State.

Objectives of the study

This study aims to examine the flipped classroom and academic performance of secondary school students in physics in Port Harcourt Metropolis, Rivers State. Specifically, the objectives of the study are as follows:

1. Examine the mean performance scores of students taught physics using the flipped classroom and those taught using the demonstration method.
2. Determine the mean performance scores of male and female students taught Physics using a flipped classroom.
3. Investigate the mean performance scores of male and female students taught physics using the demonstration method.
4. Determine the interaction effect of instructional methods (flipped classroom and demonstration method) and gender on the performance of students in physics

Research Questions

The following research question guided this study:

1. What is the difference between the mean performance scores of students taught physics using the flipped classroom and those taught using the demonstration method?
2. What is the difference between the mean performance scores of male and female students taught physics in a flipped classroom?
3. What is the difference between the mean performance scores of male and female students of physics using the demonstration method?
4. What is the interaction effect of instructional methods (i.e., flipped classroom and demonstration method) and gender on the performance of students in physics?

Hypotheses

The following null hypotheses were tested at a significance level of 0.05.

HO_1: There is no significant difference between the mean performance scores of students taught physics using flipped classroom and those taught using demonstration method.

HO_2: No significant difference was found between the mean performance scores of male and female students taught Physics using a flipped classroom.

HO_3: There is no significant difference between the mean performance scores of male and female students taught physics using the demonstration method.

HO_4: There is no significant interaction effect of the instructional methods (flipped classroom and demonstration

method) and gender on the performance of students in Physics.

Methods

Quasi-experimental pretest- posttest experimental and control groups design was used in the study. The study population consists of 17,780 Senior Secondary School II students in 45 public secondary schools in Port Harcourt Metropolis, Rivers State. By simple random sampling, four (4) co-educational schools strategically located in the study area were chosen for the study. A non-randomized sample size was 209 students offering Physics in SS 2 class, comprising 114 male and 95 female students. The researcher used an instrument titled Physics Performance Test (PPT) and a set of lesson plans (intervening instruments) for data collection. The instrument was validated with a reliability coefficient of 0.86 using Spearman-Brown formula. Mean and standard deviation were used to answer the research questions, while the hypotheses were tested at a significance level of 0.05 using analysis of covariance.

Results

Research Question One: What is the difference between the mean performance scores of students taught physics using the flipped classroom and those taught using the demonstration method?

Table 1 Mean and standard deviation performance scores of students teach physics using flipped classroom and those taught using demonstration method?

Group	n	Pretest Mean	Pretest SD	Post test Mean	Post test SD	Mean Gain
Flipped Classroom	104	23.49	6.202	66.14	11.342	42.65
Demonstration Method	105	22.15	5.812	46.72	8.527	24.57
Mean diff		1.34		19.42		18.08

Table 1 shows that the students who were taught physics using the flipped classroom had a pretest mean performance score of 23.49 and a posttest mean performance score of 66.14, with a gained mean performance score of 42.65, while those in the control group who were taught with the demonstration method had a pretest mean performance score of 22.15 and a posttest mean score of 46.72, with a gained mean of 24.57. Students who were taught physics using the flipped classroom had less homogeneous scores in their posttest (11.342) than those who were taught using the demonstration method (8.527). The difference between the students' mean gained performance scores is 18.08 in favor of flipped classroom. This shows that students taught using flipped classroom did better than students taught using demonstration method.

Research Question Two: What is the difference between the mean performance scores of male and female students taught in a flipped classroom?

Table 2 Mean performance scores of male and female students taught physics using flipped classroom

Method	Gender	n	Pretest Mean	Pre test SD	Post test Mean	Post test SD	Gain Mean
	Male	54	22.70	5.382	69.30	10.604	46.60
Flipped Classroom	Female	50	24.34	6.936	62.74	11.226	38.40
	Mean diff		1.64		6.56		8.16

Table 2 reveals that the male students who taught Physics using the Flipped Classroom had a pre-test mean performance score of 22.70 and a post-test mean performance score of 69.30 with a gain mean performance score of 46.60, while the female students had a pre-test mean performance score of 24.34 and a post-test mean performance score of 62.74 with a gain mean performance score of 38.40. The difference between the students' mean gained performance scores is 8.16. This shows that the male students did betterthan the female students who used the Flipped Classroom.

Research Question Three: What is the difference between the mean performance scores ofmale and female students of physics using the demonstration method?

Table 3 Mean performance scores of male and female students taught physics using the demonstration classroom

Method	GENDER	n	Pre test Mean	Pre test SD	Post test Mean	Post test SD	Gain Mean
	Male	60	21.93	5.468	47.08	8.398	25.15
Demonstration	Female	45	22.44	6.294	46.24	8.768	23.8
	Mean diff		0.51		0.85		1.35

Table 3 reveals that the male students who were taught physics using the demonstration method had a pre-test mean performance score of 21.93 and a post-test mean performance score of 47.08 with a gain mean performance score of 25.15, while the female students had a pre-test mean performance score of 22.44 and a post-test mean performance score of 46.24 with a gain mean performance score of 1.35.

Research Question Four: What is the interaction effect of instructional methods (i.e., flipped classroom and demonstration method) and gender on the performance of students in physics?

Table 4 Effect of interaction between instructional methods (flipped classroom and demonstration method) and gender on the performance of students in physics

GROUP	GENDER	n	Pre test Mean	Pre test SD	Post test Mean	Post test SD	Mean Gain
	Male	54	22.70	5.382	69.30	10.604	46.60
Flipped Classroom	Female	50	24.34	6.936	62.74	11.226	38.40
	Mean diff		1.64		6.56		8.16
	Male	60	21.93	5.468	47.08	8.398	25.15
Demonstration Method	Female	45	22.44	6.294	46.24	8.768	23.80
	Mean diff		0.51		0.85		1.35

Table 4 reveals that the male students taught Physics using flipped classroom had a pretest mean performance score of 22.70 and posttest mean performance score of 69.30 with a gain in mean scores of 46.60 while the female students had a pretest mean performance score of 24.34 and posttest mean performance score of 62.74 with a gain in mean scores of 38.40. Table 4.4 also reveals that the male students taught Physics using demonstration method had a pretest mean performance score of 21.93 and posttest mean performance score of 47.08 with a gain in mean scores of 25.15 while the female students have pretest mean performance score of 22.44 and posttest mean performance score of 46.24 with a gain in mean scores of 23.80. From the table above, the males in the flipped classroom performed better than the males in the demonstration method. Similarly, the females in the flipped classroom performed better than the females in the demonstration method. This indicates a greater interaction effect of instructional methods (flipped classroom and demonstration method) and gender (male and female) on students' academic performance in physics.

Hypothesis One: There is no significant difference between the mean performance scores of students taught physics using flipped classroom and those taught using demonstration method.

Table 5 Analysis of ANCOVA on the mean performance scores of students teach physics using flipped classroom and those taught using demonstration method

Source	e III sum of squares	df	Mean Square	F	Sig.	'artial eta squared
Corrected Model	19767.080[a]	2	9883.540	98.118	.000	.488
Intercept	45965.545	1	45965.545	456.321	.000	.689
Pretest	61.299	1	61.299	.609	.436	.003
Group	19705.858	1	19705.858	195.629	.000	.487
Error	20750.528	206	100.731			
Total	705045.000	209				
Corrected Total	40517.608	208				

a. R Squared = .488 (adjusted R Squared = .483)

Table 5 shows the result of the test of hypothesis one, which states that there is no significantdifference between the mean performance scores of students taught physics using flipped classroom and those taught using demonstration method. The results of analysis of covariance (ANCOVA) $F(1, 206) = 195.629$, $P = 0.000 < 0.05$ level of significance indicate a significant difference in the treatment (Flipped Classroom) on the academic performance of the students in physics. Therefore, the null hypothesis was rejected, meaning that a significant difference exists between the mean performance scores of students taught Physics using the flipped classroom and those taught using the demonstration method. This implies that the flipped classroom is effective for improving the academic performance of students in Physics. The partial Eta square estimate was.487, accounting for 48.7% of the variance observed in the post-test performance in the flipped classroom.

Hypothesis Two: There is no significant difference between the mean performance scoresof male and female

students taught physics in a flipped classroom.

Table 6 Analysis of ANCOVA on the Mean Performance Scores of Male and Female Students Teaching Physics in a Flipped Classroom

Source	ype III sum of squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected Model	1134.431[a]	2	567.216	4.728	.011	.086
Intercept	27324.687	1	27324.687	227.773	.000	.693
PRETEST	18.474	1	18.474	.154	.696	.002
GENDER	1134.404	1	1134.404	9.456	.003	.086
Error	12116.405	101	119.964			
Total	468257.000	104				
Corrected Total	13250.837	103				

b. R Squared = .086 (adjusted R Squared = .068)

Table 6 shows the result of the test of hypothesis two, which states that there is no significantdifference between the mean performance scores of male and female students taught physics using a flipped classroom. The result shows a significant difference in gender (male and female) on students' performance in Physics, F (1, 101) = 9.456, P = 0.003 < 0.05 level of significance. Therefore, the null hypothesis was rejected, indicating a significant difference between the mean performance scores of male and female students taught physics using the flipped classroom. The partial Eta square estimate was.86, indicating that gender accounted for 86% of the variance observed in the post-test performance.

Hypothesis Three: There is no significant difference between the mean performance scoresof male and female students taught physics using the demonstration method.

Table 7 Analysis of ANCOVA on the mean performance scores of male and femalestudents teach physics using the demonstration method

Source	Type III sum of squares	df	Mean Square	F	Sig.	'artial eta squared
Corrected Model	140.643[a]	2	70.321	.967	.384	.019
Intercept	17198.704	1	17198.704	236.413	.000	.699
Pretest	122.547	1	122.547	1.685	.197	.016
Gender	14.182	1	14.182	.195	.660	.002
Error	7420.347	102	72.749			
Total	236788.000	105				
Corrected Total	7560.990	104				

c. R Squared = .019 (adjusted R Squared = -.001)

Table 7 shows the result of the test of hypothesis three, which states that there is no significantdifference between the mean performance scores of male and female students taught physics using the demonstration method. Results of analysis of covariance (ANCOVA) $F_{(1,\ 102)} = .195$, P = .660

> 0.05 level of significance shows that there is no significant difference in the effect of the demonstration method on students' academic performance in physics. Hence, the null hypothesis was accepted, indicating that there is no significant difference between the mean performance scores of male and female students taught physics using the demonstration method. Thepartial Eta square estimate was 0.002, which means that gender (male and female) accounted for 0.2%of the variance observed in the post-test performance.

Hypothesis Four: There is no significant interaction effect of the instructional methods(i.e., flipped classroom and demonstration method) and gender on the performance of students in physics.

Table 8 Analysis of ANCOVA on the Effect of Instructional Methods (Flipped Classroom and Demonstration Method) and Gender on Physics Performance

Source	'ype III sum ofdf squares		Mean Square	F	Sig.	'artial eta squared
Corrected Model	20860.116[a]	4	5215.029	54.120	.000	.515
Intercept	43886.683	1	43886.683	455.444	.000	.691
PRETEST	20.282	1	20.282	.210	.647	.001
Group	19257.553	1	19257.553	199.850	.000	.495
Gender	679.715	1	679.715	7.054	.009	.033
Group * Gender	412.725	1	412.725	4.283	.040	.021
Error	19657.491	204	96.360			
Total	705045.000	209				
Corrected Total	40517.608	208				

d. R Squared = 0.515 (adjusted R Squared = 0.505)

Table 8 shows the result of the test of hypothesis four, which states that there is no significantinteraction effect of the instructional methods (i.e., flipped classroom and demonstration method) and gender on students' performance in physics. The result shows that there is no significant interaction between instructional methods and gender on students' performance in Physics $F_{(1,\ 204)} = 4.283$ P = .040 < 0.05 level of significance. Therefore, the null hypothesis was rejected, meaning that there is a significant interaction effect of instructional methods (flipped classroom and demonstration method) and gender on the academic performance of students in physics. This implies that the combination of treatment (flipped classroom and demonstration method) and gender significantly affects students' academic performance in physics.

Discussion of the Findings

Tables 1 and 5 show thatthere is a significant difference between the mean performance scores of students taught physics using the flipped classroom and those taught physics using the demonstration. This implies that the flipped classroom is effective for improving the academic performance of students in Physics. It has great potential to

support active learning, technology utilization, rich learning content, and flexible learning.

The findings support those of Idisape and Kpanaka (2024), who revealed that the students taught using theflipped instructional model outperformed their counterparts taught the same concept using the modified lecture method. Liang Yu (2023) also found that flipped classrooms significantly improved student academic performance compared with non-flipped classrooms. The study also found that flipped classrooms have a more progressive impact on students' problem-solving skills,which always require a long teaching period. The research findings also revealed that most students preferred or strongly preferred the flipped classroom approach after they experienced it.

In support of this finding, Obiagel et al. (2021) revealed that students in the experimental group whowere taught using a flipped classroom had higher mean scores than those in the control group who were taught using a conventional lecture method. The results further revealed that both male and female students in the experimental group improved their performance. However, male studentsachieved slightly better results than female students after the treatment. Based on this, flipped classrooms are an effective alternative teaching method for enhancing students' academic performance. Ipem (2021) showed that the flipped teaching and learning method is very effective in enhancing students' academic performance. In support of this, Gambari et al. (2016) showed that the experimental group taught using a flipped classroom performed better than the control group taught using only the conventional method.

Tables 2 and 6 reveal a significant difference between the mean performance scoresof male and female students taught Physics using the flipped classroom. The flipped classroom provides students with more time and opportunities for activelearning, collaboration, and problem-solving guided by a teacher, which enhances their academic performance.

This is in line with the findings of Egara and Mosimege (2023), who showed that learnerswho were taught using the flipped classroom approach had higher average scores than those who weretaught using the traditional method. Furthermore, the results revealed a significant gender (maleand female) difference in the mean scores of students taught using the flipped classroom approach. Ibenegbu and Ugwu (2022) also revealed that there was a significant effect for the approach for students' performance; there was a significant effect for gender (male and female) on students' performance, and there was a significant effect for the approach gender on students' performance. Understatingthe need to address gender differences represents a vital step, making education gender responsive will require a genuine commitment to provide teaching-learning experiences that reflect male and female differences. In physics learning, females tend to shy away from it because they perceive itas difficult and are not fully ready to conduct experiments.

Tables 3 and 7 reveal no significant difference between the mean performance scores of male and female students taught physics using the demonstration method. Given the finding from the ANCOVA.

This aligns with the report of Harrison (2023) that no significant difference exists between the mean performance scores of physics students by gender (male and female) when taught using the demonstration teaching method and between the mean score ofphysics students by ability level when taught using the demonstration teaching method. Therefore, it was recommended that physics teachers incorporate a demonstration method of teaching during lesson delivery in physics. Jumbo's (2019) results also showed no significant difference in the performance

of males and females exposed to the demonstration of teaching methods. Similarly, Udom (2019) showed no significant difference in the performance of male and female students when determining the effect of demonstration methods. Gender is not a significant determinant of students' performance in physics. This observation agrees with that of Udo and Udo (2017). Therefore, in physics, there is no significant difference on the basis of gender in students' performance; thus, no special attention may be attached to the gender of the students when teaching and learning occurs.

Tables 4 and 8 show the interaction effect of the instructional methods (i.e., flipped classroom and demonstration method) and gender on the performance of students in physics. However, based on the findings, the null hypothesis was rejected, and an alternative hypothesis was accepted that there is a significant interaction effect of instructional methods (flipped classroom and demonstration method) and gender on students' academic performance in physics. The result implies that the combination of treatment and gender affects students' learning and academic performance in physics.

This supports Japee et al. (2018), who revealed a significant improvement inthe conceptual understanding of the students in both the control and treatment groups. However, the student in the treatment group has significantly higher gain scores. The results revealed that the flipped classroom had a positive impact on the students' understanding. Atim et al. (2019)also revealed that the use of a flipped classroom instructional model enhanced the academic performance of science education students in understanding the concept of science teaching. In support of this finding, Obiagel et al. (2021) revealed that students in the experimental group who were taught using a flipped classroom had higher mean scores than those in the control group who were taught using the conventional method. The results further revealed that both male and female students in the experimental group improved their performance. However, male students achieved slightly better results than female students after the treatment. Similarly, Udom (2019) showed no significant difference in the performance of male and female students when determining the effect of demonstration methods.

The combination of instructional method and gender has a significant impact on the academic performance of students in Physics. The study found that the performance of male and female students differedaccording to the instructional methods used. This study highlights the importance of considering teaching methods and gender when designing educational programs to improve the performance of students in physics.

Conclusion

From the findings of this study, it is hereby concluded that the performance of students taught physics using the flipped classroom and those taught usingthe demonstration method differs significantly. The performance of male and female students teaching physics using the flipped classroom differedto a large extent. The performance of male and female students teaching physics using the demonstration method didnot differ significantly. The combination of instructional methods and gender has a significant impact on the academic performance of students in Physics.

5.1 Recommendations

Based on the study findings and conclusions, the following recommendations were made:

1. Teachers and instructors should use flipped classrooms to teach physics and other subjects in senior secondary schools.

2. School administrators and other educational stakeholders should organize conferences, seminars, and workshops to prepare teachers on how to include and use flipped classrooms, especially for teaching physics.
3. For mixed-gender classes, both male and female students should be given equal opportunitiesto learn.
4. Educators should be prepared to adjust their teaching methods based on their students' needs and characteristics, including gender. The flipped classroom and demonstration methodsshould be combined or adopted when and where necessary for effective teaching and learning.

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