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Students Self-Assessment of Demonstration-Based Flipped Classroom on Senior Secondary School Students' Performance in Physics in Ilorin Metropolis, Nigeria

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ABSTRACT

The purpose of this study was to investigate students' self-assessment demonstration-based flipped classroom instructional strategies on pre-degree students' achievement in Physics in the Ilorin metropolis. A quasi-experimental non-equivalent pretest-posttest control group design was performed to measure the effect of flipped classrooms on high school physics performance using a mixture of qualitative and quantitative methods. The sample included two specially selected intact physics classes of Advanced Level II (S.S. 2), each containing 30 participants. The experimental group was taught using a flipped classroom model and the control group was taught using conventional teaching methods. Studies have found no significant difference in performance between students taught using a demonstration-based flipped classroom and students taught using traditional methods. As a result, it was found that the use of demonstration classes did not significantly affect the improvement of students' academic performance. The study also found that some students felt confident that they were responding positively on pretests and posttests to their flipped curriculum performance. It was recommended to conduct physics teaching and learning in an engaging and learner-centered manner, and demonstration-based-flipped learning instructional strategy should be adopted and encouraged among teachers and students.

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1. INTRODUCTION

The development of the modern educational system has created the ability to apply new methods in practice through the teaching of various subjects. The introduction of flipped classroom technology in general secondary schools demonstrates that the emergence of the flipped classroom concept will transform future teaching and assessment, linking pedagogy and learning outcomes (Sointu *et al.*, 2023). In a flipped classroom, students acquire knowledge before class and then deepen and apply that knowledge during class. In this way, lower-level learning objectives are achieved before the lesson, and higher-level skills are achieved during the lesson (Oudbier *et al.,* 2022).

This study draws on knowledge accumulated from senior secondary education and Flipped classroom studies to explore educational strategies to better understand the key elements of a successful Flipped classroom course from the student's perspective. A flipped classroom is a student-centered approach in which students actively participate in classroom activities. e, teachers take on the role of facilitator, motivator, and guide, providing immediate feedback on student performance (Zahoor & Gh, 2018). Flipped classrooms allow students to watch and review video tutorials outside the classroom at any time, need, or location. Students can study and learn at their own pace. In a flipped classroom, students don't have to listen to long, boring lectures in the classroom and have much more time and opportunity to find solutions to problems on their own or with our students outside the classroom learning (Mashxura & Siddiqov, 2023).

Physics is the foundation of scientific and technological progress in both developed and developing countries around the world. It is widely recognized and aims to expand the knowledge and horizons of learners' understanding of physics. It has several characteristics. The correct and critical application of these functions to specific situations and times makes it easier for learners to understand the subject matter, thereby clearing up misunderstandings among people, students, physics teachers, and teachers. It is considered essential because it is expected to impact subjects, parents, and the broader physical community (Adeyemo, 2011).

Science is still one of the most difficult subjects for him. The difficulty of physics is reflected in the school curriculum. A study by Omosewo and Onasanya (2010) found that Nigerian students performed at normal levels.

The physics was bad across the board. Cabi (2018) cites laboratory equipment, the inability of physics teachers to communicate ideas to students, and an inadequate number of learning facilities in schools as causes of students' overall poor performance in science, technology, and mathematics. It is mentioned that It includes an increase in the number of enrollees when compared to a consistent one. Moreover, due to its mathematical nature, students are not interested in science, especially physics, but do not realize that physics cannot be studied independently without knowledge of mathematics (Arnold, 2014).

Karadag and Keskin (2017) found that flipped learning enriches the learning environment, increases classroom efficiency, and makes learning and teaching more communicative. Ot benefits of flipped learning include the opportunity for individual learning in terms of learning pace and learning style, and the ability to study content before practice. Allow students to take more responsibility for their learning. and creating a more transparent learning environment that allows learning outside the classroom (Haristiani & Rifa'i, 2020; Rasim *et al.,* 2021).

This study attempted to answer two research questions:

(i) How do students perform in an experiential flipped classroom?

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(ii) What are the differences in performance between boys and girls taught in grade-based flipped classrooms?

Two hypotheses were made:

(i) HO1. No significant difference in performance between males and females taught in a demonstration-based flipped classroom

(ii) HO2: Te is no significant difference in performance between students taught in the exemplary flipped classroom and those taught in the traditional way.

2. METHODS

A mixed qualitative and quantitative method was employed to measure the effect of a flipped classroom on the physics performance of high school students in the Ilorin metropolitan area, using a quasi-experimental non-equivalent pretest-posttest control group design. Executed. Four research tools including research-based activity sheets and customized instructional video packs. An activity test developed by research. Adopted Cognitive Rubric Checklist. A research-generated questionnaire was used to collect information about the study. This quasi-experimental, non-equivalent pretest-posttest design was chosen due to the inability to perform randomization in obtaining the sample population. Therefore, we used the control group knowing that randomization of the sample was also not possible. Because sample randomization was not possible, pretests were used to control for differences in motivation and academic performance.

2.1. Research Context

This study focused on the effect of student self-assessment through a flipped classroom demonstration on the physics performance of high school students in the Ilorin metropolitan area. Study variables included independent variables (query basis). dependent variable (self-rating); and moderator variable (gender). The sample included two specially selected intact Advanced Level II (S.S. 2) physics courses, each containing 30 participants. One of the groups will serve as the experimental group and the other as the control group.

2.2. Participant

Participants in the study included two high school 2 (S.S. 2) physics classes as an intact group, each with 30 participants. One of the groups served as the experimental group and the as the control group. One of the two classes formed the experimental group and the formed the control group. These schools are school A (experimental group) and school B (control group).

The experimental group was taught according to the flipped classroom model and the control group was taught according to conventional teaching methods. The teacher administered physical performance pretests on selected topics to determine the current level of competence of students in control and experimental groups. After the pre-test, a regular physics teacher from the selected school began the experiment, strictly adhering to the researcher's duties. The experimental group was provided with the necessary flipped classroom resources to teach the selected topic (projectile motion). The control group was taught using a flipped classroom model. After the experimental group's treatment session, both groups underwent a post-test to test their level of performance. The study design is shown in **Table 1** below.

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Table 1. Experimental and control group.

Group	Pretest	Posttest
Experiment (Group I)	O_1	O2
Control (Group II)	O2	O4

Keys:
O_1, O_2 = Pretest administered on Experimental and Control Groups
O_3, O_4 = Posttest administered on Experimental and Control Groups

2.3. Data Collection

After obtaining permission from selected schools, the research trained subject teachers as research assistants in the use of the CTG. First, a pre-test was performed on both the experimental and control groups, and treatment was performed on the experimental group using FCIM. FCIM was written on a (CD) compact disc for students. CDs were released weekly. Students were instructed to watch the video at home before class. Also, to avoid doubts, they were given 30 minutes to watch the video in class before the lesson. During a physics class, students were given several tasks to solve based on the video clips they watched. Additionally, she was allowed to come home with FCIM at the end of each week to better understand and master the concepts. A control group of students, on the other hand, was taught the same concepts using conventional teaching methods. After 4 weeks of treatment, both experimental and control groups were administered PAT to determine the implementation of learned concepts in FCIM use. A 2-week waiting period was observed, and PAT was remixed and rerun as a retention test. Pre-tests, post-tests, and retention tests were evaluated according to a rating scheme, and the results generated were subject to data analysis. Students interviewed for this study also included minor children attending dependent secondary schools. Therefore, all students were given a consent form to take back to their parents to allow them to participate in the experiment. Students were informed of the research intent and provided with appropriate information regarding the conduct of the experiment.

2.4. Data Analysis

Data obtained from the pre-test and post-test were compiled and analyzed using descriptive statistics of mean and standard deviation to answer study questions, and inferential statistics of ANOVA were used to test hypotheses alpha of significance for various statistical analyzes was determined at an alpha level of 0.05. The social science statistics package (IBM SPSS version 24.0) was used for data analysis. The results of the research questions and hypotheses are presented in the table.

3. RESULTS AND DISCUSSION

3.1. Self-Evaluation of Demonstration-based Flipped Classroom as An Educational Strategy

One classic definition of ``self-assessment'' describes it as ``a student activity to assess the student's learning, particularly achievements and, achievements'' (Basal, 2015). Although this is a widely used definition, this article uses the definition with some innovative features not included in the original definition. In our view, ``Self-assessment is a qualitative assessment of the learning process and its final deliverables carried out against pre-established criteria'' (Basal, 2015). About these criteria, it is important to note that self-assessment is determined by the level of perfection the student wishes to achieve. Next, we carefully discuss the definition and think about what each element means (Maryanti, 2021; Wijaya *et al.,* 2022).

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The first part of the definition states that self-assessment is a "qualitative assessment". This phrase suggests that self-assessment is not just a quantitative evaluation or "scoring yourself". This latter practice has long been conceptualized as self-evaluation, but should have originally been called ``self-evaluation'' (in social science, self-assessment, self-assessment, or self-evaluation) (Davies *et al.,* 2013). To this end, they started from the pedagogical perspective of self-assessment, a view that underlies formative assessment research, and first identified the nature of the self-assessment process and its relationship to self-assessment (Nuhu *et al.,* 2023; Pathania, 2023; Riza *et al.,* 2021). Regulation and, second, the classroom learning conditions that facilitate the acquisition of this skill. The basic premise of the flipped classroom is that the shift of lecture materials and learner content interactions to an online digital delivery format creates opportunities for learning through socially constructed face-to-face classroom events (Huber *et al.*, 2016).

3.2. Interactive Effects of Gender on Students' Use of Flipped Classroom Learning

Gender plays a role in science and technology education (STE) in many ways. He is many questions about the relative participation of boys and girls in science, technology, and vocational programs. Each curriculum necessarily selects and privileges certain types of activities and knowledge forms, sending explicit and implicit messages about them to both students and teachers (Adeyemi, 2017). Teac responses to these messages raise a third problem when attempting to teach science and technology in classrooms and labs.

In embedding needs into the curriculum offered and addressing the dynamics of classroom interaction, teachers inevitably draw on their understanding of their subject matter and their beliefs about how best to teach and facilitate learning. It is also based on broader cultural assumptions, particularly the roles expected of boys and girls in society. These assumptions vary widely between societies, often within societies, and can vary widely between teams within the same institution. It is also highly variable over time, and it is this potential for change that allows us to be optimistic when addressing many gender issues in science, technology, and VET (Baepler *et al.*, 2014).

A large body of literature finds that males and females are characterized by many social and biological differences. The role of gender differences in the use of technology for learning has been extensively studied (Basal, 2015).

3.3. Effects of Flipped Classroom on Students' Academic Performance

Recent studies have explored the impact of the flipped classroom model on student performance, engagement, learning outcomes, and motivation. Studies have shown that this approach improves student learning (Cabi, 2018). Most studies show that the flipped classroom model has a positive impact on student learning, but some studies do not show the expected positive effects. For example Pugatch and Schroeder (2014) no observable increase in student performance was observed. Anot study conducted by Cabi (2018) found no evidence that flipped classrooms contribute to student achievement. Similarly, using a flipped classroom model in one study did not affect teacher-student interaction or learning satisfaction. To illustrate the effectiveness of the flipped classroom model, Talbert (2015) investigated the extent to which teaching in the flipped classroom model affected the academic performance of nursing students. Study participants were taught using a flipped classroom model and a control group was instructed using conventional teaching methods and were given nationally standardized tests and tests from the Council for Health Education Systems Cavi rice field.

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A comparison of the experimental group's test scores with the control group's results on a national standardized test showed that the experimental group's students achieved high academic performance than the control group's (Siegle, 2014).

The learning environment of the flipped classroom model can also contribute to preschool learning, teaching skills, and emotional development by creating a particularly meaningful and authentic learning environment. For example, Oliván *et al.* (2019) conducted a study highlighting the benefits of a flipped classroom model for student teams, its impact on student performance, and the difficulty of the model. According to Cabi (2018), participating in a flipped classroom has been observed to make learners more productive and engaged.

A key principle of the flipped classroom model is to deepen and reinforce understanding of the content. Students listen to lectures and watch videos outside the classroom to focus on the topic, and then internalize and interact with the teacher through practical application in the classroom. In recent years, several studies have focused on the impact of flipped classroom model learning environments on student academic performance, one of which was conducted by (Ashkhia, 2016).

The learning environment was developed using a flipped classroom model in collaboration with Khan Academy and free open source. Participants in this study included 28 students pursuing a mathematics curriculum at a public university in Turkey. A study showed that a flipped classroom model learning environment developed by both Khan Academy and Math Software doubled student academic performance (Cantor *et al.,* 2018). Furthermore, this learning approach has been shown to facilitate student learning, enable visualization in mathematics lessons, and contribute to sustained learning (Kim *et al.,* 2014).

In the modern classroom, the way students learn is beginning to change. As online technology advances, teams are using increasingly novel approaches to reach their students. The flipped classroom model allows teachers to integrate more technology into student learning environments to support self-directed learning. The idea behind the flipped classroom model is to change the environment in which new material is first introduced (Hammond, 2019).

Poor performance in physics among science students is a common problem. For example, many researchers in Nigeria have conducted various studies to elucidate the cause of the problem. Factors such as lack of suitable laboratory equipment, teacher inefficiency and instructional skills, lack of qualified teachers, and school-related factors have been identified as major causes of poor physics performance among science students. gain. Despite all this, students still perform poorly (Adeyemo, 2017). Considering that many challenges in physics must be solved within the limited class time and not enough to comprehensively cover the curriculum to improve learning It makes to enrich the course with new things and enrich the innovative course. skills to teach. Maximize the time allotted to improve student performance in physics (Aremu *et al.*, 2015). In a flipped classroom, students watch the theoretical portion of the lesson on video at home. This allows students to manage their learning through video, increasing student participation and collaboration during regular class hours (Cabi, 2018).

In addition, learners must engage in activities that promote the acquisition of problem-solving skills and scientific attitudes that cannot be achieved with poor lab equipment or traditional physics classroom activities. Flipped classrooms are a great opportunity for educators to harness the power of video lectures, virtual labs, and simulations to help learners improve their learning outcomes while developing better cognitive processes and problem-solving skills. is. It is considered a valuable and useful medium. Against this background, this study aimed to investigate self-assessment of student performance by physics department students using an evidence-based flipped classroom teaching strategy.

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3.4. Demography

Table 2 shows the distribution of the respondent by gender. For the control group pre-test, te were 15 (50.0%) male and 15 (50.0%) female respondents, respectively while for the control group post-test,t te were 16 (53.3%) male and 14 (46.7%) female. For the experimental group pre-test, we were 18 (60.0%) males and 12 (40.0%) females while for the experimental group post-test, we were 11 (36.7%) males and 19 (61.3%) females.

Table 2. Percentage distribution of respondents by gender.

Gender/Group Attendance	Control Group Pre-Test	Control Group Post-Test	Experimental Group Pre-Test	Experimental Group Post-Test
Male	15 50.0%)	16 (53.3%)	18 (60.0%)	11(36.7%)
Female	15 (50.0%)	14 (46.7%)	12 (40.0%)	19 (61.3%)
Total	30 (100.0%)	30 (100.0%)	30 (100.0%)	30 (100.0%)

3.5. Research Question 1

Table 3 and **Figure 1** show the performance of students taught with students self-assessment demonstration-based flipped classroom. The table reveals that 3(10%) students scored between 31-40 marks, 3(10%) students scored between 41-50 marks, 5(16.7%) students scored between 51-60 marks, 9(30%) students scored between 61-70 marks, 3(10%) students scored between 71-80 marks, 4(13.3%) students scored between 81-90 marks, 3(10%) students scored between 91-100 marks. It can be derived from this result that about 63.3% of the students scored above 60 marks in their test while about 36.7% of the students scored 60 marks and below.

Table 3. How do students perform in experiential flipped classrooms? Performance of students taught with demonstration-based flipped classroom .

Students' Scores	Frequency	Percentage (%)
31-40	3	10.0
41-50	3	10.0
51-60	5	16.7
61-70	9	30.0
71-80	3	10.0
81-90	4	13.3
91-100	3	10.0
Total	30	100

3.6. Research Question 2: What is the Difference Between the Performance of Male and Female Students Taught in Demonstration-based Flipped Classrooms?

Table 4 and **Figures 2a** and **b** show the performance of male and female students taught with students' self-assessment demonstration-based flipped classroom. The table reveals that out of the total of 18 male students who participated in the study, 12(66.7%) students scored above 60 marks and 6(33.3%) students scored below 60 marks while out of the 12 female students who participated in the study, 7(58.3%) students scored above 60 marks and 5(41.7%) students scored below 60 marks.

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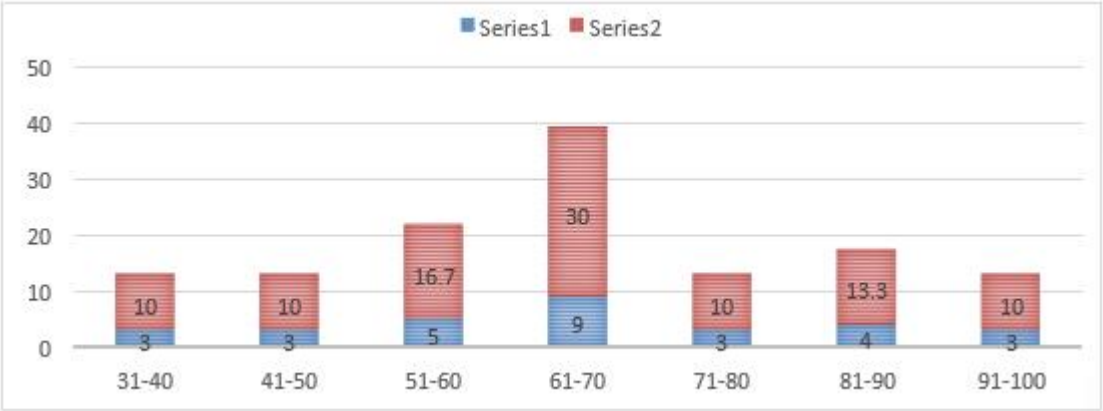

Figure 1. Experimental post-test score.

Table 4. Performance of male and female students taught with students' self-assessment demonstration-based flipped classroom.

Students' Scores	Male	Female	Total
31-40	0(0.0%)	3(25.0%)	3(10.0%)
41-50	2(11.1%)	1(8.3%)	3(10.0%)
51-60	4(22.2%)	1(8, 3%)	3(10.0%)
61-70	6(33.3%)	3(25.0%)	9(30.0%)
71-80	3(16.7%)	0(0.0%)	3(10.0%)
81-90	1(5.6%)	3(25.0%)	4(13.3%)
91-100	2(11.1%)	1(8.3%)	3(10.0%)
Total	**18(100%)**	**12(100%)**	**30(100%)**

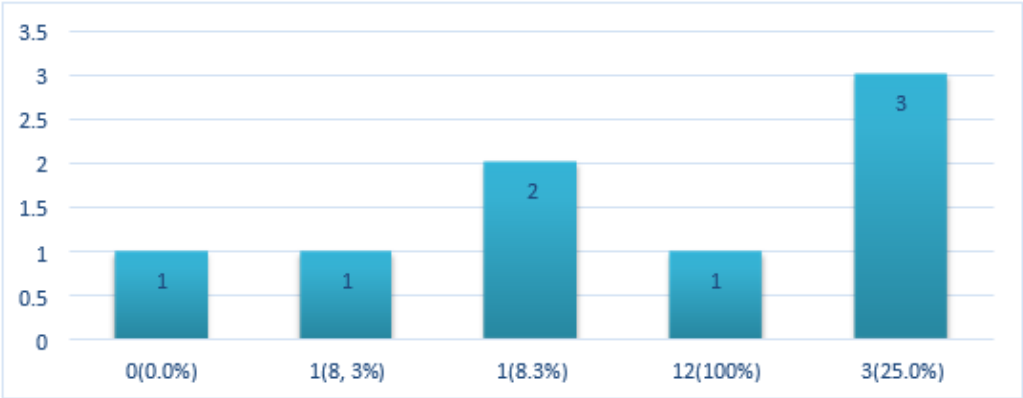

Figure 2a. Count of students' scores by female.

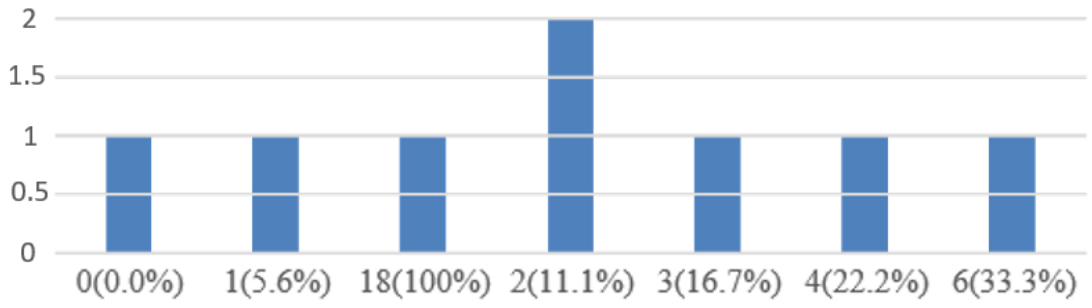

Figure 2b. Count of students' scores by male experimental post-test score.

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3.7. Research Hypothesis One Ho1: Te is No Significant Difference Between the Performance of Male and Female Students Taught with Students' Self-Assessment Demonstration-Based Flipped Classroom.

To determine what was a significant difference in the performance of male and female students taught with self-assessment demonstration-based flipped classrooms, data were analyzed using ANOVA, and the result obtained is presented in **Table 5** below. **Table 5** shows that he is no significant difference in the performance of male and female students taught with self-assessment demonstration-based flipped classroom with $F(1, 28) = 0.394$, $p > 0.05$. This, therefore means that the null hypothesis is accepted because the significant value (0.535) is greater than the alpha value (0.05). By implication, the null hypothesis was established thus: Te is no significant difference in the performance of male and female students taught with students' self-assessment demonstration-based flipped classroom.

Table 5. The performance of male and female students taught with students' self-assessment demonstration-based flipped classroom.

	Some of Squares	Df	Mean Square	F	sign
Between Groups	1.250	1	1.250	0.394	0.535
Whitin Groups	88.750	28	3.170		
	90.000	29			

3.8. Research Hypothesis Two HO2: Te Is No Significant Difference Between the Performance of Students who are Taught with Students' Self-Assessment Demonstration-Based Flipped Classrooms and Their Counterparts Taught Through the Conventional Method.

To determine what was a significant difference in the performance of students who are taught with students' self-assessment demonstration-based flipped classroom and their counterparts taught through the conventional method, the data obtained were analyzed using ANOVA paired sample test, and the result obtained is presented in **Table 6** below. **Table 6** shows that he was a significant difference in performance between students taught using the student self-assessment flipped classroom method and peers taught using the conventional method $F(29) = 0.577$, $p > 0.05$.

Table 6. Paired samples test: The performance of students who are taught with students' self-assessment demonstration-based flipped classroom and their counterparts taught through conventional method.

	Paired Difference		95%Confidence The interval of the Difference		t	df	Sig(2-tailed)
	Meaan	Standard Deviation	Lower	Upper			
Control group Post-test score Experimental Post-test Score	0.267	2.532	-679	1.212	0.577	29	0.028

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3.9. Summary

A summary of the results of this study based on research questions and hypotheses is as follows:

(i) 63.3% of students who self-assessed in the flipped classroom scored above 60% on the test.

(ii) About 67.7% of the male students taught self-assessment demonstrations in the flipped classroom, and 58.7% of female students scored above 60% on the test.

(iii) About 63.7% of the students who taught the flipped classroom method with self-assessment demonstration scored above 60% score, while 49.3% of the students taught with the conventional method scored above 60% score. Earned. They found no significant difference in performance between boys and girls taught in a classroom-based flipped classroom.

Using a grade-based flipped classroom system in high school physics has improved my students' grades compared to those =who have had a conventional education. These results are consistent with the research Duffield *et al.* (2014) suggesting that poor teaching habits by physics teachers are a major cause of poor performance in physics students. Both studies show that using a learner-centered, activity-based approach to teaching physics can improve students' overall performance in physics. However, according to the data analyzed, te was no gender difference in learning physics in the flipped classroom. This finding contradicts claims that enrollment and performance trends in science subjects, especially physics, have reached anomalous and frightening rates (Akanbi, 2018). The research hypothesized that rat than male and female physics students failing physics, male and female physics students fail. Contrary to these findings, research Cabi (2018) postulated gender performance in science subjects, and research found that gender affected students' overall performance in science subjects. bottom. considered an important factor.

Studies have found no significant difference in performance between students taught in a grade-based flipped classroom and students taught traditionally. The results show that the use of evidence-based flipped classrooms does not significantly affect student performance. Few studies support this finding (Kim *et al.*, 2014; Smallhorn, 2017). Conversely, however, results from relevant studies in the relevant literature show that demonstration-based flipped classrooms enhance students' academic success (Pierce & Fox, 2012).

The study also found that students' self-assessment of lesson-based flipped classrooms in secondary schools was also positive. The study found that using a demonstration-based flipped classroom makes learning physics more interesting. Students feel involved in class activities, making learning engaging and inclusive. They look forward to introducing the demonstration-based flipped classroom strategy into subsequent classes and to science subjects. They feel responsible for their learning.

Based on this research, we have the following suggestions:

The results of this study will have a significant impact on how physics teachers involve learners in the teaching process. This study presents a hands-on, activity-based approach to physics teaching and learning that engages learners, specifically as an alternative approach to forcing physics learners to learn physics concepts. We recommend using a demonstration-based flipped classroom approach.

The study has compelling implications for the advancement of science and technology in Nigeria. In this study, a demonstration-based flipped classroom approach was found to be most effective in improving the cognitive skills of physics students. To deepen students' interest in science and technology by introducing pedagogical approaches that can encourage and motivate students to properly plan, practice, and apply the scientific knowledge they

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have learned to new situations. This could ultimately lead to the acquisition and development of technology domestically.

4. CONCLUSION

This study investigated student self-assessment in a demonstration flipped classroom on the physics performance of high school students from the Ilorin metropolitan area. Results showed that students taught in a demonstration-based flipped classroom performed better than female respondents in the pre-test control group was boys performed better than girls in the post-test control group. was shown. Males outperformed females in projectile performance in the experimental group pre-test and post-test.

The findings of the study revealed that the students agreed to the fact that video instructional package on students' self-assessment demonstration-based flipped classroom is useful for learning physics; that video instructional package on self-assessment demonstration-based flipped classroom is motivating and catches attention, video instructional packages increase the learning in physics; they would like to watch and rewatch the video instructional package to learn, more video instructional packages on Physics should be used for more advanced topics on physics; students' understanding is improved if video instructional package on self-assessment demonstration-based flipped classroom is used; students would like their teacs to complement regular classes on projectile with video instructional packages; students prefer video instructional package to traditional delivery method; video instructional package provides a comprehensive learning experiences on Physics; video instructional package makes learning more meaningful and interesting, video instructional package on Physics facilitates and improves teaching on projectile, while the students disagreed to the fact that watching the video instructional package was boring and bored. Based on the findings of the study, the following recommendations were made:

Physics teaching and learning should be conducted in an engaging and learner-centered manner, this is because physics is better understood when it is learned within the context of the learners. Demonstration-based-flipped learning instructional strategy should be adopted and encouraged among teachers and students. This will provide an avenue for learners to learn at a personalized, individualized, and self-paced level, which will in turn translate to better academic performance and cognition.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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