# Effects of Flipped Classroom Strategy and Laboratory Methods on Students' Attitude Towards Physics in Abak Education Zone of Akwa Ibom State, Nigeria

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## Abstract

*This study explored the impact of flipped classroom and laboratory teaching methods on secondary school students' attitudes toward Physics in the Abak Education Zone of Akwa Ibom State, Nigeria. A quasi-experimental design with pre-test and post-test assessments was used across three groups: the Flipped Classroom Method (FCM), the Laboratory Teaching Method (LTM), and a control group taught with the traditional Lecture Method (LM). From a population of 13,730 Senior Secondary Two (SS2) students in 63 public schools, a purposive sample of 168 students from three schools was selected. The research instrument, the Physics Students' Attitudinal Scale (PSAS), was validated by experts and demonstrated a reliability coefficient of 0.80 using the Kuder-Richardson 20 (KR-20) method. Data were analyzed using mean, standard deviation, and ANCOVA. Findings revealed that students exposed to the flipped classroom method achieved significantly higher mean attitude scores than those in the other groups. Although male students had slightly higher gains, there was no statistically significant gender difference across the teaching methods. The study concluded that the flipped classroom approach effectively improves students' attitudes toward Physics regardless of gender and recommended its adoption in public schools, along with the provision of adequate resources for successful implementation.*

**Keywords**: Flipped classroom, Laboratory teaching method, Achievement, Students

## Introduction

Physics is a vital branch of science that examines the nature and properties of matter and energy. It encompasses various key areas, including mechanics, heat, light, sound, electricity, magnetism, and the structure of atoms. In Nigeria, the significance of Physics is underscored by

its inclusion in the Senior Secondary Schools Curriculum, as emphasized by both the Federal and State Governments (Federal Republic of Nigeria, FRN, 2013). The knowledge gained from Physics is essential across numerous fields and professions, impacting everything from the development of electrical appliances to advancements in information technology and medical imaging.

However, despite its importance, student performance in Physics has been unsatisfactory in recent years, particularly in the Senior Secondary School Certificate Examinations (SSSCE). Between 2014 and 2018, less than 50% of students achieved credit levels in Physics. Reports from the West African Examinations Council (WAEC) highlighted specific challenging concepts, such as Friction and Tension, which many students struggle to grasp. These difficulties are often linked to ineffective teaching methods used in classrooms (WAEC Chief Examiners Reports 2014, 2015, 2016, 2017 & 2018).

Teaching methods are crucial for facilitating student learning and can be categorized into three main groups: teacher-centered methods, student-centered methods, and teacher-student interactive methods. Teacher-centered methods focus on the teacher controlling the flow of information, while student-centered methods emphasize active learning and student engagement. Teacher-student interactive methods combine elements of both approaches, promoting collaboration and deeper understanding (Eze, Ezenwafor, and Molokwu, 2015).

One notable interactive teaching approach is the flipped classroom method. This model allows students to learn content outside of class through videos and readings, freeing up classroom time for problem-solving and collaborative discussions. The flipped classroom has been shown to enhance student engagement, foster personalized communication between teachers and students, and improve adaptability to diverse learning needs (Milman, 2012; Talbert, 2012). It encourages active participation and cultivates a positive attitude toward learning.

Another effective teaching method is the laboratory approach, which emphasizes hands-on, experimental learning. This approach allows students to apply theoretical concepts in practical settings, improving their observational skills and fostering a deeper understanding of scientific principles. Laboratory instruction is essential for sparking student interest in science and developing critical data analysis abilities (Dienye and Gbamanja, 2010; Queens University, 2008).

Academic achievement in students is typically assessed through tests and assessments that measure the knowledge and skills gained during their education. A significant factor influencing this achievement is students' attitudes toward the subject. Attitude can be described as a predisposition to respond favorably or unfavorably to a subject, significantly affecting

performance (Okobia & Ogumogu, 2012). Traditional teaching methods, often characterized by lectures and rote learning, have dominated Physics education for decades. This approach can hinder understanding, as it may not address individual learning paces or prior knowledge. In this model, the teacher remains the central figure in the learning process, limiting student engagement and interaction (Akanbi & Kolawole, 2014). Moreover, gender differences in academic achievement in Physics have been a topic of research, with findings varying widely. Some studies suggest that male students perform better, while others indicate that females excel under different teaching methods. The lack of consensus on this issue highlights the need for further investigation into how gender influences student performance and attitudes in Physics (Gupta, Sharma & Gupta, 2012).

As technological advancements continue to reshape society, there is an increasing expectation for educational institutions to equip students with critical thinking, problem-solving, and collaborative skills. Traditional methods are viewed as inadequate for preparing students for contemporary challenges. Both the flipped classroom and laboratory methods align with modern educational demands, fostering the skills necessary for success in a technology-driven world. The ongoing need to explore the effectiveness of modern teaching strategies—specifically flipped classroom and laboratory methods—highlights their potential to enhance students' attitudes toward Physics. As the educational landscape evolves, adapting teaching methods to meet the needs of today's learners is essential for bridging the attitudinal gap in Physics education.

An attitude is an individual's feelings and evaluation of some object, event or some other person. It has two main aspects: Direction and intensity. Here direction can be positive or negative and intensity is the extent of strength for the particular feeling. Attitude is defined as positive or negative emotions or feelings that a person has for other person, object, situation or event. In general, it is the way how a person feels towards socially significant object or a person. Attitude is guided by one's experience of life. It is long lasting as it comes or builds over time. According to Aditi (2017), attitudes are evaluative reactions to a person, object and event. This includes your beliefs and positive and negative feelings about the attitude object.

Attitude refers to predisposition to classify objects and events, to react to them with evaluative consistency. A person who shows a certain attitude towards something is reacting to his conception of that thing rather than to its actual state. Attitude are formed by people as a result of some kinds of learning experience if the experience is favourable a positive attitude is found and vice versa (Orunaboka, 2011). The attitude people hold can frequently influence the way they act in person and larger situation. For this reason, administrators, psychologists and sociologists

are concerned with attitude development, how they affect behaviour and how they can be changed. Attitude does not only include the negative attitude such as prejudices, biases and dislikes, but also positive attitudes are sometimes called sentiment, which include our attachment and loyalties to person, objects and ideas.

Malto, Dalida, and Lagunzad (2018) investigated the effectiveness of the flipped classroom approach in teaching Biology by comparing students' academic achievement and attitudes between a Traditional Group (TG) and a Flipped Classroom Group (FCG) using a quasi-experimental design with 80 Grade 10 students in Metro Manila. The study found that the FCG significantly outperformed the TG in both lower and higher-order thinking skills, as well as in interest and confidence in Biology. Teacher-observers also noted increased collaboration, interaction, and opportunities for scaffolding and differentiation within the flipped classroom. Quantitative data were collected through a researcher-developed achievement test and an attitude scale, while qualitative data were obtained via semi-structured interviews and student learning logs. The study employed a one-group pre-test and post-test experimental design and involved 26 students from Istanbul with access to personal computers and the internet. Analysis included mean, standard deviation, and t-tests for quantitative data and content analysis for qualitative insights. Results indicated that the flipped learning approach had a positive effect on students' academic performance and attitudes toward Mathematics.

Katcha and Wushishi (2015) investigated the impact of laboratory equipment on student performance and attitude toward Biology among Senior Secondary School II students in Abuja using a quasi-experimental pre-test and post-test matched group design. The study involved 136 students from two co-educational secondary schools selected through criterion sampling. Three instruments—Biology Laboratory Equipment Checklist (BLCL), Biology Practical Achievement Test (BIOPAT), and Biology Students' Attitude Change Questionnaire (BSACQ)—were used, all with acceptable reliability indices. The findings revealed that students with access to adequately equipped laboratories performed significantly better and showed more positive attitude changes compared to those with limited equipment, with no gender-based differences in attitude change.

**Statement of the Problem**

The teaching of Physics in secondary schools within the Abak Education Zone of Akwa Ibom State, Nigeria, has faced significant challenges, particularly in fostering positive student attitudes toward the subject. Despite the crucial role Physics plays in understanding scientific concepts and technological advancements, many students exhibit a lack of interest and motivation, leading to poor academic performance. Traditional teaching methods, often characterized by rote

learning and passive engagement, have proven ineffective in addressing the diverse learning needs of students. As highlighted in recent WAEC reports, the persistent difficulties in grasping key concepts further exacerbate students' negative attitudes, hindering their overall achievement in Physics.

In light of these challenges, there is a pressing need to explore innovative teaching approaches that can enhance students' attitudes and performance in Physics. The flipped classroom and laboratory teaching methods have emerged as promising alternatives that encourage active participation and experiential learning. However, their effectiveness in improving students' attitudes toward Physics in the context of Abak Education Zone remains under-researched. This study aims to investigate the effects of these teaching methods on secondary school students' attitudes in Physics, thereby providing valuable insights for educators and policymakers to reform instructional strategies and improve student engagement in the subject.

**Purpose of the Study**

The general purpose of this study was to ascertain the effects of flipped classroom and laboratory teaching method on secondary school students' attitude towards Physics in Abak Educational zone of Akwa Ibom State. Specifically, the study tended to ascertain the:

1. Mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods.
2. Mean attitude scores of male and female students taught Physics using flipped classroom, laboratory teaching and lecture methods.

**Research Questions**

The following research questions were posed to guide the study:

1. What are the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods?
2. What are the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods?

**Research Hypotheses**

The following null hypotheses were formulated and were tested at 0.05 level of significance:

**$Ho_1$:** There is no significant difference among the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods.

**$Ho_2$:** There is no significant difference between the mean attitude scores of male and female students taught Physics using flipped classroom and laboratory teaching methods.

**Methodology**

The study employed a quasi-experimental design, specifically a non-equivalent control group approach, which included pre-test, treatment, and post-test measures. This design aimed to establish a cause-and-effect relationship between the independent variables (teaching methods) and the dependent variables (students' achievement and attitudes towards Physics). Intact classes were utilized, with one group taught using the Flipped Classroom Method (FCM), another with the Laboratory Teaching Method (LTM), and a control group following the Lecture Method (LM). By comparing pre-test and post-test scores, the study sought to address internal validity threats like history and maturation, ensuring the groups remained comparable. Conducted in the Abak Education Zone of Akwa Ibom State, Nigeria, the research focused on Senior Secondary Two (SS2) Physics students across 63 public secondary schools. The total population comprised 13,730 students, from which a purposive sample of 168 students was selected, including 97 females and 71 males. This sample included students from three schools equipped with Wi-Fi and digital devices, with one serving as a control group and the other two as experimental groups. The data collection instrument was the Physics Achievement Test (PAT), validated by experts and tested for reliability, achieving a coefficient of 0.87. Data collection involved administering the PAT as a pre-test, followed by three weeks of treatment where each group was taught their respective topics, after which the post-test was conducted. Data analysis used mean and standard deviation for research questions, while Analysis of Covariance (ANCOVA) was applied to test null hypotheses at a 0.05 significance level. Efforts were made to control extraneous variables, including training for teachers, engaging with students to reduce anxiety, and ensuring homogeneity among the selected schools.

**Results**

**Research Question 1:** What are the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods?

**Table 1: Mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods**

| S/N | Group/ Method | n | $\bar{X}$ | SD | Rank |
|---|---|---|---|---|---|
| 1 | Flipped Classroom | 57 | 61.60 | 7.42 | 1 |
| 2 | Laboratory teaching | 53 | 52.98 | 7.75 | 2 |
| 3 | Lecture Method | 58 | 42.14 | 10.81 | 3 |

The data in Table 1 is a summary of the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods. The result shows that the mean attitude scores of students who were taught using flipped classroom is 61.60 with standard

deviation of 7.42. The corresponding figures for those students who were taught using laboratory are 52.98 and 7.75 respectively. Table 3 further shows that the mean attitude score of students who were taught using lecture method is 42.14 with standard deviation of 10.81. It could be observed that students who were taught using flipped classroom had the highest mean attitude score than those who were taught using laboratory and lecture methods respectively. This result suggests that teaching Physics using flipped classroom enhances students' attitude towards Physics than using laboratory and lecture methods.

**Research Question 2:** What are the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods?

**Table 2: Mean attitude scores of male and female students taught physics using flipped classroom, laboratory and lecture teaching methods**

| S/N | Group/ Method | Gender | n | $\bar{X}$ | SD | Rank |
|---|---|---|---|---|---|---|
| 1 | Flipped classroom | Male | 23 | 62.96 | 8.79 | 1 |
| | | Female | 34 | 60.68 | 6.29 | 2 |
| 2 | Laboratory | Male | 25 | 51.08 | 9.15 | 4 |
| | | Female | 28 | 54.68 | 5.90 | 3 |
| 3 | Lecture method | Male | 23 | 45.48 | 11.49 | 5 |
| | | Female | 35 | 39.94 | 9.90 | 6 |

The data in Table 2 is a summary of the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods. The result shows that male students taught using flipped classroom obtained a mean attitude scores of 62.96 with standard deviation of 8.79 while the corresponding figures for female students in the same group are 60.68 and 6.29 respectively. The mean attitude scores of male students who were taught using laboratory is 51.08 with standard deviation of 9.15 while their female counterparts obtained 54.68 and 5.90 respectively as their mean attitude scores and standard deviation respectively. Table 2 further shows that the mean attitude scores of male students who were taught using lecture method is 45.48 with standard deviation of 11.49 while their female counterparts obtained 39.94 as their mean attitude score with standard deviation of 9.90. It could be observed that male students who were taught using flipped classroom had the highest mean attitude score followed by female students who were taught using flipped classroom while female students who were taught using laboratory came third followed by their male counterparts in the same group. The male students who were taught using lecture method took the fifth position while their female counterparts came

last with the least mean attitude score of 39.94. This result suggests that teaching Physics using flipped classroom enhances male students' attitude towards Physics than their female counterparts. Also, teaching Physics using laboratory enhances female students' attitude towards Physics than their male counterparts while lecture method enhance male students' attitude towards Physics than it does to the female students.

**Research Hypothesis $Ho_1$:** There is no significant difference in the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods

**Table 3: Test for Significant Difference in the mean attitude Scores of Students taught Physics using flipped classroom, laboratory and lecture teaching methods**

| Source | Sum of Squares | Df | Mean Square | F | Sig. | Decision |
|---|---|---|---|---|---|---|
| Corrected Model | 10938.02 | 3 | 3646.01 | 46.50 | 0.00 | |
| Intercept | 10670.26 | 1 | 10670.26 | 136.09 | 0.00 | |
| PRETEST | .96 | 1 | 0.96 | 0.01 | 0.91 | |
| GROUP | 10845.79 | 2 | 5422.89 | 69.16 | 0.00 | S |
| Error | 12858.64 | 164 | 78.41 | | | |
| Total | 480881.00 | 168 | | | | |
| Corrected Total | 23796.66 | 167 | | | | |

S = Significant at 0.05 level of significance

The data in Table 3 is a summary of the Analysis of Covariance (ANCOVA) conducted to test for significant difference in the mean attitude scores of students taught Physics using flipped classroom, laboratory and lecture teaching methods. The students were divided into three groups based on teaching methods. The f-value for group or teaching method is 69.16 with p- value (level of significance) being 0.00. Since the obtained p-value is less than the stipulated probability level of 0.05, it implies that the value of f is significant at 0.05 level of significance. On this basis, the null hypothesis is rejected implying that there is significant difference in the mean attitude scores of students taught physics using flipped classroom, laboratory and lecture teaching methods. A post hoc test was conducted to determine where the difference lies.

**Table 4: Summary of Post-hoc Pairwise comparison of the mean attitude scores of students in the three groups**

| Groups | Mean difference | Standard Error | Sig |
|---|---|---|---|
| 1 Vs 2 [61.596- 52.98] | 8.62 | 1.68 | 0.00* |
| 1 Vs 3 [61.596- 42.137] | 19.46 | 1.65 | 0.00* |

| | | | |
|---|---|---|---|
| 2 Vs 3 [52.98-42.137] | 10.84 | 1.68 | 0.00* |

*The mean difference is significant at the .05 level.

The summary of the post hoc pairwise comparison in Table 4 shows that the mean difference between group 1(flipped classroom) and group 2 (laboratory) was 8.62 which was significant at 0.05 level of significance. Table 4 also reveal that the mean difference between group 1 (flipped classroom) and group 3 (lecture method) was 19.46 in favour of group 1 and this difference was also found to be significant at 0.05 level of significance. Significant difference was also found between the mean of group 2 and group 3. This result implies that the mean attitude scores of students in the two experimental groups (flipped classroom and laboratory) was significantly better than those in the control group (lecture method). However, the mean attitude scores of students in group 1 is significantly better than those in the other two groups. This is evident in the mean attitude scores of the three groups (flipped classroom, laboratory and lecture method) which are 61.60, 52.98 and 42.14 respectively as presented in Table 1. The significant difference was therefore caused by group 1 (flipped classroom) which recorded the highest mean attitude score.

**Hypothesis 4**: There is no significant difference in the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods

**Table 5: Test for Significant Difference Between the mean Attitude Scores of Male and Female Students taught Physics using flipped classroom, laboratory and lecture teaching methods**

| Source | Sum of Squares | Df | Mean Square | F | Sig. | Decision |
|---|---|---|---|---|---|---|
| Corrected Model | 11611.33 | 6 | 1935.22 | 25.57 | 0.00 | |
| Intercept | 9058.45 | 1 | 9058.45 | 119.69 | 0.00 | |
| PRETEST | 6.64 | 1 | 6.64 | 0.09 | 0.77 | |
| GROUP | 9864.97 | 2 | 4932.49 | 65.17 | 0.00 | |
| GENDER | 62.09 | 1 | 62.09 | 0.82 | 0.37 | NS |
| GROUP * GENDER | 581.50 | 2 | 290.75 | 3.84 | 0.02 | |
| Error | 12185.33 | 161 | 75.69 | | | |

| | | |
|---|---|---|
| Total | 480881.00 | 168 |
| Corrected Total | 23796.66 | 167 |

NS = Not Significant at 0.05 level of significance

The data in Table 5 is a summary of the Analysis of Covariance (ANCOVA) conducted to test for significant difference in the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods.. The f-value for gender is 0.82 with p-value (level of significance) being 0.37. Since the obtained p-value is greater than the stipulated probability level of 0.05, it implies that the value of f is not significant at 0.05 level of significance. On this basis, the null hypothesis is retained implying that there is no significant difference in the mean attitude scores of male and female students taught Physics using flipped classroom, laboratory and lecture teaching methods.

**Discussion of Findings**

The study found that students taught Physics using the flipped classroom method had the highest mean attitude scores compared to those taught through laboratory and lecture methods. This indicates that the flipped classroom approach significantly enhances students' attitudes towards Physics, as it addresses individual learning needs and fosters greater engagement and participation. The hypothesis testing confirmed a significant difference in mean attitude scores in favor of the flipped classroom method. This aligns with findings from Malto, Dalida, and Lagunzad (2018) and Karadag and Keskin (2017), both of which reported positive impacts of the flipped classroom on students' attitudes and achievement in their respective subjects.

Additionally, the research indicated that while male students taught with the flipped classroom had higher mean attitude scores than those taught using laboratory and lecture methods, the difference was not statistically significant between genders. This suggests that the teaching methods employed—flipped classroom, laboratory, and lecture—are not biased towards either gender, as they positively affected both male and female students equally. This finding corroborates Katcha and Wushini (2015), who reported no significant differences in attitudes based on gender despite variations in academic achievement.

**Conclusion**

Based on the findings of the study, it could be concluded that the use of flipped classroom method enhances students' academic achievement and attitude towards Physics than using laboratory

teaching and lecture methods. Also, the three teaching methods (flipped classroom, laboratory and lecture teaching methods) are not gender biased with respect to students' academic achievement and attitude towards Physics.

**Recommendations**

Physics teachers in all public secondary schools in Akwa Ibom State should adopt the flipped classroom and laboratory teaching methods to enhance students' attitude toward Physics.

1. Physics teachers in public secondary schools in Akwa Ibom State should treat male and female students equally, as the flipped classroom, laboratory, and lecture methods do not favour one gender over the other in terms of attitude.
2. The Akwa Ibom State Ministry of Education should promote and ensure the implementation of the flipped classroom and laboratory teaching methods for teaching Physics in all public secondary schools across the state.
3. The Ministry of Education should provide computers and other essential resources needed for the effective use of the flipped classroom method in all public secondary schools in the state to support improved students' attitude toward learning Physics.

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