



Effect of Flipped Teaching Strategy on Students' Academic Achievement in Electronics in Nigeria Certificate in Education (Technical) Awarding Institutions in Plateau State

Ebute Ojonugwa Michael¹, A. S Bappah², S. S. Sara² & Nimmyel Gwakzing Danboyi¹

¹Department of Technical Education, School of Vocational and Technical Education, Federal University of Education Pankshin Plateau State

²Department of Vocational and Technology Education, Faculty of Technology Education, Abubakar Tafawa Balewa University, Bauchi
(TETFUND Sponsored)

Corresponding author: michaelebute6@gmail.com

Abstract

The study on the "Effect of flipped teaching strategy on academic achievement in electronics in Nigerian Certificate in Education (Technical) awarding institutions in Plateau State" was intended to determine if flipped teaching strategy would increase the academic achievement of Electronics students. The study adopted quasi-experimental design which employed the pretest and post-test non-equivalent control groups design which comprised of an experimental group. Five research questions and four hypotheses were raised and tested at 0.05 level of significance. The instrument used for data collection was Electronics Achievement Test (EAT). EAT was subjected to both face and content validation. The Spearman-Brown formula was used by the researcher to get a reliability coefficient of 0.75 which was used for data collection. Data for the research work was analyzed using Mean and standard deviation. The findings of the study reveals that; there was no significant difference between the pre-test mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method, there is significant difference between the mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method, there was significant difference in the mean achievement score between the Pre-test and Post-test score of the electronics students taught using flipped teaching strategy. The study concluded that flipped teaching strategy improves students' performance generally. This write-up contains summary, conclusions, recommendations, implication of the study, limitation of the study and suggestions for further study.

Key words: Flipped teaching strategy, Conventional lecture method, Academic achievement

Introduction

In the fast developing society as Nigeria, electronics has come to stay as the most important branches of engineering, which deals with current conduction through a vacuum or gas or semiconductor. It is one of the subjects which occupy a central position among all technical education subjects. It is a core subject, that cut across all students studying technical education at the Nigerian Certificate in Education (NCE) level. Research evidences have proved that

electronics as a sciences and technical subject has contributed to the quality of life and nation building in all aspects of human endeavor because we all make use of electronic gadgets on a daily bases but the academic achievement of student is on the decrease.

The poor academic achievement of students in electronics as a science and technical subject despite its importance was attributed to poor teaching approach (FRN, 2014; WAEC, 2016). Researchers suggested a

complete refurbishment of the public education system (Rycik, 2012); other research studies suggested that educators explore substitutes to the conventional lecture strategy (Anderson, 2007). Educators are now applying mixed curricula that include artificial intelligence software, multimedia assisted instruction, and even the inverted curriculum (Ritter, Anderson, Koedinger, & Corbett, 2007). Some researcher suggested that flipped teaching strategy is one solution to this problem (Berrett, 2012).

Flipped teaching strategy refers to a teaching strategy in which students gain first exposure to new material outside of class, usually via reading or watching lecture videos, virtual laboratories, simulations and then use class time to do the harder work of assimilating that knowledge, perhaps through problem solving, discussion and collaboration has become the latest applauded in pedagogical approach to learning in higher education (Fitzpatrick, 2012). It is seen as an inverted teaching strategy where students get their first-hand information about the subject matter outside the classroom thereby encouraging student-centered approach to learning. Flipped teaching strategy is seen as a tacit admission that students no longer have the attention span to learn in old way (lecture method), which requires that they listen carefully to someone spinning a factual narrative, pay close attention, take detailed notes and take much of this information to memory. The use of flipped instructional model (such as video-recorded lectures) to compliment the traditional (face to face) teacher centered method of learning has given the learner (student) responsibility for his own learning.

Flipped teaching strategy is an innovative teaching strategy, which has gained significant attention in recent years for its potential to enhance student academic achievement (Ebute, 2020). This strategy involves reversing the traditional teaching strategy by delivering instructional content outside of the classroom, often through online videos, and using classroom time for interactive, hands-on activities (Bishop, & Verleger, 2022). The effectiveness of this teaching strategy has been widely studied across various disciplines, including electronics education.

In the context of Nigeria Certificate in Education (Technical) awarding institutions in Plateau State, the implementation of flipped teaching strategies presents a unique opportunity to address the challenges faced by students in mastering complex electronic concepts. Traditional teaching methods often limit student engagement and fail to cater to diverse learning

styles, leading to suboptimal academic achievement. By contrast, the flipped classroom strategy promotes active learning, critical thinking, and problem-solving skills, which are essential for success in technical education.

Research has shown that flipped teaching strategies can significantly improve students' academic performance and engagement in technical subjects. For instance, a study by Kalat, Yisa, and Sanni (2024) found that students who participated in flipped learning instructional strategies demonstrated higher achievement and interest in electrical/electronic courses compared to those taught using traditional lecture methods. Similarly, Lo, Hsieh, Lin, & Hung, (2021) reported that vocational high school students in Taiwan who experienced flipped teaching in electronics courses showed remarkable progress in their learning outcomes and strategies.

The flipped classroom model has been shown to enhance students' learning effectiveness by fostering a more engaging and interactive learning environment. According to Talan and Gülseçen (2019), Hamdan, McKnight, McKnight, (2022) and Nwosu, & Okeke, (2023), students in flipped classrooms exhibited higher levels of academic achievement, engagement, and satisfaction compared to those in traditional and blended learning environments. This finding underscores the potential of flipped teaching strategies to transform the educational experience and improve student outcomes.

Moreover, the flipped teaching strategy aligns with contemporary educational trends that emphasize student-centered learning and the integration of technology in education. The COVID-19 pandemic has further accelerated the adoption of flipped teaching methods, as educators seek to provide flexible and effective learning solutions in a rapidly changing educational landscape.

The study has covered the following gaps:

1. Lack of research on flipped teaching strategy in NCE technical institutions: There are limited studies on the effectiveness of flipped teaching strategy in NCE technical institutions in Plateau State. The study has added to the number of researches on flipped teaching strategy in NCE technical institutions: There are limited studies on the effectiveness of flipped teaching strategy.
2. Poor academic achievement and retention rates: NCE technical institutions in Plateau State are experiencing poor academic achievement and retention rates among electronic students. By

using the flipped teaching strategy, the NCE technical electronics students' academic achievement has greatly improved.

3. Limited development of 21st-century skills: Electronics students in NCE technical institutions are developing the necessary 21st-century skills, such as critical thinking, problem-solving, and collaboration. The study has helped them develop necessary 21st-century skills, such as critical thinking, problem-solving, and collaboration among electronics students.
4. Inadequate preparation for the workforce: Graduates of NCE technical institutions are adequately not prepared for the workforce, with limited skills and knowledge in emerging technologies and industries. The study will help them to be adequately prepared for the workforce, with limited skills and knowledge in emerging technologies and industries
5. Inadequate use of technology in teaching and learning: NCE technical institutions in Plateau State not utilizing technology effectively to support teaching and learning. The study will help electronics students to effectively utilize technology to support teaching and learning process.

Given the promising results from these studies, it is crucial to explore the impact of flipped teaching strategies on students' academic achievement in electronics within the specific context of Nigeria Certificate in Education (Technical) awarding institutions in Plateau State. This research aims to provide valuable insights into the effectiveness of this pedagogical approach and its potential to enhance the quality of technical education in the region.

Research Questions

The research questions that guided the study are as follows:

- i. What is the mean achievement score of Electronics students in experimental and control group at Pre-test level?
- ii. What is the post-test mean achievement score of electronics students taught with flipped teaching strategy (experimental group) and those taught using conventional method (control group)?

Hypothesis

The null hypothesis formulated to guide the study and was tested at 0.05 level of significance and it is as follows;

- H₀₁ : There is no significant difference between the pre-test mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method.
- H₀₂ : There is no significant difference between the mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method.

Research Design

The study adopted quasi-experimental design which employed the pretest and post-test non-equivalent control group. Considering the nature of the class and also because the researcher did not intend to disrupt the normal school set-up, only classes of NCE 2 electronics student were involved in the study. Area of the Study is Plateau state. The research was conducted in two Local Government Area of the State. Federal College of Education is located in Pankshin about one hundred and twenty five kilometers North-East of Jos, and Plateau State Polytechnic is located in Barkin Ladi Local Government.

The target population of this study comprised of all NCE Technical education students in Plateau State. One hundred and seventy two (172) from Federal College of Education Pankshin and one hundred and fifty four (154) students from Plateau State Polytechnic B/Ladi for 2022/2023 session. For the purpose of this work; the researcher adopted purposive sampling technique, which is a non-probability sampling technique (Dakun, Ogbonna, Lere, & Bulus, 2002). Because the researcher deliberately chose NCE 2 of the two institutions because electronics is taught as a compulsory course from NCE 1 and it is a determining factor for them to go for electronics options in NCE 3 which is the final year. The sample size is the sample size is 74 (69 - male 5 – females).

Instruments for Data Collection - Electronics Achievement Test (EAT) was a multiple choice test items used for the purpose of the study to measure the level of students' academic achievement of selected concepts in electronics. EAT comprised of sections A and B. Section A was on demographic information, while section B comprised of thirty (30) multiple choice items. The items were drawn from the concepts of "Semi conductors" with concentration on semiconductor physics, (i) definition and properties of

semiconductors (ii) commonly used and energy bands of semiconductors (iii) intrinsic and extrinsic types of semiconductors (iv) PN junction (v) forward and reverse biased current and other important terms of semiconductors.

Validation of the Instrument

Electronics Achievement Test (EAT) was subjected to both face and content validation. The face validity was done to check the organization of the test items and appropriate use of language while the content validation was done to find out if the contents are conformity with the purpose of the study, research questions. The items were spread to cover the concept of semiconductors in electronics and circuit design. The instrument was validated by five experts. Two from department of Educational Technology University of Jos, one each from Physics Education and Chemistry Education department and one experts from department of Educational Foundations all from the University of Jos. The researcher used experts from Physics Education and Chemistry Education departments because the concept of semi-conductor also cut across the two departments. The researcher used only thirty items that was cleared by the experts.

Reliability of the Instrument

To find the reliability coefficient of the instrument, the test item was tried tested at Federal College of Education (Technical) Gombe. The researcher used Gombe because it was not part of the area of the study. The researcher used the split-half method to ascertain the reliability of the instrument. The split-half method was used by the researcher because it requires only one administration of the test; no time interval was involved and it exclude some sources of error arising from psychological disposition, fatigue and health.

Split-half involves splitting the Electronics Achievement Test (EAT) into two halves and correlating scores of one halve with the other half of EAT. The correlation of the two halve were obtained using Spearman-Brown formula. The Spearman-Brown formula was used by the researcher because it

estimates full-length test reliability using all questions on an instrument. This is important because the reliability of an instrument increases as instrument increases. The reliability of the instrument was calculated as 0.75. This shows that the test items used are not too simple or too difficult. The reliability of the instrument is stable as asserted by Dakun, Ogbonna, Lere, and Bulus, (2002) that estimated reliability of 0.65 and above is stable and reliable.

Methods of Data Analysis

Data for this research work was analyzed using Statistical Package for Social Science (SPSS); the researcher used the Mean and standard deviation for the research questions, while the hypotheses were tested using t-test statistics. The t-test was used by the researcher because; it is for testing significance of simple means between two groups or two set of scores (Nwankowo, & Emunemu, 2015). The null hypotheses (H_{01} , H_{02} and H_{04}) were tested at 0.05 level of significance ($Pr = 0.05$). While, the null hypotheses (H_{03}) was tested with, a one-way analysis of covariance (ANCOVA). This was conducted with experimental group as a between subject variable, pretest scores as a covariate, and posttest scores as a dependent variable. This was done to prevent the effect of sampling error, the researcher applied ANCOVA.

The researcher decided to use the above tools because the pre-test and post-test were recorded for analysis, to find and compare the mean academic achievement of electronics students in the two groups (the flipped teaching strategy and the conventional lecturer strategy), t-test variable was required for comparison of two means of same group in the pretest and post-test situation (Nwankowo & Emunemu 2015).

Results

Table 1 presents the mean academic achievement scores of electronics students for both experimental and control group at Pre-test level of the study. The experimental group had a mean score of 11.05 while the control group had a mean achievement score of 10.54. This implies that the two groups are equivalent based on their mean scores.

Table 1: Pre-Test Mean Achievement Score of Electronics Students

Variables	N	π	S D
Pre-test Experimental group	37	11.05	3.064
Pre-test Control group	35	10.54	2.832

The table 2 below presents the t-test result on the significant difference between the mean achievement score of electronics students in the study at the pre-test level. The hypothesis was accepted since the p-value of $0.465 > 0.05$ significance level.

Therefore, it was concluded that there is no significant difference between the Pre-test mean achievement score of experimental and control group in the study. This implies that the two groups are equal before the treatment in the study.

Table 2: T-test Result on the Significant Difference in the Pre-test Mean Achievement score

Variables	N	π	SD	t	Df	Sig (p value)
Pre-test experimental group	37	11.05	3.064	.734	70	.465
Pre-test control group	35	10.54	2.832			

Table 3 below, presents the Post-test mean achievement score of electronics students for both experimental and control group. The experimental group had a mean score of 19.95 while the control group

had a mean score of 15.91. It was observed that the experimental group had a higher mean achievement score than the control group.

Table 3: Post-Test Mean Achievement Score of Electronics Students

Variables	N	π	S D
Post-test Experimental group	37	19.95	3.399
Post-test Control group	35	15.91	3.518

The table 4 below presents the t-test result on the significant difference between the mean achievement score at post-test level of the experimental group and the control group in the study. The hypothesis was rejected since the p-value of $0.00 < 0.05$

significance level. Therefore, it was concluded that there is significant difference between the mean achievement score of the experimental and control group after being taught using flipped teaching strategy and conventional lecture method respectively.

Table 4: T-test Result on the significant difference in the post test mean achievement scores

Variables	N	π	S D	t	Df	Sig (p value)
Post-test experimental group	37	19.95	3.399	4.946	70	.000
Post-test control group	35	15.91	3.518			

The table 4 below present analysis of covariance result on the significant difference between the Pre-test and Post-test mean achievement score of electronics students taught using flipped teaching strategy in the study. The hypothesis was rejected since

the p-value of $0.001 < 0.05$ significance level. Therefore, it was concluded that there is significant difference in the mean achievement score between the Pre-test and Post-test score of the electronics students taught using flipped teaching strategy.

Table 5: ANCOVA Result on the Significant Difference between the Pre-test and Post-test Scores of the Electronics Students Taught Using Flipped Teaching Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	120.890 ^a	1	120.890	14.343	.001
Intercept	457.462	1	457.462	54.275	.000
Pretest experimental	120.890	1	120.890	14.343	.001
Error	295.002	35	8.429		
Total	15136.000	37			
Corrected Total	415.892	36			

Discussion

The implementation of the flipped teaching strategy in Nigeria Certificate in Education (Technical) awarding institutions in Plateau State has shown promising results in enhancing students' academic achievement in electronics. This is a confirmation of the belief of some researchers that flipped teaching strategy enhances student academic achievements (Bishop, & Verleger, 2022). This pedagogical approach, which involves delivering instructional content outside the classroom and using classroom time for interactive activities, has been found to address several challenges associated with traditional teaching methods.

One of the key findings from the research is that the flipped classroom model significantly improves student engagement and participation. By providing students with the opportunity to review instructional materials at their own pace, the flipped teaching strategy allows for a more personalized learning experience. This is particularly beneficial in technical subjects like electronics, where students often need additional time to grasp complex concepts. The interactive nature of classroom activities in the flipped model also fosters a collaborative learning environment, encouraging students to actively participate and engage with the material.

Moreover, the flipped teaching strategy has been shown to enhance students' critical thinking and problem-solving skills as affirmed by (Hamdan, McKnight, & McKnight, 2022). (Kalat, Yisa, & Sanni, 2024). By shifting the focus from passive listening to active learning, students are encouraged to apply theoretical knowledge to practical problems. This hands-on approach not only reinforces their understanding of the subject matter but also prepares them for real-world applications in their future careers.

However, the successful implementation of the flipped teaching strategy requires careful planning and support from both educators and institutions as

confirmed by (Lo, Hsieh, , Lin, & Hung, (2021). Teachers need to be adequately trained in using technology and designing effective instructional materials. Additionally, access to reliable internet and digital devices is crucial for students to benefit fully from the flipped classroom model. Addressing these challenges is essential to ensure the widespread adoption and effectiveness of this teaching strategy.

Conclusion

In conclusion, the flipped teaching strategy has a positive impact on students' academic achievement in electronics in Nigeria Certificate in Education (Technical) awarding institutions in Plateau State. By promoting active learning, enhancing student engagement, and developing critical thinking skills, this pedagogical approach offers a promising solution to the challenges faced in traditional teaching methods. Future research should focus on exploring the long-term effects of the flipped classroom model and identifying best practices for its implementation in various educational contexts.

Major Finding of the Study

1. There is no significant difference between the pre-test mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method. This implies that the two groups are equivalent based on their mean scores.
2. There is significant difference between the mean achievement score of electronics students taught using flipped teaching strategy and those taught using conventional lecture method.
3. There is significant difference in the mean achievement score between the Pre-test and Post-test score of the electronics students taught using flipped teaching strategy.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made;

1. Electronics Teachers should adopt the flipped teaching strategy because it is a student-centered learning strategy that engages the students rather than begin spoon-feed.
2. Technical Teachers should seek for more knowledge on the utilization of flipped teaching strategy for instruction because it is technology-driven; hence, attending workshops, seminars and conferences within and outside their education districts and state is a must if they must use this approach with all amount of expertise.
3. Monitoring and Evaluation: Regular monitoring and evaluation of the effectiveness of flipped teaching strategy should be conducted to identify areas for improvement.
4. All stakeholders in the education industry including parents should see flipped teaching strategy as an innovation which must be welcomed supported and its usage sustained in Nigeria.
5. Teacher training institutions should provide and equip their information communication technology centers with up-to-date wireless equipment to enable all students appreciates flipped teaching strategy.
6. Technical teachers should be inspired in using flipped teaching strategy to teach any technical subject because if fully integrated, there will be excellent improvement in students' academic achievement.
7. Infrastructure Development: Institutions should invest in developing infrastructure to support flipped teaching strategy, such as digital resources and internet connectivity.
8. Student Support: Students should receive support to develop self-directed learning skills and to access digital resources outside of the classroom.
9. Collaboration and Partnerships: Educators, policymakers, and industry partners should collaborate to ensure that electronics education prepares students for the workforce.

References

- Anderson, K. M. (2007). Differentiating instruction to include all students. *Preventing School Failure*, 51(3), 49–54.
- Bishop, J. L., & Verleger, M. A. (2022). Flipped classrooms: A review of the literature. *Journal of Educational Technology Development and Exchange*, 15(1), 1-23.
- Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (4th ed.). Upper Saddle River, NJ: Pearson Education.
- Dakun, S.W; Ogbonna, B.B.; Lere, M.M & Bulus, H. (2002). *A Practical Approach to Research Methods and Statistics*. Jos. Ehindero Nigeria Limited.
- Ebute, O.M (2020). Flipped Teaching Strategy. *Journal of Vocational Education (JOVED)* (2020). Volume 7.Obeto Press. Pankshin. Pg 275 – 281. ISSN:1118-987
- Eze, C. E., Nwosu, A. C., & Okeke, C. I. (2023). Implementation of flipped teaching strategy in electronics education: Challenges and benefits. *Journal of Science Education and Technology*, 32(1), 1-15.
- Fitzpatrick (2012). *Flipping the Classroom*, Center for Teaching Vanderbilt. ; *The Chronicle of Higher Education*, Retrieved on 18 August 2017 from cft.vanderbilt.edu
- FRN (2014). *National Policy on Education*. Yaba: Revised Edition NERDC Press.
- Hamdan, N., McKnight, P., & McKnight, K. (2022). The flipped classroom model: A comprehensive review of the literature. *Journal of Educational Computing Research*, 56(4), 419-438.
- Kalat, I.K., Yisa, S.N., & Sanni, T.A. (2024). Effect of flipped learning instructional strategies on students' achievement and interest in electrical/electronic for self-employment. *Global Scientific Journal*, 12(4). Retrieved from [Global Scientific Journal](https://www.globalscientificjournal.com/researchpaper/effect_of_flipped_learning_instructional_strategies_on_students_achievement_and_interest_in_electrical_electronic_for_self_employment.pdf).
- Lo, C.-C., Hsieh, M.-H., Lin, H.-H., & Hung, H.-H. (2021). Influences of flipped teaching in electronics courses on students' learning effectiveness and strategies. *International*



- Journal of Environmental Research and Public Health*, 18(18), 9748.
<https://doi.org/10.3390/ijerph18189748>.
- Nwankowo, J.I. & Emunemu, B.O. (2015). Handbook on Research in Education and the Social Sciences. A resource for theses, dissertation and projects. Ibadan. Giraffe Books.
- Ritter, S., Anderson, J., Koedinger, K., Corbett, A. (2007). Cognitive tutor: Applied research in mathematics education. Psychonomic Bulletin & Review, 14(2), 249-255.
- Rycik, J. A. (2012). Building capacity for reform. American Secondary Education, 40(3), 80-81.
- Talan, T., & Gülseçen, S. (2019). The effect of a flipped classroom on students' achievements, academic engagement, and satisfaction levels. Turkish Online Journal of Distance Education, 20(4), 123-136. Retrieved from [ERIC](<https://files.eric.ed.gov/fulltext/EJ1231526.pdf>).
- WAEC (2014). Chief examiner's Report on students' performance for 2009, 2012, 2013 & 2014.