

EFFECT OF FLIPPED CLASSROOM LEARNING APPROACH ON ACADEMIC PERFORMANCE OF SCIENCE, TECHNOLOGY AND ENGINEERING STUDENTS TOWARDS ALGEBRA AND ELEMENTARY TRIGONOMETRY

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ABSTRACT

The flipped classroom, a type of blended learning approach where students receive multimedia introductions to the subject matter at home and practice it extensively in class, is thought to be one of the most relatively easy modern methods of making use of instructional technology without compromising the fundamentals of traditional education, which are primarily interaction between students and lecturers. This study aimed at determining the effect of flipped classroom learning approach on academic performance of science, technology and engineering students towards algebra and elementary trigonometry. The study employed a pretest-posttest quasi-experimental design with a population of all National Diploma One (ND I) students enrolled in algebra and elementary trigonometry course at a polytechnic, of which 120 students comprise the sample. Data were collected using a developed pretest and posttest. A pilot test of the instruments was carried out with students who were not in the sample but are in the population, and Cronbach's alpha was used to determine the reliability coefficient, which turned out to be 0.81. The data was analyzed using t-test, mean, and standard deviation statistics. The results showed that students who were taught algebra and elementary trigonometry using the flipped classroom technique performed better than their counterparts who were taught using the conventional method. To help students improve their performance in algebra and elementary trigonometry, it was recommended that lecturers should use the flipped classroom learning approach.

Keywords: Flipped classroom, academic performance, algebra and elementary trigonometry

1. INTRODUCTION

Flipped learning is a type of blended learning approach to training that promotes student-centered learning, engagement, and performance. It's also a hybrid technique, where instructors incorporate both online and conventional in-person instruction (Muhammad, Abdullahi, Aliyu & Bello, 2023). According to Muhammad, Bello, and Hassan (2024), the core elements of flipped learning are typically highlighted as video lectures and multimedia resources to enhance instruction and learning at any grade level appropriate for the students. In flipped learning, the instructor acts as a guide and responds to students' questions, while in the conventional approach of classroom instruction, the instructor is typically the main focus of a lesson and the main leader of information during the class hour. In a classroom with an essentially conventional educational approach, individual lessons may be subject-based and pedagogical. Under the conventional structure, student interaction can be limited to tasks where students complete an assignment developed by instructors either alone or in small groups. Class conversations are typically centered on the lecturer, who regulates and guides the topic's flow when needed (Muhammad et al., 2023). Assigning students the task of learning from a textbook or practicing a subject by doing an assignment is typically another aspect of this teaching approach. Among other strategies, flipped classrooms reimagine in-class activities by incorporating action learning or more conventional homework assignments.

Video lectures and multimedia apps are frequently referred to as the key components of flipped learning in order to enhance instruction and learning at a level appropriate for the students (Muhammad et al., 2023). In a typical flipped classroom setting, students may watch prerecorded films at home before coming back to school to complete assignments that include questions and at least some background information. The objective of the flipped classroom learning approach is to reevaluate when students should have access to the resources they need most. The flipped classroom approach reverses this tendency if the issue is that students require help completing the task instead of being exposed to the new perspective that motivates the effort (Hassan, 2021). Computer literacy is crucial because the use of flipped classrooms is becoming increasingly important in contemporary teaching and learning. According to Bello, Samaila, Bashar, and Sani (2023), computer literacy is a set of skills related to using basic information and communication technology (ICT) in an online setting and being aware of the drawbacks and moral and legal issues surrounding ICT use.

The goal of the flipped classroom approach, according to Shorman (2015), is to reverse or invert the teaching and learning procedures. In a conventional educational environment, students learn new material in class and then go home to finish their assignments. The flipped classroom approach, on the other hand, enables students to use a variety of digital resources including teacher-created and shared instructional websites to study new material in advance at home. For instance, instructors might produce and share a 5-10 minute video. Additionally, they can promote the flipped classroom method by using multimedia, social media platforms, educational games, YouTube for instructional purposes, TED Talks, Khan Academy, iTunes University, and other educational websites (Elian & Hamaidi, 2021). Students could use computers or smartphones to learn new material at home. With the use of these technological resources, students can view instructional films multiple times in order to thoroughly understand the new material. Additionally, students can review previously studied sections and take notes by fast-forwarding the instructional videos. According to Asiksoy and Ozdamli (2016), the flipped classroom method takes into account each student's individual differences, boosts output, gets rid of frustration, and fosters enthusiasm and learning satisfaction. Following their review of the course materials, students return to the classroom environment to apply what they have learned at home. Instead of concentrating on classroom time and passively listening to the teacher's explanation, the teacher starts by evaluating the students' comprehension and reviewing what they have learned at home. After that, they present the activities and group problem-based tasks that need to be finished in the classroom (Elian & Hamaidi, 2021).

In terms of student and lecturer academic performance, the flipped classroom paradigm has a number of advantages and disadvantages, according to Egara and Mosimege (2024). These include: reducing challenges with student behavior in classroom management; giving students opportunities to actively interact, cooperate, and practice based on their learning abilities at different times; ensuring constant access to information; giving parents the opportunity to help their children follow classes; and giving students the ability to take charge of their own learning activities. Just like classroom instruction is effective for some people but not for others, the flipped classroom approach will not be suitable for everyone. The main drawback of the flipped classroom approach nowadays is that not all institutions and students have access to the resources necessary to implement it. The computers and internet technologies that the flipped classroom requires might not be available to lower-income families and children. Even though there are typically time limits and access may be limited if the computers are overloaded, students without personal computers or internet connections would still be forced to use public computers at the library or at school. This somewhat lessens the personal experience of going to a lecture. Students can complete it on their own time and in their own style, which is why having lectures as homework is so effective.

2. STATEMENT OF THE PROBLEM

Flipped classrooms often have two drawbacks. One of these is the challenge of adjusting to the students and acting in accordance with the norms of the flipped classroom, which call for prior knowledge of the subject matter. The fact that the flipped classroom necessitates a great deal of preparation and labor on the part of the lecturer is a further drawback. Lack of comprehension in algebra and elementary trigonometry, as well as lecturers continued use of traditional methods of instruction that solely rely on memorization and remembrance, are among the main fundamental issues that both students and educators are concerned about. Given the information now available, the challenge is to try to involve students as partners in the learning process by teaching them how to use flipped learning in the classroom and igniting their interest in learning. It is against this that this study aimed at determining the effect of flipped classroom learning approach on academic performance of science, technology and engineering students towards algebra and elementary trigonometry.

3. OBJECTIVES OF THE STUDY

The objectives of this study are to:

- Determine how science, technology, and engineering students' academic performance in algebra and elementary trigonometry is affected by the flipped classroom learning approach
- Discover ways on how to assist science, technology, and engineering students to learn algebra and elementary trigonometry more effectively.

Research Questions

The following questions are raised for answering:

- Is there any significant difference in the mean pretest scores academic performance of science, technology and engineering students taught using flipped classroom and conventional learning approach in algebra and elementary trigonometry?

- Does the academic performance of science, technology, and engineering students taught utilizing the flipped classroom and conventional learning approach in algebra and elementary trigonometry change significantly in terms of mean posttest scores?

Hypotheses

The following null hypotheses are formulated for testing:

H₀₁: There is no significant difference in the mean pretest scores academic performance of science, technology and engineering students taught using flipped classroom and conventional learning approach in algebra and elementary trigonometry.

H₀₂: There is no significant difference in the mean posttest scores academic performance of science, technology and engineering students taught using flipped classroom and conventional learning approach in algebra and elementary trigonometry.

4. METHODOLOGY

To find out how well students understood the subject areas, a pretest-posttest quasi-experimental design was employed with two groups (control and experimental). Before and after undergoing a treatment, the groups were monitored and measured (Sani, 2017).



Figure 1: Research design illustration

EG – experimental group CG – control group

O₁ – pretest

O₂ – posttest

X₁ – flipped classroom learning approach treatment

X₂ – conventional learning approach

All National Diploma One (ND I) students enrolled in the algebra and elementary trigonometry course at Waziri Umaru Federal Polytechnic Birnin Kebbi, Kebbi State Nigeria were the population of the study. Using a simple balloting process, two ND I classes are chosen at random from the institution's four Directorates to serve as study samples. The experimental and control groups were assigned to the chosen classrooms using a hat-draw procedure. A total of 120 students took part in the study, with 68 from ND I Department of Computer Engineering (experimental group) and 52 from ND I Department of Architectural Technology (control group). This student population is enough for collecting and evaluating both qualitative and quantitative data (Sani, 2017). The samples taken into consideration for the research are presented in Table 1:

Table 1: Samples selected for the study

Group	Department	Classes	Samples
Experimental	Computer Engineering	ND I	68
Control	Architectural Technology	ND I	52
Total			120

The research instrument used was a pretest and posttest that were self-developed. A pilot test of the instruments was carried out among ND I students in the Computer Science Department who were not included in the sample but are members of the population in which a reliability coefficient of 0.81 was achieved using Cronbach's alpha.

5. RESULTS AND ANALYSIS

Pretest

The same pretest was administered to both groups prior to the intervention process in order to determine their level of homogeneity.

H₀₁: There is no significant difference in the mean pretest scores academic performance of science, technology and engineering students taught using flipped classroom and conventional learning approach in algebra and elementary trigonometry. As indicated in Table 2, independent sampled t-test statistic is used to determine whether or not the mean pretest scores are statistically significant:

Table 2: T-test comparison on pretest for both experimental and control groups

Group	N	X	SD	Mean Diff.	df	t	Remark
Experimental	68	52.16	3.05	1.78	118	0.215	NS
Control	52	50.38	3.02				

NS – Not significant

As shown in Table 2, there is no significant difference $t(118)=0.215$ at $\alpha=0.05$ between the experimental group's ($x=52.16$, $SD=3.05$) and the control group's ($x=50.38$, $SD=3.02$) mean pretest scores. According to this, the null hypothesis is retained. This analysis shows that the experimental and control groups are equivalent and comparable.

Posttest

After the treatment process, both groups were given the same posttest in order to see the effect of the intervention.

H₀₂: There is no significant difference in the mean posttest scores academic performance of science, technology and engineering students taught using flipped classroom and conventional learning approach in algebra and elementary trigonometry.

The posttest scores mean, SD and t-test statistics are shown in Table 3:

Table 3: T-test comparison on posttest for both experimental and control groups

Group	N	X	SD	Mean Diff.	df	t	Remark
Experimental	68	56.07	4.12	6.46	118	0.000	S
Control	52	49.61	3.27				

S – Significant

As shown in Table 3, there is significant difference $t(118)=0.000$ at $\alpha=0.05$ between the experimental group's ($x=56.07$, $SD=4.12$) and the control group's ($x=49.61$, $SD=3.27$) mean pretest scores. According to this, the null hypothesis is rejected whereas the alternate hypothesis is accepted.

6. DISCUSSION

According to the findings of Table 3, students who were taught algebra and elementary trigonometry through a flipped classroom approach performed better than those who were taught the same content using the conventional approach. As a result, the flipped classroom strategy effectively improved students' performance in algebra and elementary trigonometry. The students' direct involvement in the learning process and their interpersonal interactions with the video resources and materials used in the flipped classroom may have contributed to this significant variance. The fact that students appreciated acquiring knowledge at their own pace and the fact that their instructors created interesting, useful lectures may perhaps have contributed to their excellent performance. The results are consistent with those of Muhammad et al. (2023) and Uy (2022), who found that students in the experimental group who were taught mathematics using the flipped classroom method performed significantly better than their counterparts in the control group. Furthermore, the results support those of Harmini et al. (2022), who found that students in the experimental group who learned calculus through a flipped classroom approach achieved greater scores than those in the control group. The results of this study also corroborate those of Wei et al. (2020), who found that students in the experimental group who got arithmetic instruction using the flipped classroom technique did far better than their counterparts who received instruction using the conventional approach. The result of this study, however, is consistent with those of Shaqalal (2018) and Ahmed and Haji (2020), who used flipped classrooms to compare how well flipped classroom approaches performed for improving students' high order thinking skills. These findings proved that flipped classroom approach resulted in much higher academic performance than traditional instruction.

7. CONCLUSION

This study examined the effects of flipped classrooms on the academic performance of science, technology, and engineering students in algebra and elementary trigonometry. Like previous studies, this study employed a quasi-experimental method and evaluated the conventional approach to learning with the flipped learning approach as an independent variable. The results of this study showed that the flipped classroom method greatly improved students' performance in algebra and elementary trigonometry lessons. Students in the experimental group demonstrated this by outperforming their counterparts in the control group on the posttest. Additionally, it can be concluded from the group's interactions and solutions that the flipped classroom helped the students gain a deeper understanding of the subject. This conclusion is also supported by the students' posttest results, which resulted in a higher performance level for the group that received the flipped classroom intervention on specific topics.

8. RECOMMENDATIONS

The following recommendations are made:

- In order to improve students' performance in mathematics, lecturers should employ the flipped classroom approach when teaching algebra and elementary trigonometry.

- To teach and learn mathematical concepts, government and other educational organizations should organize seminars and workshops for mathematics lecturers on the flipped classroom learning approach.
- To improve students' performance in mathematics, school administrators should make sure that ICT tools and resources are available to facilitate the effective implementation of the flipped classroom learning approach.

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