

IMPACTS OF FLIPPED CLASSROOM APPROACH ON PRE-SERVICE TEACHERS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ADEYEMI COLLEGE OF EDUCATION, ONDO

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Abstract

Modern teaching and learning methods now follow new trends as a result of the world's rapid advancements in information and educational technologies. Flipped classroom teaching and learning pedagogy is one of the most effective ways of enhancing students' active engagement in the teaching and learning process. This study examined the impacts of the flipped classroom approach as a way of developing problem solving skills among pre-service teachers in Nigeria. The study employed a mixed methods approach. The researchers' Flip Learning Attitude Measure and the Algebra Achievement Test were used to get quantitative data, while the Focus Group Discussion was used to gather qualitative information. The Statistical Package for Social Science application was used to compute and analyze the arithmetic mean, standard deviation, and t-test, while thematic content analysis was employed to analyze the qualitative data. The study included 88 pre-service teachers in all. The findings shows that the flipped classroom approach has a favorable impact on pre-service teachers' academic performance, attitude, and perspective on Mathematics. Based on the findings of the study, it was recommended that Mathematics lecturers should adopt flipped classroom approach as a student-driven instructional approach capable of sustaining students' interest and improving academic achievement.

Key words: Flipped Mathematics classroom, Problem solving skills, Attitude, Perception, Pre-service teachers.

1. Introduction

Mathematics is one of the core subjects globally recognized as crucial because of its relevance to science and technology (Oyarinde, 2021). The relevance of Mathematics has positioned the subject as a converging force across all levels of

education. Mathematics plays an important role in our modern society, in which it has become an indispensable tool for the development of mankind. The importance of Mathematics cannot be over emphasized, as it has been considered a necessary

tool to function effectively in the society. There is no doubt that an individual can sometimes operate in the society without knowing how to read and write. However, such individual cannot function successfully without being able to count, measure, add, and subtract, which are all mathematical applications. This is well encapsulated by Akinsola, Okanlawon & Ajani (2014) that the importance of Mathematics goes beyond its contributions to scientific and technological development. It also includes how useful it is in daily interactions at the market places, transportation, business and other areas in which it is used by both literate and illiterate members of the society.

Despite the importance of Mathematics to societal development, it is a subject that students fear, fail and dislike (Areelu, 2014). The reason for this may vary but this could sometimes be related to the teaching method used by teachers (Chianson, Kurumeh & Obida, 2010). In Nigerian higher institutions, lecturers use lecture method, a teacher-centred method, to teach Mathematics. Mathematics at this level is full of teacher-centred procedures that have to be mastered. Basically, learning and doing Mathematics entail effective problem solving, exploration of Mathematical concepts, ability to dynamically link representations of ideas and develop meta-cognitive skills in planning and checking solutions. Tularam (2013) supports this assertion, noting that Mathematics at this level might be different not only because the topics are different, but there is an increased depth, with respect to the technical abilities needed to manipulate new objects and the conceptual understanding underlying them.

In an attempt to find a viable solution to the challenges of Mathematics at this level, Mathematics lecturers need to improve on their teaching methods to ensure that students are

adequately engaged during the instructional process to better students' learning outcomes. The instructional method used by lecturers plays a significant role in the understanding of instructional contents for meaningful learning and development of necessary skills. The lecturers' use of teacher-centered instructional methods in the teaching of Mathematics has been widely criticised for failing to prepare students to attain high achievement level in Mathematics (Oyarinde & Komolafe, 2019; Emaiku, 2012). It makes students passive with less interaction.

However, there seems to be a growing concern for the adoption of new methods that promote student engagement and involvement in their learning in the twenty-first century. Scholars have consistently advocated the need to evolve more student-centred approaches that promote students' active participation in the instructional process instead of the popular teacher-centred approaches that give a passive role to students in classroom activities (Teo, 2010). In this regard, it may equally be profiting to enhance this method with technology-based instructions that could actively engage students in instructional process and help them in gaining mastery of the contents. This is in connection with studies which have shown that technology proves to be helpful in engaging students in learning mathematics and also found useful to demystify abstract concepts in Mathematics (Oyarinde & Komolafe, 2019; Olumuyiwa, 2019; Abah, Anyagh, & Age, 2017; Esperanza, Fabian & Toto, 2016; Remalyn, 2016; Charles-Ogan & Williams, 2015). In this regard, the flipped learning approach among other modern means may be useful.

Flipped classroom approach is one of the emerging technological tools that could be employed by Mathematics lecturers to overcome the challenges of engaging pre-services mathematics teachers in

classroom instruction. The flipped classroom approach is an innovative pedagogical approach that focuses on learner-centred instruction to learning where the students are more active than the instructor in the classroom activity (Gilboy, Heinerichs & Pazzaglia, 2015). In this approach, the instructor acts as a facilitator to motivate, guide, and give feedback on students' performance (Bergmann & Sams, 2012).

In the flipped classroom approach for teaching and learning of Mathematics, the instructor can move the traditional lecturer's talk to video and the students can listen to the lectures anywhere outside of class. The flipped classroom allows students to watch the video at their preferred time and need, and they can study at their own pace. These types of activities increase students' collaborative learning outside the four walls of classrooms. In this mode, students can explore the mathematical details of the content and sustain curiosity to the highest levels. The carefully structured activities used in flipping the mathematics class may have enriched the students' Mathematics learning in very specific ways.

However, with the emerging trend in technology-assisted learning, it is observed that not so much has been done to ameliorate the problems of teaching Mathematics in higher instructions in Nigeria with the use of technology, particularly flipped classroom approach. It seems the approach has not been extensively utilised in teaching and learning of Mathematics. Thus, there is the need for learner-centered instructional methods that would actively engage pre-service teachers in the use of technology for classroom activities. Flipped classroom has potentials to fill this gap in instructional delivery, as it will directly expose the pre-service teachers to the use of technology to engage them in the classroom activities. Therefore, this paper examined the effects of flipped classroom approach on

achievement and attitude of pre-service teachers to algebra aspect of Mathematics in Adeyemi College of Education, Ondo State, Nigeria. It also investigated their perception of flipped classroom approach with reference to their problem solving skills.

2. Objectives of the study

The study's primary goal was to investigate how the flipped classroom approach affected students' learning outcomes. The specific objectives of the study are:

- 1) To determine the difference(s) in the post-test performance of students taught Mathematics using flipped classroom approach and those taught using the traditional classroom method.
- 2) To determine the attitude of students towards the use of flipped classroom approach in Mathematics instruction.
- 3) To examine the perception of students taught Mathematics using flipped classroom approach and those taught using the traditional classroom method.

3. Research Questions

- 1) What impact does the flipped classroom approach have on the Mathematical achievement of pre-service teachers?
- 2) What is the impact of flipped classroom on pre-service teachers' attitude towards algebra aspect of Mathematics?
- 3) How do pre-service teachers perceive flipped classroom approach?

4. Methodology

This study adopted mixed method research design to investigate the effects of flipped classroom

approach as a way of developing problem-solving skills among pre-service teachers in Nigeria. The qualitative data was collected because the quantitative data alone would not be sufficient to answer the research questions that were raised. Quantitative data were generated from the questionnaires while qualitative data were collected through Focus Group Discussion developed by the researchers. All pre-service teachers in the school of Science at Adeyemi College of Education Ondo, Nigeria, who registered for an Algebra course made up the study's population. The research sample was purposive, and a total of 88 pre-service teachers took part in the study. In order to choose the research sample, the researchers were forced to use a non-probability sampling technique. The type of non-probability method the researcher employed is purposive non-probability sampling.

Three research instruments were used to obtain information from the respondents Flip Learning Attitude Scale (FLAS), Pre-service Teachers' Perception to Flip Learning (PTPFL) and the Algebra Achievement Test (AAT) developed by the researchers. The reliability coefficient of the instruments was obtained using Cronbach's alpha. For FLAS, Cronbach alpha value of 0.72 was obtained, for PPTFL, Cronbach alpha value of 0.76 was obtained and for AAT, Cronbach alpha value of 0.86 was obtained. The completed copies of the questionnaire were collected, coded and analysed using the standard deviation, arithmetic means and paired sample t-test analyses were computed. The qualitative data were analysed using thematic analysis after being subjected to the process of data reduction via transformation, summarisation and transcriptions.

5. Results

Research Question 1

What impact does the flipped classroom approach have on the Mathematical achievement of pre-service teachers?

In order to investigate the impacts of flipped classroom approach on pre-service teachers' achievement in algebra aspect of Mathematics, the pre-test and post-tests were given, and their mean scores were computed to determine whether there was a statistically significant difference between them using paired sample t-test. The findings of the analysis are shown in Table 1.

Table 1: Difference between experimental and control groups before the Flipped classroom approach

Groups	N	Mean	SD	t-value	P-value
Experimental	43	4.37	1.88		
Control	45	4.66	1.75	-.655	0.53

Table 1, shows that there was no statistically significant difference between the pre-test scores of the experimental group ($\bar{x} = 4.37$, $N=43$, $SD=1.88$) and control group ($\bar{x} = 4.66$, $N=45$, $SD=1.75$) and ($T = -.655$, $P=0.53$) before they were exposed to the flipped classroom strategy. In other words, before the intervention, both groups of students exhibited the same levels of problem solving skills.

Table 2. Difference between experimental and control groups after the Flipped classroom approach

Groups	N	Mean	SD	t-value	P-value
Experimental	43	6.21	1.82		
Control	45	5.43	1.84	2.015	0.046

However in table 2, paired sample t-test revealed that there was a significant difference between the mean scores of the experimental group at the end of the flipped classroom method ($\bar{x} = 6.21$, $N=43$,

SD=1.82) and the control group ($\bar{x} = 5.43$, N=45, SD=1.84). This shows that on the post-tests, there was a statistically significant difference between the two groups ($T=2.015$, $P=0.046$). In fact, the post-test data show that the differentiated classroom approach is substantially responsible for the difference between the mean scores. Pre-service instructors in the experimental group significantly improved on the post-test scores ($P<0.05$). This indicates that the flipped classroom group outperformed its peers in the traditional group in terms of performance.

Research Question 2

What is the impact of flipped classroom on pre-service teachers' attitude towards algebra aspect of Mathematics?

In order ascertain the impact of the flipped classroom approach on pre-service teachers' attitudes toward the algebra component of Mathematics, data were obtained and evaluated using the paired sample t-test. Table 3 displays the results of the analysis.

Table 3. Paired sample t-test results of the pre- and post-attitude scale towards algebra aspect of mathematics.

Tests	N	Mean	SD	t-value	P-value
Pre-Attitude	43	3.58	1.82		
Post-Attitude	45	6.22	1.96	3.39	0.000

Table 3, compares the pre- and post-attitude mean scores and shows that the post-attitude mean score ($\bar{x} = 6.22$) is higher than the pre-attitude mean score ($\bar{x} = 3.58$). A paired sample t-test was employed to assess whether the difference between the pre- and post-attitude mean scores (2.64) was statistically significant. The t-value was revealed to be 3.39. This figure exceeds 2.02 at 0.05 degrees of freedom, indicating that the flipped classroom approach has a

positive impact on students' attitude towards algebra aspect of Mathematics.

Research Question 3

How do pre-service teachers perceive flipped classroom approach?

The perception of the pre-service teachers towards flipped classroom approach were also qualitatively explored through the focus group discussion.

Table 4. Perception of pre-service teachers towards flipped classroom approach

S/n	Item	Mean	SD
1	The flipped classroom allows me to plan ahead for my lecture.	3.30	0.93
2	My understanding of algebra has improved as a result of the flipped classroom approach.	3.21	0.90
3	Flipped classroom approach makes the classroom more enjoyable	3.33	0.82
4	Flipped classroom helped me love algebra more.	3.25	0.78
5	The flipped classroom allowed me to pace my own learning	3.07	0.80
6	I became more motivated to study algebra aspect of Mathematics as a result of the flipped classroom approach.	3.17	0.96
7	My problem solving skills are better as I have more time to watch the prepared videos, over and over, before the class	3.10	0.87
8	The flipped classroom is more engaging than the traditional classroom.	3.55	0.91
9	Flipped classroom helped my retention rate in algebra	3.12	0.86
10	other Mathematical classes, I prefer to use these approaches of Instruction.	3.29	0.98
Grand Mean		3.23	

Table 4, shows that the flipped classroom approach is appreciated by the pre-service teachers than traditional Mathematics classes. They reported that flipped classroom helps them to prepare for class in advance; improves their understanding; and allows them to pace their own learning.

In support, one of the participants said, *“The videos help me to be prepared well before the class time; I can watch the videos anytime and anywhere.”* Also, another participant stated that, *“Previously, I didn't participate as much in algebra class because I didn't know much about the course. Now, after watching the videos over and over, I can have a better understanding of the content.”*

In addition, one participant stated that: *“It helps my retention rate in algebra and if it is possible I should*

prefer to have these kind of learning approach in other Mathematics courses.”

6. Discussion

Findings from the study showed that the flipped classroom approach has improved pre-service teachers' academic performance. Also, findings revealed that the flipped classroom strategy makes instructional content more accessible to them at any time they choose, encourages active learning, and allows them to study at their own pace. In addition, it gives them the opportunity to spend more time on their assigned tasks and gives them more time to prepare and review the lesson material outside of class. This finding agrees with Abah, Anyagh, & Age (2017), who observed that flipped learning stimulates students' curiosity, engagement and enlightenment. The study by Akingbemisilu (2017) revealed that flipped learning has an impact on students' academic development in biology; and the study by Charles-Ogan & Williams (2015) revealed similar results in mathematics.

This study also showed that pre-service teachers' attitudes toward the algebra aspect of Mathematics were positively influenced by the flipped classroom approach. The results are consistent with those of studies conducted by Karadag & Keskin (2017),

Esperanza, Fabian, and Toto (2016), Abeysekera & Dawson (2015), Butt (2014), Kong (2014), and Sever (2014), which showed that flipped learning promoted students' positive attitudes toward mathematics class and increased participants' motivation. Additionally, this is in line with Adedjoja (2016) study, which found that the majority of the pre-service teachers in an Introduction to Instructional Technology class have a positive attitude towards flipped classroom instruction.

In the same vein, the participants in this study personally recommended the flipped classroom approach for other courses in mathematics. This is an advantage over the traditional model of instruction. This positive acceptance agrees with Muir and Chick (2014), who reported students' perceptions of the flipped classroom as sustainable and transferable to other classes. Pierce & Fox (2012) draw the conclusion that students were aware of the usefulness and educational benefits of the flipped classroom instructional model.

7. Conclusion and Recommendations

The results of this study indicate that that the pre-service teachers have a positive attitudes toward flipped classroom approach. They claim that the strategy encourages active learning and makes the learning content more accessible to them anywhere, anytime. According to the study's findings and the pertinent literature, the flipped classroom approach has been shown to be quite effective and efficient in improving pre-service teachers' academic achievement and promoting positive attitudes to algebraic aspect of Mathematics. This might imply that the application of technology in teaching and learning processes could increase the attitudes of pre-service teachers to algebra. The flipped classroom approach is rapidly catching on as increasing numbers of educators begin to experiment with this new way of teaching. Hence, the advantages of flipped classroom approach can

be brought into use for achieving quality in the teaching process at all levels of education.

opportunity for competition when learning in a chaotic environment.

The following recommendations are hereby made:

1. Mathematics lecturers in the colleges of education should adopt flipped classroom approach in teaching all Mathematics courses.
2. Curriculum planners and Mathematics lecturers should emphasise integration of flipped classroom approach into the pre-service teachers' curriculum at the teacher-preparation institutions in Nigeria
3. Lecturers should be adequately trained on how to successfully adopt the flipped classroom approach. They should be trained on how to design instruction of good quality that would be suitable for flipped learning model.
4. The government and other stakeholders in education should embrace and exploit the full benefits of flipped classroom approach in teaching and learning as these would bring in meaningful instruction and satisfaction.

The improvement of awareness skills through the use of digital learning tools affects school quality. The first step in developing these skills is preparing teachers when they are enrolled in programs for teacher education. The secondary school program's adoption of digital learning tools provides insight into the various forms of online learning and their efficacy during the instructional process under unusual circumstances. The study showed that parents' socioeconomic status could influence their awareness of digital learning tools. The study emphasizes the value of digital learning technologies for managing academic content effectively and efficiently, sharing information among learners online or in person, and reducing the

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