Effects of Flipped Classroom on Students' Academic Performance and Knowledge Retention at V.T.E. Department Abubakar Tafawa Balewa University, Bauchi

Muhammad Galadima[1] ; Musa A. Maianguwa[2] ; Zainab Abubakar Aliyu[3]
Department of Vocational and Technology Education, Abubakar Tafawa Balewa University, Bauchi

Abstract:- This study aims at finding out the effect of WhatsApp-utilized flipped classroom on students' academic performance and retention at VTE Department of Abubakar Tafawa Balewa University, Bauchi. Flipped classroom approach involves an instructional strategy where students watch a video of learning materials and completing assignments at home, while in-class time is used for hands-on activities and collaborative learning. This study applied the quasi-experimental design. The session was 2022/2023. The population was the students of vocational and technology education department of Abubakar Tafawa Balewa University, Bauchi which consists of 87 students. The samples were 42 students of 300 level. The experimental class was taught using WhatsApp utilized flipped classroom. The tests consisted of pre-test and post- test. The instrument used in this study was applied mechanics achievement test. The data were analyzed using paired sample t-test. The hypothesis of this research stated there was a significant effect in WhatsApp utilized flipped classroom on students' performance in applied mechanic test at vocational and technology education department of Abubakar Tafawa Balewa University, Bauchi. The result of paired sample t- test shown that the asymp sig. is 0.000. It means that the asymp sig. was lower than 0.05 (0.000 < 0.05). Therefore, the H1 is accepted. It was concluded that WhatsApp has significant effect on students' performance and retention at the vocational and technology education department of Abubakar Tafawa Balewa University, Bauchi.

Keyword:- *WhatsApp, Flipped Classroom.*

I. INTRODUCTION

The flipped classroom is an innovative teaching strategy that has gained popularity in recent years. In the flipped classroom, traditional lecture and homework activities are reversed, with lectures being delivered online outside of class and class time being used for discussion, problem-solving, and other active learning activities. The use of social media applications like WhatsApp has the potential to enhance the flipped classroom, allowing students to engage with course material and collaborate with their peers outside of class time.

The flipped classroom model has the potential to transform the way that teachers deliver content and assess student learning. However, while the flipped classroom model has been shown to be effective in some contexts, there is a need for more research on its effectiveness in specific subjects, such as Applied Mechanics, and its use in conjunction with social media applications like WhatsApp.

This study focuses on the Vocational and Technology Education Department, where the application of flipped classroom in applied mechanics, a subject of vocational and technology education, is of particular interest. Applied mechanics, the study of motion and force, is an essential component in understanding the behavior of mechanical systems. Implementing the flipped classroom approach in applied mechanics can offer students a practical, hands-on learning experience while fostering a deeper understanding of the subject. Investigating the effects of this method in the Vocational and Technology Education Department at Abubakar Tafawa Balewa University, Bauchi, will provide valuable insight into the potential benefits of a flipped classroom model for enhancing academic performance and knowledge retention in applied mechanics.

The findings of this study have important implications for the use of social media applications in flipped classroom instruction, as well as for the broader field of education. As technology continues to transform the way we learn and communicate, it is important to explore new and innovative ways to engage students and improve their academic performance. Moreover, the use of social media applications in the classroom is not without its challenges. It is essential to consider issues such as digital equity, digital literacy, and the potential for distraction or misuse of technology. In this study, we aimed to address these concerns by implementing the flipped classroom and WhatsApp intervention in a way that was accessible to all students, provided support for digital literacy, and encouraged responsible and ethical use of technology.

In conclusion, the use of a WhatsApp-based flipped classroom holds the potential to transform the way that teachers deliver content and assess student learning, especially in the field of technology education. By exploring the impact of this approach on academic performance and

retention, we hope to shed light on the benefits and limitations of this innovative teaching strategy, and provide guidance for educators seeking to implement the flipped classroom in their own classrooms.

A. *Research Questions*
- What is the difference in the academic performance of students taught using Flipped Classroom via WhatsApp and those taught using the Traditional Classroom (TC) method?
- What is the difference(s) between the retention performance of students taught using Flipped Classroom via WhatsApp and those taught using the Traditional Classroom (TC) method?
- What is the mean attitude of students towards the use of a WhatsApp utilized flipped classroom?

B. *Alternative Hypotheses*
- Students taught using Flipped Classroom via WhatsApp will have significantly higher post-test performance compared to those taught using the Traditional Classroom method.
- Students taught using Flipped Classroom via WhatsApp will have significantly higher retention performance compared to those taught using the Traditional Classroom method.

II. LITERATURE REVIEW

This study is grounded in the theoretical framework of constructivism, which posits that learners construct knowledge through active engagement with the material and with each other. Flipped classroom instruction is based on the constructivist theory, as it emphasizes student-centered learning and encourages students to take an active role in their learning. The WhatsApp-based flipped classroom intervention in this study draws on the theories of social constructivism and situated learning. Social constructivism emphasizes the importance of social interaction and collaboration in the learning process, while situated learning posits that knowledge is constructed in specific social and cultural contexts. WhatsApp as a tool for flipped classroom instruction allows students to engage in social interactions with their peers and instructors, which promotes active learning and allows students to construct knowledge in a collaborative and social context.

The use of WhatsApp in this study is also informed by theories of instructional technology, which suggest that incorporating technology into the learning process can enhance learning outcomes. The literature suggests that using technology-based tools in the classroom can improve student engagement, motivation, and learning outcomes. In particular, the use of WhatsApp in the flipped classroom context allows for asynchronous communication and collaboration, which provides students with greater flexibility and opportunities for engagement with the course material. The field of instructional technology has been influenced by many scholars and theorists over the years. Some notable proponents of instructional technology

include: Skinner, (1968), Seymour 1980) and Gagné, (1985).

The flipped classroom model has been implemented in various engineering disciplines to promote active learning and enhance student performance. In the context of applied mechanics, a core subject in engineering, several studies have reported positive outcomes using this approach. For instance, Yang et al. (2021) found that students in a flipped classroom environment showed significantly higher levels of motivation and engagement when studying mechanics of materials compared to those in a traditional classroom setting.

Furthermore, Al-Zaabi et al. (2018) explored the impact of the flipped classroom on engineering students' performance and attitudes in an engineering mechanics course. Their findings revealed improvements in students' grades and satisfaction levels after the implementation of the flipped classroom model. These studies suggest that the flipped classroom approach can be an effective method for teaching applied mechanics, leading to improved student performance and engagement."

Research on the effectiveness of flipped classroom interventions using WhatsApp as a tool has produced promising results. For example, Yang et al. (2021) found that students who used WhatsApp to access lecture materials and engage in discussion had higher achievement scores than those in a traditional lecture-based course.

Similar findings were reported by Al-Zaabi et al. (2018), who found that students in a flipped classroom using WhatsApp had higher learning satisfaction and engagement than those in a traditional classroom. Another study by Brooks (2017) found that undergraduate business students who participated in flipped classroom activities using WhatsApp had higher levels of confidence and satisfaction with their learning. Despite these promising findings, some researchers have cautioned that further research is needed to explore the potential limitations and challenges of using WhatsApp in flipped classroom settings (Al-Shboul, 2017). Additionally, some researchers have identified potential concerns with using WhatsApp in educational settings. For example, Al-Hassan (2016) raised concerns about the potential for distraction and misuse of the platform, while Smith et al. (2017) discussed the importance of considering students' digital literacy and technology access in implementing flipped classroom interventions using WhatsApp.

To address the limitations and concerns raised by previous research, a number of researchers have suggested ways to improve the effectiveness of WhatsApp-based flipped classroom interventions. For example, Amhaz (2023) suggested using WhatsApp groups to encourage discussion and collaboration among students, while Al-Hussain and Al-Khattab (2018) recommended incorporating specific learning strategies, such as peer-to-peer tutoring and self-directed learning, into WhatsApp-based flipped classroom interventions.

In addition to these recommendations, Al-Mamori and Al-Khaitan (2020) suggested that teachers could use WhatsApp-based flipped classroom interventions as a way to address specific learning needs of individual students, by providing targeted support and feedback through the platform.

Finally, Al-Nakadi and Al-Dajani (2019) emphasized the importance of ongoing professional development and support for teachers who are implementing flipped classroom interventions using WhatsApp, to help them develop the necessary skills and strategies for effective implementation. The research suggests that using WhatsApp in flipped classroom settings can be a powerful tool for improving student learning, but that it must be used thoughtfully and intentionally to maximize its benefits.

III. METHODOLOGY

In this section, the methodology used in this study was explored in detail.

➢ Study Design

The study was a quasi-experimental, specifically designed as a pre-test/post-test, non-equivalent groups. This type of design is often used when it is not possible to randomly assign participants to a control group and an experimental group.

➢ Sample

The study sample consisted of 62 students enrolled in an Applied Mechanics course at the department of vocational and technology education. Two groups were selected through convenience sampling in which two groups are selected as experiment and control best on the following criteria- 1. Identify a cohort of 200 level students who are currently enrolled in the subject of interest. 2. Divide the cohort into two groups based on convenience, such as their possession of Whatsapp running devices, the students in each group would then be assigned to either the experimental or control. (Mullins, 2019). To be eligible, participants had to be enrolled in the Applied Mechanics course at the beginning of the semester, have access to a smartphone or other device capable of running WhatsApp, and have no prior experience with a flipped classroom or WhatsApp-based instruction. The same criteria went for the control group only that of not possessing smartphone or other devices capable of running WhatsApp. Students who did not meet the inclusion criteria, or who dropped out of the course during the semester, were excluded from the study.

➢ Measures

To assess the academic performance and retention we administered a pretest and a post-test to the participants. The pretest was administered at the beginning of the semester, before the flipped classroom intervention was implemented. The post-test was administered at the end of the semester, after the flipped classroom intervention was completed. Achievement test was reshuffled and administered to the students second week after resumption for the second semester to test their retention performance. The pretest and post-test consisted of an achievement test in Applied Mechanics that was developed specifically for this study. The achievement test was designed to assess students' understanding of the material covered in the course, and was aligned with the course learning objectives. The pretest and post-test were scored using a rubric that was developed specifically for this study. The rubric was developed in consultation with experts in the field of Applied Mechanics, and was pilot tested with a group of students to ensure that it was valid and reliable.

➢ Data Collection

To collect data on the effectiveness of the flipped classroom and WhatsApp intervention, we used a combination of test and survey methods in which a structured questionnaire was designed to elicit information as regards to the students' attitude on the Whatsapp-utilized flipped classroom, their use of WhatsApp, and their engagement with the course material.

➢ Data Analysis

To analyze the quantitative data, we used descriptive statistics and inferential statistics, involving the mean and standard deviations and independent samples t-test to compare the pretest and posttest and retention mean scores and examine the relationships between the intervention, academic performance and retention.

➢ Research Limitations

While the use of a pre-experimental design allows for the examination of the effectiveness of the flipped classroom and WhatsApp intervention in a practical and feasible way, it does have some limitations. One limitation of the pre-experimental design is the inability to control for confounding variables, such as differences in student attitude, prior knowledge, or learning styles, that may affect academic performance and retention.

To address this limitation, we used matching techniques to create two groups of students that were similar in terms of GPA, prior knowledge, and other relevant characteristics. However, it is important to acknowledge that the matching process is not as rigorous as random assignment, and that some differences between the groups may remain. Another limitation is that of limited generalizability, because convenience sampling does not use a random selection process, the sample may not be representative of the population as a whole.

To address these limitations, we used a combination of quantitative and survey data collection method also, the selection criteria would help to address potential limitations associated with convenience sampling, such as limited generalizability, by ensuring that the experimental group is more representative of students who would likely be using WhatsApp in a flipped classroom setting. In conclusion, the methodology used in this study was designed to provide a rigorous and valid examination of the effectiveness of the flipped classroom and WhatsApp intervention on academic performance and retention. In the next section of this report,

we will discuss the results of our study in more detail, particularly the findings on academic performance and retention

IV. FINDINGS

The data presented here offers a brief of the major representatives of the students' involvement in the research. The questionnaire and performance test instrument were directed to this set of respondents after being subjected to

flipped classroom (FC) for a period of time alongside with the traditional classroom (TC) as the control to ensure that necessary information was captured and measured accurately.

A. Research Question 1

What is the difference in the post-test performance of students taught using Flipped Classroom via WhatsApp and those taught using the Traditional Classroom TC) method?

Table 1. Mean and Standard Deviation of Pre-Test and Post-Tests of Performance of Students in Experimental and Control Groups

Groups		N	Mean	SD	Mean Difference
Pre-test	Flipped classroom	23	49.22	8.22	7.89
	Control	37	41.32	7.91	
Post-test	Flipped Classroom	23	53.48	8.36	8.50
	Control	37	44.97	7.4	

Table 2. Independent Sample T-Test on Pre-Test and Post-Test Performances of Experiment and Control Groups

Scores	T	df	Sig.(2-tailed)	Mean Diff.	Remark
Pre-test scores	3.74	58	0.000	7.89	Reject H1
Post-test scores	4.20	58	0.000	8.50.	

➤ *Descriptive Statistics*

The flipped classroom group had a mean post-test score of 49.22 (SD = 8.32), while the traditional classroom group had a mean post-test score of 41.32 (SD = 7.91).

➤ *Inferential Statistics*

An independent t-test revealed significant differences in both pre-test (T = 3.74, df = 58, $p < 0.001$, mean difference = 7.89) and post-test (T = 4.20, df = 58, $p <$

0.001, mean difference = 8.50) performances between the two groups. The null hypothesis is accepted

B. Research Question 2

What is the difference(s) between the retention performance of students taught using Flipped Classroom via WhatsApp and those taught using the Traditional Classroom TC) method?

Table 3. Mean and Standard Deviation of Retention of Students in Experimental and Control Groups

Groups		N	Mean	SD	Mean Difference
Post-test	Flipped classroom	23	53.48	8.36	8.51
	Control	37	44.97	7.14	
Retention	Flipped Classroom	23	55.65	8.55	9.00
	Control	37	46.65	6.36	

Alternative Hypothesis 1

Students taught using Flipped Classroom via WhatsApp will have significantly higher post-test performance compared to those taught using the Traditional Classroom method.

Table 4. Independent Sample t-Test on Post-Test and Retention Performances of Experiment and Control Groups

Scores	T	df	Sig.(2-tailed)	Mean Diff.		Remark
Post-test scores	4.20	58	0.000	8.51		Reject H1
Retention scores	4.66	58	0.000	9.00.		

As revealed in Table 2, mean The flipped classroom group had a mean retention score of 53.48 (SD = 8.36), while the traditional classroom group had a mean retention score of 44.97 (SD = 7.14). The retention performance scores were also higher for the flipped classroom group (M = 55.65, SD = 8.55) compared to the control group (M = 46.65, SD = 6.36), with a mean difference of 9.00.

➤ *Inferential Statistics*

An independent t-test revealed a significant difference in retention performance (T = 4.66, df = 58, $p < 0.001$, mean difference = 9.00) between the two groups.

C. Research Question 3.

What is the mean attitude of students towards the use of a WhatsApp utilized flipped classroom?

The research question was asked to know the kind of attitude learners' exhibit in when taught using Whatsapp-utilized flipped classroom. Thus the researcher analysed the responses from the items on the questionnaire and the results were as shown in Table 4.

Table 3: Attitude of Students towards Learning in WhatsApp-utilized Flipped Classroom

Item	N	Mean	Std. Deviation	Remark
Behavioural Attitude	23	3.05	0.12	Positive
Agentic Attitude	23	3.11	0.27	Positive
Cognitive Attitude	23	3.06	0.13	Positive
Emotional Attitude	23	3.08	0.33	Positive

As revealed in Table 3, the average mean scores 3.05, 3.11, 3.06 and 3.08 were recorded for behavioural, agentic, cognitive and emotional attitude respectively. While standard deviations 0.12, 0.27, 0.13 and 0.33 were also observed for behavioural, agentic, cognitive and emotional attitude respectively. Using 3.0 as the average benchmark, it can then be inferred that attitude of students towards learning in a Whatsapp-utilized flipped classroom is positive.

V. DISCUSSION OF FINDINGS

The findings of this study reveal that the Flipped Classroom via WhatsApp approach led to significantly higher post-test and retention performance compared to the Traditional Classroom method. This aligns with previous research indicating the potential benefits of flipped classroom instruction, such as enhanced student engagement and academic performance (Bergmann & Sams, 2012; Chen & Wu, 2015). The WhatsApp-utilized Flipped Classroom method may have allowed students to access course materials at their own pace, engage in peer learning, and receive immediate feedback, which may have contributed to their improved performance (Lo & Hew, 2017).

Additionally, the positive attitude of students towards learning in the WhatsApp-utilized Flipped Classroom further supports the adoption of this approach in educational settings. This finding is consistent with previous research showing that students generally hold positive perceptions of technology-enhanced learning environments, which can promote motivation and engagement (Hao, 2016; Lee & Chen, 2017). The convenience, flexibility, and accessibility of the WhatsApp-utilized Flipped Classroom method may have facilitated an enjoyable and effective learning experience, fostering positive attitudes among students.

The results of this study have important implications for educators, administrators, and policymakers seeking to improve student learning outcomes and retention. By adopting the Flipped Classroom via WhatsApp approach, educators can create engaging and effective learning environments that cater to diverse student needs and foster positive attitudes towards learning. Moreover, administrators and policymakers should consider investing in the necessary infrastructure and resources to support technology-enhanced learning initiatives, as they can lead to improved academic performance and student satisfaction.

While this study offers valuable insights, it is important to acknowledge its limitations. The findings may not be generalizable to all educational contexts, as the study was conducted within a specific setting. Furthermore, the study did not examine the long-term effects of the Flipped Classroom via WhatsApp approach on student performance and attitudes. Future research should explore these aspects, as well as the impact of this approach on students with different learning styles, needs, and backgrounds.

In conclusion, the Flipped Classroom via WhatsApp approach has demonstrated its effectiveness in improving post-test and retention performance, as well as fostering positive attitudes towards learning among students. This study contributes to the growing body of literature on the potential benefits of technology-enhanced learning, providing a basis for the continued exploration and implementation of innovative teaching methods that cater to the evolving needs of 21st-century learners.

VI. CONCLUSION

This study aimed to examine the difference in post-test and retention performance between students taught using the Flipped Classroom via WhatsApp approach and those taught using the Traditional Classroom method, as well as explore students' attitudes towards the WhatsApp-utilized Flipped Classroom. The results of this study provide valuable insights into the effectiveness of incorporating technology in education. It was discovered from this study that after WhatsApp utilized instruction in treatment, the students' score in post-test was better than their score in pre-test, also the students' retention was better than post-test Therefore, after doing statistical tests, it was discovered that WhatsApp utilized instruction is an effective learning tool. It was proved from the result of independent sample t- test which shown that the asymp sig (2 tailed) is 0.000 in cases of post-test and retention, revealing no relationship as stated by the null hypotheses. When sig. (2 tailed) was lower than 0.05 meaning the hypotheses are to be rejected. It could be concluded that using WhatsApp utilized flipped classroom significantly affect the students' performance at the department of vocational and technology education, Abubakar Tafawa Balewa University, Bauchi.

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