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Investigating the Effect of the Traditional Flipped Classroom in Teaching Primary 3 Class Mathematics

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Abstract

Purpose: The purpose of the study is to investigate how the "flipped" classroom impacts Primary 3 Mathematics students' learning and achievement.

Methodology: In this study, mathematics instruction in Primary 3 was recontextualised using the Flipped Classroom methodology. Using pre- and post-test methodology, a quasi-experimental research design was used with 81 lower essential school students from two private primary schools. Data collection utilised three designed instruments: the Mathematics Achievement Test (MAT), Traditional Flipped Classroom Instructional Guide (TFCIG), and Control Group Instructional Guide (CGIG). The test-retest reliability of MAT was established at 0.75. The study explored the potential benefits of the flipped classroom model in improving pupils' mathematics achievement and interest within the three primary classes. Two hypotheses were formulated and analysed using descriptive statistics for demographics and Analysis of Covariance (ANCOVA) at a 0.05 significance level.

Findings: The findings shed light on the success of using a flipped model to recontextualise math classes at the Primary 3 level in Mathematics in Ilorin South Local Government Area of Kwara State, Nigeria. The findings indicate a significant positive effect of traditional flipped classroom instructional strategy on pupils' academic achievement in Mathematics. However, there was no significant interaction effect between treatment and gender. The conclusion is that the traditional flipped classroom instructional strategy improves pupils' academic achievement, irrespective of gender. This study found a statistically significant effect size for the flipped classroom instructional strategy.

Unique Contributions to theory, policy and practice: This research contribution is twofold. Firstly, the study advances our understanding of the advantages, difficulties, and prospective improvements of flipped learning in Mathematics classes in Primary schools. Secondly, this study helps teachers understand how to integrate the flipped classroom within the learning and teaching system. The study recommends that school teachers or educators undergo training to implement traditional flipped classroom instructional strategies in math classes effectively.

Keywords: *Blended Learning, Constructivist, Flipped Classroom, Learner-Centred Pedagogy, Teacher-Centred Pedagogy*

Introduction

The education system has evolved from a teacher-centred approach to a pupil-centred, constructivist one, allowing pupils to access information independently. This shift focuses on pupils' assimilation and structuring of knowledge, increasing the permanence of learning. Educational technologies have also evolved, integrating blended learning (FCM) models, which combine home-based activities with classroom-based practices. This model aims to facilitate information transfer and retention, enhancing the permanence of knowledge. Overall, the evolution of education has led to a more flexible and effective learning environment.

Ağırman and Ercoşkun (2022) defined the traditional flipped classroom as a blended learning strategy that enhances pupil engagement by combining online readings, lectures, and discussions with active classroom participation, emphasising self-directed learning outside the classroom and active class participation. In this case, the pupils come to the classroom to learn the subject before the lesson. (Abeysekeraa and Dawson, 2015) corroborate the views of (Ağırman, & Ercoşkun, 2022) by stating that the FCM Model is a teaching approach that combines classroom instruction with out-of-class learning using educational technologies. It reverses the traditional teaching process, where teachers lecture in the classroom and then provide homework. Instead, the FC Model focuses on out-of-class lectures and higher-level studies, allowing pupils to practice in the classroom. Another view of flipping the classroom implies that flipping the classroom involves pupils' first exposure to new material outside of class, such as reading or lecture videos, and then utilising class time for assimilating that complex knowledge. Izadpanah (2022) noted that the flipped classroom is a pupil-centred educational strategy that focuses on deepening understanding and creating learning opportunities in a pupil-centred manner. The Flipped Learning model allows pupils to access lessons anytime and anywhere, using trusted websites to host videos or classes, allowing them to view or visit the website. *Why Flip the Class in Primary 3*

There are several ways of flipping the class; note that each model depends on the subject and level of learners. The flipped classroom is considered a new paradigm shift in educational pedagogy. The flipped Instructional classroom is considered a new change in thinking in the educational arena since the focus is now shifting from the teacher to the pupil. The results of the 2020 study by (Strelan et al., 2020) show how the flipped classroom has transformed education through a meta-analysis that included a review of 198 studies involving 33,678 pupils. Of all these studies, three were from elementary schools, twenty-one were from secondary schools, and 174 were from post-secondary education.

Overall, the findings showed that the flipped classroom somewhat improved pupils' performance (g =.50). The flipped classroom was discipline-neutral and beneficial. To support this view, Strelan et al. (2020) cited the works of (Moravec et al., 2010), who asserted that pre-class learning could influence post-class outcomes. Several cited sources advocate for the flipped classroom model, which they view as a performance enhancer (Abeysekera & Dawson, 2014; Sakulprasertsr, 2017;

Strelan et al., 2020& Izadpanah, 2022). The flipped classroom model enhances pupils' academic achievement by encouraging active learning before class, improving in-class learning, and promoting active learning before class.

The Learner in the Flipped Classroom?

In a flipped classroom, pupils' primary duty is to engage with the course materials(Sakulprasertsr, 2017). outside of class by reading books or watching lectures that have been pre-recorded. This enables more collaborative and team-based learning in the classroom. In-person sessions require pupils to take more ownership of their education and be prepared to participate in discussions, ask questions, and work on problem-solving activities. Flipped learning encourages pupils to oversee their education (Ozdamli & Asiksoy, 2016).

However, it might be difficult for pupils accustomed to listening to lectures while seated. To learn in a flipped classroom, pupils must be able to assist themselves and collaborate. Furthermore, pupils in a flipped classroom must conduct independent research to delve deeper into the material. By the learning opportunities the teachers provide, they should also be able to develop higher-order thinking skills. Additionally, pupils in flipped classrooms actively gain knowledge by having more opportunities to participate in their lessons (Sakulprasertsr, 2017).

The teacher's role in a flipped Classroom.

The teacher serves as a facilitator within the flipped class (Ozdamli & Asiksoy, 2016). they organise material, outline homework, and create a welcoming learning environment. In Traditional teaching methods, homework is built on lessons from class discussions. In the flipped classroom, the teaching occurs online, outside the classroom, allowing pupils to explore and learn more interactively. The teacher does not provide direct instruction in a flipped classroom. Schmidt & Ralph (2014) state that in the flipped classroom, the teacher focuses on individualising learning for each pupil. Hence, the teachers take on the role of facilitators, organising the material, outlining homework, and creating a warm, inviting learning environment for the pupils to explore. Traditional teaching methods are reversed in a flipped classroom.

The Problem with Mathematics in the Primary School

There are several reasons why learners may struggle with mathematics in early grades. Firstly, some learners may have difficulty connecting math families, so they may not see the relationship between specific numbers and equations. Secondly, learners may have difficulty managing time, making completing math assignments or tests challenging. Thirdly, learners may experience math anxiety, leading to forgetting what they have learned or how to apply it when it is time to do math. Fourthly, learners may have difficulty planning and organising math activities due to quick distraction of children's attention, transportation problems, noisy places, physical conditions, and the absence of an independent garden. Fifthly, some learners may struggle with math concepts like

counting, identifying numbers, and subtracting. Lastly, studies have demonstrated that math test results for elementary pupils who fell into the lowest 25th percentile have remained unchanged.

Why flip the mathematics class

Reston (2014) asserted that educators experience pedagogical challenges when teaching elementary mathematics due to limited time. In addition, Reston listed the following: teacher inadequate training, teacher poor subject background, and child factors. Furthermore, research has proved that challenges are experienced in the mathematics classroom. For example, (Maloy and LaRoche, 2015) observed that the conventional method of teaching mathematics—characterised by little to no interaction between the teacher and the pupils- has proved ineffective. Therefore, the shortcomings of the conventional method gave rise to new methods of teaching Mathematics (Wei et al., 2020), one of which was the flipped method. Furthermore, child factors are attributed to learners' challenges in Mathematics learning. (Mogege & Egara, 2022; Nzeadibe et al., 2019; Okeke et al., 2023) cited various factors contributing to poor Mathematics performance and poor pedagogical approaches (Mogege & Egara, 2022). Factors include instructors' insensitivity when teaching mathematics, pupils' (Okeke et al., 2023) laziness and disregard for mathematical discipline, overcrowded classrooms, worn-out resources, anxiety related to mathematics, and poor instructional strategies (Mosimeki,2021). and a lack of resources for teaching and learning mathematics.

So, due to the new change in thinking, Flipping the Mathematics class proved to be enticing because it presents a new perspective on Mathematics achievement. This study developed a Model for the flipped classroom.

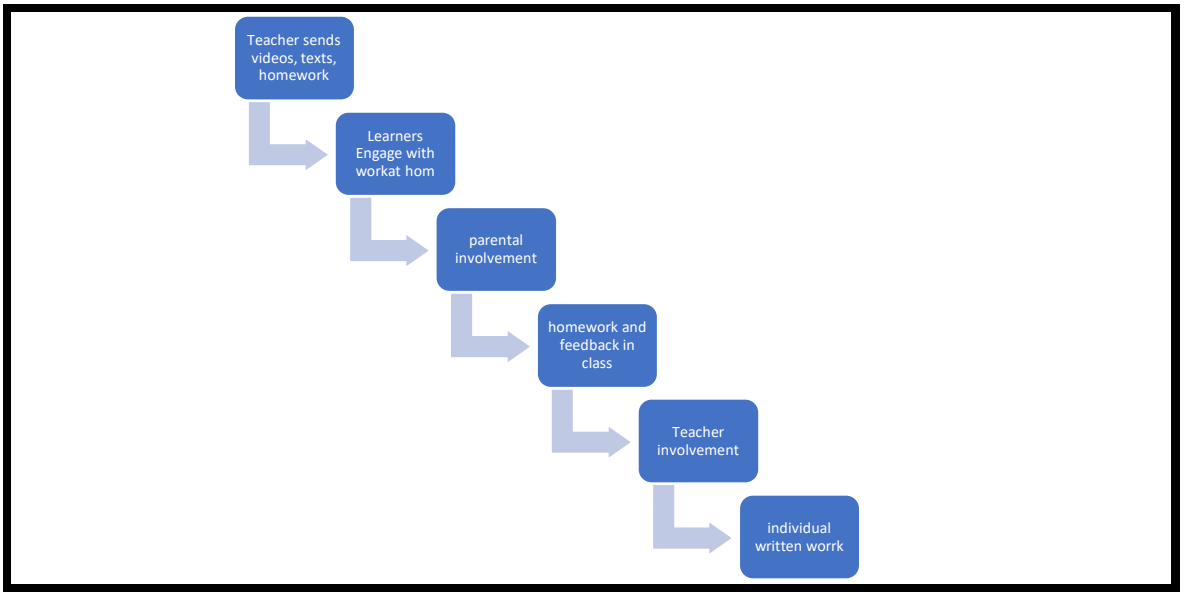

Figure 1 :The Flipped Classroom Model of the Study *Adapted from the works of (Sakulprasertsr, 2017; Strelan et al.;2020; Abeysekera & Dawson,2014; Strelan et al. 2020 & Izadpanah 2022).*

Strelan et al. (2020) observed that the flipped classroom allows pupils to engage with the lesson independently, freeing up class time for more interactive and collaborative activities. Secondly, it gives pupils more practice with problem-solving and more collaboration time with their peers. Thirdly, it allows teachers to provide more personalised guidance to pupils and increases the amount of one-on-one time between teachers and pupils. Fourthly, it promotes pupil-centred learning and collaboration, which can lead to improved academic achievement. Finally, it allows pupils to access multiple sources of information on a topic, increasing their comprehension of the subject. Overall, flipping the mathematics class can lead to better short-term pupil learning outcomes, increased pupil-teacher interaction, and more practice with problem-solving. The flipping classroom model encourages active learning, allowing pupils to progress independently and accommodate diverse learning needs, fostering a proactive attitude towards education.

The study's theoretical framework

The study's theoretical framework, the Traditional Flipped Classroom Instruction Model, is described by (Brown, 2016) as equivalent to turning the conventional teaching paradigm inside out. This approach resonates with constructivism and active learning (Strelan et al., 2020) outside the classroom. The study's theoretical framework, the Traditional Flipped Class Instructional Model, is rooted in principles like constructivism and active learning outside of the classroom (Strelan et al., 2020). The Model also advances pupil academic achievement through active participation and enhanced in-class instruction. With constructivist and active learning theories as its foundation, the Flipped Model Class theory focuses on enhancing learning by promoting active learning outside of scheduled class time. Pupils in a flipped classroom receive instruction and complete homework assignments or other tasks after school. While instructional content is delivered outside the classroom—usually through videos or internet resources—interactive activities, discussions, and problem-solving occur during class (Ozdamli & Asiksoy, 2016). This strategy works well to encourage the growth of higher-order thinking abilities. Constructivist learning theory, which holds that pupils actively construct knowledge by building on their prior experiences and understanding, is one of the critical theoretical tenets of the flipped classroom. Under a flipped classroom model, pupils work independently with the course material before class, developing building blocks for the impending lesson. By moving passive information consumption from the classroom to independent study time, the flipped classroom encourages pupils to participate actively in class through discussions (Ozdamli & Asiksoy, 2016), problem-solving, group projects, and practical exercises. There is a belief that this method improves pupils' comprehension and memory of the subject matter

Methodology:

Research Design

The study design was quasi-experimental, a quantitative research technique combining statistical analysis and numerical data collection. Although quantitative data is the cornerstone of this

methodology, qualitative data can also improve quasi-experimental research. This study used a quantitative methodology. The sample, as previously indicated, included 81 school pupils from two private primary schools. Data collection applied three designed instruments: the Mathematics Achievement Test (MAT), Traditional Flipped Classroom Instructional Guide (TFCIG), and Control Group Instructional Guide (CGIG)

Method

Procedure for study

In this study, the following procedures were taken in the Traditional Flipped Classroom Strategy Procedure: We used WhatsApp as our tool.

Step 1: Obtain School Approvals, Pupils' and Parents' Consents, and Administer Pretests.

Step 2: Use parents' contacts to create WhatsApp groups for experimental pupils.

Step 3: The researcher records video teaching sessions.

Step 4: Share the videos on the parents' WhatsApp platforms, allowing pupils access to lesson contents before the initial classroom interaction. Videos are shared over the weekend.

Step 5: The class teacher acts as the research assistant. During the initial 4-week instruction period, the teacher presents collaborative questions to explore pupils' understanding of the video content.

Step 6: Administer the post-test.

The study adopted a pretest posted control group quasi-experimental research design with a factorial design 2X2.

Table:1 Factorial Matrix 2X2 for the variable of the study

Treatment	**Gender**
Experimental	Male
	Female
Control	Male
	Female

Table 2: Design Layout

Group	**Pre-Test**	**Treatment**	**Post-Test**
Experimental	O_1	X	O_2
Control	O_1		O_2

Key:

O_1 ---------- Pre-test score for the Experimental and Control Group

X ----------Treatment for the Experimental Group

O_2 ---------- Post-test score for the Experimental and Control Group

The population of this study comprised two selected primary school pupils in Ilorin South Local Government Area of Kwara State, with the target population being three primary (3) pupils. A probability sample, utilising simple random sampling, was employed to select two (2) private primary schools. These two private schools were randomly assigned to the experimental and control groups. The experimental group received instruction using the traditional flipped classroom instructional strategy, while the control group was taught using the conventional method. The total number of pupils participating in the research was 81, three from the two selected schools.

Three research instruments were employed for data collection: the Mathematics Achievement Test (MAT), the Traditional Flipped Classroom Instructional Guide (TFCIG), and the Control Group Instructional Guide (CGIG). The questions for the Mathematics Achievement Test (MAT) were drawn from the primary three mathematics scheme of work, consisting of twenty (20) multiple-choice questions. To validate the data collection instruments, the MAT, TFCIG, and CGIG drafts were submitted to three lecturers in the Department of Adult and Primary Education at the University of Ilorin, Kwara State, Nigeria.

The reliability of MAT was assessed using the test-retest reliability method. The administration took place at a two-week interval, involving 22 primary three pupils who were not part of the study. The data collected from the two administrations were analysed using the inferential statistics of Pearson Product Moment Correlation (PPMC), resulting in a reliability coefficient of 0.75. The study spanned seven weeks, and the results were analysed by employing an Analysis of Covariance (ANCOVA) at a 0.05 significance level.

Results

Demographic Distribution of the respondents

Table 2: Distribution of participants based on group

Treatment	Total
Experimental	47
Control	34
Total	81

Table 2 presents the distribution of participants based on their randomly assigned groups in the study. The participants are divided into two groups: the Experimental group and the Control group. The experimental group consisted of 47 participants, while the control group consisted of 34 participants. The total number of participants across both groups is 81. This table provides a clear overview of how the participants are distributed between the Experimental and Control groups in the study, with the respective totals for each group explicitly stated

Research Hypothesis One: There is no significant main effect of treatment (traditional flipped classroom instructional strategy) on pupils' academic achievement in mathematics.

Table 3: Summary of ANCOVA showing the main effect of treatment on pupil's Mathematics achievement

Source	Type III Sum of Squares	do	Mean Square	F	Sig.
Corrected Model	12024.257[a]	4	3006.064	9.102	.000
Intercept	7735.828	1	7735.828	23.423	.000
Pretest	486.381	1	486.381	1.473	.229
Treatment	11485.497	1	11485.497	34.776	.000
Error	25100.731	76	330.273		
Total	328605.000	81			
Corrected Total	37124.988	80			

Table 3 above shows the main effect of treatment (traditional flipped classroom instructional strategy) on pupil's academic achievement in mathematics. ($F_{(1:76)} = 34.776$; $p < 0.05$). The hypothesis is therefore rejected in line with the results obtained since the significant value (.000) is less than 0.05 level of significance, which implies that treatment has a significant main effect on pupils' academic achievement in mathematics.

Table 4: Summary of Bonferroni's Post Hoc pairwise Comparison of the scores between the Groups

Treatment	Mean Score	Experimental	Control Group
Traditional flipped classroom strategy	70.00		*
Conventional Method	46.15	*	

The table above revealed that the pupils exposed to the traditional flipped classroom instructional strategy (had a mean score of 70.00), which reveals a significantly superior performance to the conventional group with a mean score of 46.15).

Research Hypothesis Two: There is no significant interaction effect of treatment (traditional flipped classroom instructional strategy) and gender on pupils' academic achievement in mathematics.

Table 5: Summary of ANCOVA showing the interaction effect of treatment and gender on Pupils' mathematics achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12024.257[a]	4	3006.064	9.102	.000
Intercept	7735.828	1	7735.828	23.423	.000
Pretest	486.381	1	486.381	1.473	.229
Treatment	11485.497	1	11485.497	34.776	.000
Treatment * Gender	169.949	1	169.949	.515	.475
Error	25100.731	76	330.273		
Total	328605.000	81			
Corrected Total	37124.988	80			

Table 5 shows no discernible interaction between gender and treatment on pupils' math achievement. ($p > 0.05$; $F(1:76) = .515$). Thus, the earlier hypothesis—that there is no discernible

interaction effect between treatment and gender on pupils' mathematical achievement—was maintained.

Discussion

The study's findings underscore the significant main effect of the traditional flipped classroom instructional strategy on pupils' academic achievement in mathematics. This aligns with prior research, as evidenced by (Chu et al., 2019 Wei et al. 2020, and Debbağ and Yıldız,2021), all of which reported a substantial positive impact of the flipped classroom strategy on academic performance. Additionally, the study conducted by (Alviar and Solon, 2023) specifically focused on the post-pandemic flipped classroom setting and highlighted its significant effect on the achievement of grade 10 pupils in mathematics. However, it is essential to note the contrasting perspective presented by (Müge, 2017), who found no significant main effect of the flipped classroom instructional strategy on pupils' achievement in an EFL course. These divergent results stress the nuanced relationship between instructional strategies and academic outcomes, warranting further investigation into the specific contexts and subject areas where the strategy may or may not yield significant effects.

Moving on to explore the interaction effect of treatment and gender on pupils' mathematics achievement, the study found no significant interaction effect. This finding aligns with (Sulaimon et al., 2023), who reported a lack of significant interaction effects between treatment and other variables on pupils' mathematics achievement. It is worth noting that (Obafemi et al., 2023) presented an opposing viewpoint, suggesting a significant interaction effect of treatment and gender on pupils' scholastic performance in mathematics. The variation in these findings emphasises how crucial it is to consider various factors that could affect effective instructional strategies in various learning environments. Moreover, the findings of this study coincide with the research conducted by (Alviar & Solon, 2023), indicating that gender does not significantly affect pupils' mathematics achievement in the context of the flipped classroom. However, the study by (Namaziandost & Çakmak, 2020) introduces an exciting dimension by revealing that female pupils experienced more significant improvement than their male counterparts when exposed to the flipped classroom strategy**.**

Conclusion

The study findings indicate that the traditional flipped classroom instructional strategy positively improves pupils' academic achievement in mathematics. However, the absence of a significant interaction effect between treatment and gender highlights the complexity of the relationship.

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