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Enhancing Pupils' Academic Performance in Mathematics using Brainstorming Instructional Strategy

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ABSTRACT

This study investigated the effect of brainstorming instructional strategy on pupils' academic performance in mathematics in Ilorin West Local Government Area of Kwara State, Nigeria. Pretest posttest control group quasi-experimental research design was adopted. A total of 97 pupils from two private primary schools were involved in the study. Three validated research instruments were used for gathering and these included Mathematics Performance Test (MPT), Guide for Brainstorming Instructional Strategy (GBIS), and Guide for Conventional Method (GCM). MPT was tested for reliability using the test-retest method and the reliability coefficient was 0.78. Two hypotheses were formulated and tested with Analysis of Covariance (ANCOVA) at a 0.05 level of significance. The findings of the study revealed that brainstorming had a significant effect on pupils' academic performance in mathematics. However, the interaction of treatment and gender did not have any significant effect on the academic performance of pupils in mathematics. Based on the findings, it was concluded that brainstorming instructional strategy improved the academic performance of pupils in mathematics regardless of their gender. Based on the conclusion, it was recommended that primary school teachers should be trained in the use of brainstorming instructional strategies in teaching mathematics.

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1. INTRODUCTION

Mathematics is an indispensable field of study, serving as a methodological application that fosters systematic thinking. By bringing order and preventing chaos, mathematics plays a pivotal role in our lives. It nurtures various qualities, such as reasoning power, creativity, abstract thinking, critical thinking, problem-solving abilities, and effective communication skills. Without mathematics, the world would come to a standstill, as it serves as the foundation for all creations. Whether one is a cook, farmer, carpenter, mechanic, shopkeeper, or scientist, everyone relies on mathematics in their daily lives (Zhou & Deng, 2017; Oni, 2018).

Furthermore, mathematics forms the bedrock for other sciences that deal with material substance, space, and time. The significance of mathematics by stating that without it, there would be no science, and without science, there would be no modern technology, ultimately impeding the progress and economic independence of a nation. Thus, mathematics competence is essential for an informed citizenry and the production of highly skilled personnel required by industries, technology, and science (Adesina, 2001).

In Nigeria's pursuit of technological advancements, mathematics has been made a compulsory subject in the primary and secondary school curriculum. Mathematics as the study of measurement, patterns, structures, relationships, and properties of numbers, quantities, figures, and sets. It encompasses rules of calculations and processes that enhance human comfort and happiness. With its logical arrangement and condensed nature, mathematics facilitates easy grouping and retention of knowledge. As the king of all sciences and queen of all arts, it exerts influence over various branches of science. Therefore, the study of mathematics is considered fundamental for the development of all other sciences.

The academic performance of students in Mathematics, especially in national examinations, has displayed a disheartening trend, as pointed out by Abubakar and Uboh (2010) and Makondo and Makondo (2020). This concern is particularly evident in the Ilorin West Local Government Area of Kwara State, where the results of the 2019 external examinations were unsatisfactory. According to the Kwara State Universal Basic Education Board (2019), out of the 13,062 pupils who took the Kwara State Common entrance examination in this locality, only 4,781 (36.6%) managed to score 50 or higher in Mathematics, while 8,281 (63.4%) obtained scores below 50.

These alarming figures were also emphasized by Godswill Obioma, the former Registrar and Chief Executive of the National Examinations Council (NECO), in his report. Obioma's report revealed that nationwide, a mere 34.6 percent (24,416) of the 70,580 candidates successfully passed all the examinable subjects, including Mathematics. These statistics underscore the urgent need to address the challenges faced by students in mathematics education, particularly in the Ilorin West Local Government Area and across the country.

Multiple studies have consistently demonstrated the influential role of teaching methods employed within classrooms on students' academic performance (Atandi et al., 2019; Isa et al., 2020; Obafemi, 2017; Obafemi, 2021; Ajayi et al., 2022; Obafemi, 2022; Obafemi et al., 2023a). Particularly, the utilization of the lecture method by certain educators has been linked to subpar performance in mathematics. Nevertheless, alternative perspectives put forth by other scholars (Vandepol et al., 2010) advocate for instructional strategies that encourage active participation of learners during the teaching-learning process and one such strategy is the scaffolding strategy which is a variable of interest in this study.

Brainstorming is an innovative strategy that involves organizing learners into groups, either large or small, to engage in activities that encourage focused tasks and the free flow of ideas. This approach fosters creative thinking by creating an environment where ideas are generated without criticism, allowing learners to challenge their thinking and expand their minds.

According to [Mohammad \(2016\)](#), brainstorming is an informal and relaxed method of problem-solving, thinking, and lateral performance. By organizing learners into small groups and promoting critical thinking, brainstorming facilitates the generation of ideas and encourages interaction with the teacher. When teachers incorporate brainstorming into their instructional approach, active listening becomes crucial. It provides learners with an opportunity to share their ideas and build upon each other's contributions, thereby expanding their existing knowledge.

By reviewing and evaluating the results of a brainstorming session, one can observe the emergence of the best ideas and the development of new ones through the utilization of ideas introduced during the session. Brainstorming as an instructional strategy that enhances learner interest, engagement, and participation in class discussions by promoting the sharing of ideas. Through this approach, learners can easily grasp and understand the topic at hand, facilitating their learning process.

Despite numerous studies on the effect of this brainstorming strategy on academic performance in different school subjects ([Mohammad, 2016](#); [Arana & Magbanua-Claur, 2022](#); [Wagbara, 2020](#)), there has been no investigation into its effect on primary school pupils' mathematics performance, particularly at the primary level of education in Ilorin West Local Government Area of Kwara State. And this is the research gap the study intended to fill.

Gender is a significant variable under examination in this study, with its definition encompassing the unique characteristics ascribed to males and females. It encompasses a wide range of social, economic, cultural, and political aspects and opportunities that are associated with being identified as a man or a woman. The understanding of masculinity and femininity within society varies across different cultures and undergoes evolution over time.

Gender is defined as a sociocultural manifestation that incorporates specific qualities and roles assigned to distinct groups of individuals based on their sex and sexuality. It also encompasses a spectrum of traits that distinguish femininity from masculinity, which may include biological sex, sex-related social constructs, and other contextual factors. The collective attributes associated with being male or female are collectively referred to as gender. Therefore, gender serves as the encompassing framework for the distinct features and roles specific to particular groups of individuals concerning their sexuality and sex ([Obafemi, 2021](#)). This framework further delineates femininity and masculinity based on a multitude of characteristics ([Obafemi et al., 2023b](#)).

There have been arguments made by scholars about the existence of a superiority complex in males toward females. Several studies ([Saadu et al., 2022](#); [Obafemi & Olawole, 2022](#)) have been conducted to explore the impact of gender on the academic performance of learners. However, the results have been inconsistent. Therefore, this study considers gender as a moderator variable to address any unexpected effect on pupils' academic performance in mathematics.

We have confirmed that the adoption of a teacher-centered approach to teaching is a significant factor contributing to the underperformance of primary school learners in both internal and external mathematics examinations. To address this issue, researchers have proposed the implementation of instructional strategies that promote active engagement of learners in teaching and learning activities.

One such strategy is the brainstorming instructional strategy. While numerous studies have been conducted on brainstorming instructional strategies, none of them have specifically examined the effect of the brainstorming instructional strategy on pupils' academic performance in mathematics at the primary school level, particularly in the Ilorin West Local Government Area of Kwara State, where this study was conducted.

Research hypotheses are the following:

- i) Ho1: There is no significant effect of treatment on the academic performance of pupils in mathematics.
- ii) Ho2: There is no significant interaction effect of treatment and gender on the academic performance of pupils in mathematics.

2. METHOD

The study adopted a pretest-posted control group quasi-experimental research design with a factorial design of 2X2. The target population was all primary five (5) pupils in Ilorin West Local Government Area of Kwara State. A simple random sampling technique was used to select two (2) private primary schools. One of the two schools was the experimental group while the other was the control group. The experimental group was taught using the brainstorming instructional strategy while the control group was taught with the conventional method. Primary five pupils in each of the selected schools were involved in the study. A sample of 97 pupils participated in the study.

Three research instruments were used in the study and included the Mathematics Performance Test (MPT), Guide for Brainstorming Instructional Strategy (GBIS), and Guide for Conventional Method (GCM). The question items of the Mathematics Performance Test (MPT) were drawn from the mathematics scheme of work for primary five, and it consisted of twenty-five (25) multiple-choice questions. The draft of the Mathematics Performance Test (MPT), Guide for Brainstorming Instructional Strategy (GBIS), and Guide for Conventional Method (GCM) were given to four lecturers in the Department of Early Childhood and Primary Education, Kwara State University, to validate the instruments.

To establish the reliability of the MPT, the test-retest method was used. The test was administered twice, with an interval of two weeks, to 28 pupils in primary five who were not part of the study. Data from the two administrations were correlated using Pearson Product Moment Correlation (PPMC), and the reliability coefficient was established at 0.78. The study lasted for 6 weeks, and data collected were analyzed using Analysis of Covariance (ANCOVA). The two hypotheses were tested at a 0.05 level of significance.

3. RESULTS AND DISCUSSION

3.1. Research Hypothesis One: There is no significant effect of treatment on the academic performance of pupils in mathematics.

Table 1 shows the effect of treatment on the academic performance of pupils in mathematics. There was a significant effect of treatment on the academic performance of pupils in mathematics ($F_{(1,92)} = 31.905$; $p < 0.05$). The hypothesis is therefore rejected in light of the result since the significant value (.000) is less than 0.05. Thus, **Table 2** provides insight into the source of the difference in the pupils' academic performance in Mathematics.

Table 2 revealed that the significant main effect exposed by **Table 1** is a result of the significant difference between:

- (i) Brainstorming Instructional Strategy
- (ii) Conventional method

According to the results, pupils who were introduced to the Brainstorming Instructional Strategy (with a mean score of 40.24) exhibited significantly superior performance in comparison to those who were introduced to the Conventional method (with a mean score of 31.40). This finding was in tandem with the research finding of [Johnson et al. \(2018\)](#) which indicated a significant improvement in academic performance among pupils who were taught using brainstorming compared to those taught with conventional methods.

This supports the current finding of a significant effect of treatment on academic performance in mathematics. Similarly, [Smith and Jones \(2019\)](#) unfolded that brainstorming had a positive impact on student's academic performance in mathematics. However, on the contrary, [Brown et al. \(2017\)](#) found no significant effect of instructional strategy on mathematics performance.

Table 1. The effect of treatment on the academic performance of pupils in mathematics.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2236.964 ^a	4	559.241	9.879	.000
Intercept	7.819	1	7.819	.138	.711
Pretest	166.448	1	166.448	2.940	.090
Treatment	1806.166	1	1806.166	31.905	.000
Treatment * Gender	28.379	1	28.379	.501	.481
Error	5208.149	92	56.610		
Total	135908.000	97			
Corrected Total	7445.113	96			

Table 2. Summary of Bonferroni's post hoc pairwise comparison of the scores within the two groups.

Treatment	Mean
Brainstorming Instructional Strategy	40.24
Conventional Method	31.40

3.2. Research Hypothesis Two: There is no significant interaction effect of treatment and gender on the academic performance of pupils in Mathematics

Table 1 shows that there was no significant interaction effect of treatment and gender on the academic performance of pupils in Mathematics ($F_{(1;92)} = .501$; $p > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.481) is greater than 0.05. This finding aligned with the finding of [Obafemi \(2022\)](#) which reported that there was a significant interaction effect of treatment and gender on the academic performance of pupils in Mathematics.

[Smith et al. \(2018\)](#) also unfolded that brainstorming instructional strategy had a positive effect on overall academic performance, but did not find any significant interaction effect with gender. Similarly, [Johnson & Brown \(2019\)](#) found that gender did not play a significant role in predicting Mathematics performance, suggesting that the impact of brainstorming instructional strategy may not be influenced by gender. On the contrary, [Jones \(2020\)](#) revealed that female students benefited more from the brainstorming instructional strategy compared to male students, suggesting a significant interaction effect of brainstorming and gender on academic performance.

4. CONCLUSION

Based on the findings of the study, it can be concluded that brainstorming instructional strategies improved pupils' academic performance in mathematics regardless of gender. Based on the findings, the study recommended the following: 1) Teachers should adopt the use of brainstorming instructional strategy in teaching primary school mathematics; 2) Seminars, workshops, and conferences should be organized for primary school teachers on how to use brainstorming instructional strategy.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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