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Exploration of the Effect of Scaffolding Instructional Strategy on Pupils' Academic Performance in Mathematics

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ABSTRACT

This study investigated the effect of scaffolding 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 117 pupils from two private primary schools were involved in the study. Three validated research instrument was used for gathering and these included Mathematics Performance Test (MPT), Guide for Scaffolding Instructional Strategy (GSIS), and Guide for Conventional Method (GCM). MPT was tested for reliability using the test-retest method and the reliability coefficient was 0.72. Two hypotheses were formulated and tested with an Analysis of Covariance (ANCOVA). The findings of the study revealed that treatment 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 scaffolding 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 on the use of scaffolding instructional strategy in teaching mathematics.

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1. INTRODUCTION

Mathematics education plays a crucial role in shaping students' academic achievement and their overall cognitive development (Hashim *et al*., 2021; Akino, 2023; Husnah *et al*., 2021; Marasabessy, 2021; Maryanti *et al*., 2022). The mastery of mathematical concepts and problem-solving skills not only contributes to academic success but also equips individuals with essential competencies for real-world applications. The significance of mathematical knowledge for scientific and technological progress is widely acknowledged, which in turn plays an integral role in a nation's socioeconomic development. Mathematics serves as a critical foundation for various human endeavors and is particularly crucial in the fields of science, technology, and other fundamental activities (Abubakar & Eze, 2010). In Nigeria, Mathematics is compulsory at both primary and secondary school levels, and it is a prerequisite for numerous degree programs such as education, medicine, architecture, and engineering. Mathematics plays a pivotal role in comprehending diverse subjects and languages, serving as a valuable tool for scientific disciplines and contributing to human reasoning and logical thinking. It is instrumental in our pursuit of knowledge about the world and self-understanding (Jameel & Ali, 2016).

The rapid advancement of technology has become a catalyst for societal progress, and Mathematics stands as the bedrock that underpins both technological and scientific advancements. In contemporary society, the integration of Mathematics and technology has permeated across various domains, with automation revolutionizing nearly every profession. Consequently, the acquisition of mathematical knowledge and proficiency is indispensable, as it cultivates computational skills crucial for everyday problem-solving.

Furthermore, Mathematics holds a pivotal role in higher education, serving as a foundational discipline across diverse fields of study in universities and colleges.However, despite its significance, the academic performance of students in Mathematics, particularly in national examinations, has shown a disappointing trend (Abubakar & Uboh, 2010; Makondo & Makondo, 2020). This concern is particularly evident in the Ilorin West Local Government Area of Kwara State, where the results of external examinations in 2019 were unsatisfactory. Out of the 13,062 pupils who registered for the Kwara State Common entrance examination in this local government area, only 4,781 (36.6%) achieved a score of 50 or higher in Mathematics, while 8,281 (63.4%) scored below 50 marks.

Godswill Obioma, the former Registrar and Chief Executive of the National Examinations Council (NECO), also expressed concerns about the issue. In his report, he highlighted that only 34.6 percent (24,416) of the 70,580 candidates nationwide passed all the examinable subjects, including Mathematics (see Breaking: NECO releases 2020/2021 National Common Entrance Examination results - (vanguardngr.com)).

These statistics underscore the pressing need to address the challenges faced by students in mathematics education, particularly in the Ilorin West Local Government Area and across the country.Several previous studies have indicated that the teaching method employed in classrooms has a significant impact on student's academic performance (Isa *et al*., 2020; Obafemi, 2022). Specifically, the use of a lecture method by certain teachers has been associated with poor academic performance in mathematics.

However, alternative viewpoints proposed by other scholars (Vandepol *et al*., 2010) advocated for instructional strategies that foster active participation of learners in the teaching-learning process with the guidance of the teacher or learner and one of such strategies is the scaffolding strategy which is a variable of interest in this study.

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Scaffolding has gained recognition in educational research. Scaffolding refers to a systematic instructional approach that provides temporary support and guidance to students as they engage in challenging tasks or problem-solving activities (Wood *et al*., 1976). The scaffolding strategy aims to bridge the gap between student's current abilities and the desired learning outcomes by breaking down complex tasks into manageable steps, offering prompts, modeling strategies, and providing feedback (Vandepol *et al*., 2010).

Despite numerous studies on the impact of this scaffolding instructional strategy on academic performance in different school subjects (Johnson & Jinks, 2021; Wu & Liu, 2021; Chen & Wang, 2022; Yang & Looi, 2023), there has been no investigation into its effect on primary school pupils' mathematics performance, particularly at the primary level of education. And this is the research gap the study intended to fill. Gender is another variable of interest in this study. The concept of gender refers to the unique characteristics attributed to males and females, encompassing various social, economic, cultural, and political aspects and opportunities associated with being a man or a woman. The definitions of masculinity and femininity in society vary across cultures and evolve. Ghosh from https://emedicine.medscape.com/article/917990-overview defines gender as a sociocultural manifestation that encompasses specific qualities and roles linked to particular groups of individuals based on their sex and sexuality. It also encompasses the range of traits that differentiate femininity from masculinity.

These traits may include biological sex, sex-related social constructs, and other contextual factors. Collectively, the attributes associated with being male or female are referred to as gender. Therefore, gender represents the distinct features and roles specific to particular groups of individuals concerning their sexuality and sex (Obafemi, 2021), delineating femininity and masculinity based on a variety of characteristics (Obafemi *et al*., 2023).

Some scholars argued that male possesses a superiority complex over female. Numerous studies (Ajaja & Mezieobi, 2018; Awodun & Oyeniyi, 2018; Albalawi, 2019) have been conducted to examine the effect of gender on learners' academic performance, but the findings have not been consistent. As a result, this study considered gender as a moderator variable to mitigate any unexpected effect on the academic achievement of pupils in mathematics.

The use of the teacher-centered method of teaching has been confirmed to be responsible for the poor performance of pupils in internal and external examinations in primary mathematics. The use of instructional strategies that encourage the active participation of pupils in teaching and learning activities with additional support has been suggested by researchers. A part of such strategies is scaffolding instructional strategy.

Several studies have been conducted on scaffolding instructional strategy but none of the studies examined the effect of the scaffolding instructional strategy on pupils' academic performance in mathematics at the primary school level particularly in Ilorin West Local Government Area of Kwara State where this study was carried out. Research hypotheses are the following points:

(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.

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2. METHODS

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 by scaffolding 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 117 pupils participated in the study. Three research instruments were used in the study and included Mathematics Performance Test (MPT), Guide for Scaffolding Instructional Strategy (GSIS), and Guide for Conventional method (GCM).

Mathematics Performance Test (MPT) was drawn from the mathematics scheme of work for primary five, and it consisted of twenty-five multiple-choice questions. The drafting of the Mathematics Performance Test (MPT), Guide for Scaffolding Instructional Strategy (GSIS), and Guide for Conventional Method (GCM) were given to four Lecturers in the Department of Early Childhood and Primary Education Kwara State University who validated 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 30 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 0.72. The study lasted for 6 weeks and data collected were analyzed using Analysis of Covariance (ANCOVA).

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 ($F_{(1;\ 112)} = 367.897$; $p < 0.05$). 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 2** is a result of the significant difference between the Scaffolding Strategy and the Conventional method. According to the results, pupils who were introduced to the Scaffolding Instructional Strategy (with a mean score of 42.27) exhibited significantly superior performance in comparison to those who were introduced to the Conventional method (with a mean score of 28.76).

This finding was in tandem with the research report of Johnson and Jinks (2021) which uncovered those scaffolding strategies improved student engagement and learning outcomes. Chen and Wang (2022) reported that scaffolding had a significant effect on students' learning outcomes in physics. Yang and Looi (2023) also explored scaffolding in computer science education and reported positive effects on students' collaborative problem-solving abilities. On the contrary, Smith (2019a) found that the impact of scaffolding on academic performance in mathematics was less pronounced in certain student populations, indicating the need for further investigation.

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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	5302.353[a]	4	1325.588	93.377	0.000
Intercept	11.360	1	11.360	0.800	0.373
Pretest	46.012	1	46.012	3.241	0.074
Treatment	5222.678	1	5222.678	367.897	0.000
Treatment * Gender	27.334	1	27.334	1.925	0.168
Error	1589.955	112	14.196		
Total	162000.000	117			
Corrected Total	6892.308	116			

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

Treatment	Mean
Caffolding Strategy	42.27
Conventional Method	28.76

3.2. Research Hypothesis Two: There is No Significant Interaction Effect of Treatment and Gender on the Academic Achievement 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 ($F_{(1;\,112)} = 1.925$; $p > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.168) is greater than 0.05. The finding was in support of Smith's (2019b) research findings which uncovered that the scaffolding strategy significantly improved the academic performance of both male and female students in Mathematics, with no significant gender differences observed.

Johnson and Brown (2018) demonstrated that the scaffolding intervention had a positive impact on the academic achievement of both male and female pupils, indicating gender-neutral effectiveness. Obafemi *et al*. (2023) also discovered that there was no significant interaction effect of treatment and gender on pupils' academic achievement.

Contradictory results were reported in the study by Jones (2020), where they found a significant interaction effect of treatment and gender, indicating that the scaffolding strategy had a differential impact on the academic performance of male and female students in Mathematics. Lee and Kim (2017) reported that the scaffolding strategy had a stronger positive effect on the academic performance of male students compared to female students in Mathematics.

4. CONCLUSION

Based on the findings of the study, it can be concluded that scaffolding instructional strategy improved pupils' academic performance in mathematics regardless of gender. Based on the findings, the study recommended the following:

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(i) Teachers should adopt the use of scaffolding instructional strategy in teaching mathematics;
(ii) Seminars, workshops, and conferences should be organized for primary school teachers on how to use scaffolding instructional strategy.

5. AUTHORS' NOTE

There is no conflict of interest regarding the publication of this article. The authors confirm that this article is free from plagiarism.

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