



Effect of Scaffolding Instructional Strategy on Secondary School Students' Achievement in Circle-Geometry in Keffi, Nasarawa State, Nigeria

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ABSTRACT

The study investigated the Effect of Scaffolding Instructional Strategy on Secondary School Students' Academic Achievement in Circle-Geometry in Keffi, Nasarawa State, Nigeria. The population included 1,027 students' (612 male and 415 female), with the sample size of 47 students' (24 male and 23 female) selected randomly. Quasi-experimental design, specifically a pre-test, post-test, non-equivalence control group design, was employed. The study was guided by two research questions and two null hypotheses. The Circle Geometry Achievement Test (CGAT) served as the data collection instrument, which was validated by three experts and found reliable with a reliability index of 0.82 using Kuder-Richardson formula 21 (K-R21). The instrument was validated by three experts and found reliable with a reliability index 0.82 using K-R21. Descriptive statistics (mean and standard deviation) were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the null hypotheses at a 0.05 level of significance. Results indicated that students' taught circle-geometry using the scaffolding instructional strategy achieved better than those taught using conventional method. Additionally, there was no significant difference in achievement scores between male and female students exposed to the scaffolding instructional strategy. The findings suggest that scaffolding is an effective instructional strategy for enhancing students' understanding of circle-geometry. Consequently, it was recommended that mathematics teachers should adopt activity-based methods like scaffolding to improve student achievement in circle-geometry.

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INTRODUCTION

The science of mathematics is the means to develop the thinking power and reasoning abilities, which shapes the mind and makes it creative. The development of human beings and their culture depends on the development of mathematics. It is obvious that the compulsory nature of mathematics in curriculum worldwide confirms its usefulness in the development of individuals. Malik (2017)

opined that mathematics is a unifying subject that prepares pupils for a useful and meaningful living, and that mathematics is the language and key to everyday activities of mankind in science and technology. Mathematics is a core subject in school curriculum at the primary and secondary levels in Nigeria. Among the principal branches of mathematics are arithmetic, geometry, algebra, trigonometry, calculus etc. geometry is the main focus of this study and places emphasis

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on circle theorems.

Geometry forms an important part in both basic and senior secondary school curricula. However, it is often perceived as being one of the most complex parts of the curriculum. The poor understanding by the students in this area has contributed to the low achievement in mathematics (Salami & Popoola, 2016). Although circle theorems are one of the fundamentals and beautiful concepts in geometry since it ties together several important Euclidean geometry concepts, the various theorems students have to learn have proven a challenge for them (Hissan & Ntow, 2021; Dogwi, 2014). Circle geometry focuses on the properties and relations of circle and figures associated with them. It has been noted by some researchers that circle geometry is a central aspect of geometry and is crucial to mathematics education because it is a thinking tool that helps in the development of logical reasoning and thinking which strengthens the interpretation and evaluation of mathematical arguments (Ityazau, 2019). The underachievement, according to the chief examiner for the years 2021 was as a result of poor understanding of concepts such as geometry.

Students' achievement refers to what students were able to learn in a determined period of time (Barowski, 2021). The problem of poor achievement in circle-geometry has continued to rear its head in the nation's public examinations despite the relative importance of mathematics. Irrespective of the relevance of Mathematics to individual and the nation in general, the students' performance in Mathematics both at internal and external examinations has continued to deteriorate year after year (Galadima & Okogbenin, 2012). Researchers like Ndukwe (2018), Adebayo (2010), Nwankwo (2012) and Anibueze (2017) identified a major factor responsible for the low achievement and abysmal performance of students in Mathematics as the use of inappropriate and ineffective teaching strategies.

Conventional method is a teacher-oriented and information centered approach in which the teacher works as a sole-resource in

classroom instruction. Ikide and Edit (2013) described a conventional method of teaching as a one-way communication pattern in which the teacher is the dominant figure and students' participation is virtually non-existence, rather they listen, ask questions and take notes. Scaffolding refers to a method where teachers offer a particular kind of support to students as they learn and develop a new concept or skill. The need to therefore explore appropriate instructional approaches that could enhance students' achievement in geometry has continued to be a critical issue to mathematics educators. Andrianes in Omoniyi and Torru (2018) defined educational scaffolding as a teaching method that enables students to solve a problem, carryout a task or achieve a goal through a gradual shedding of outside assistance. In education, scaffolding refers to an instructional technique used to move a student progressively towards stronger understanding and ultimately greater independence in the learning process (Omoniyi & Torru, 2018).

The finding of Onukwube and Ebele (2022), Iroko and Olaoye (2022) revealed that the use of scaffolding instructional strategy in teaching significantly enhanced achievement score of students in geometry more than the conventional lecture method. When scaffolding is properly done, students are encouraged to develop their own creativity, motivation and resourcefulness. It is support and assistance given in any learning situation when the teacher provides support structures that assist the learner to develop new understanding, skills, concepts and abilities.

Gender has become a contemporary variable for mathematics educators and researchers because of its influence on mathematics teaching, learning, interest and achievement. Based on this, many researchers at both local and international levels have documented gender differences in geometry achievement of secondary school students as inconclusive (Iji, Abakpa & Fekemo, 2013). Researchers had different view on the influence of gender on students' achievement

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as gender issues have long been a topic of educational research, particularly in the area of Mathematics which has generated a lot of conflicting and inconclusive results. Result of some studies such as (Oloda, 2017) showed significant differences in the achievement of female and male students in Mathematics, others show contrary results such as (Olasehinde & Ololaye, 2014) said that there was no significant difference in the achievement of students based on gender. This claim was equally supported by Ajai and Imoke (2015) who revealed that male and female students performed equally in Mathematics whereas, Unodiaku (2015) and Anibuze (2017) in their separate study reported that female performed better than male students. This conflicting results call for continuous investigation especially with teaching strategies like Scaffolding and Round-robin strategies to bring equity in gender achievement in mathematics.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught circle-geometry using Scaffolding instructional strategy and those taught using conventional method?
2. What are the mean achievement scores of male and female students taught circle- geometry using Scaffolding instructional strategy?

Objectives of the Study

The objectives of the study were to determine the effect of Scaffolding instructional strategy on students' achievement in circle geometry. Therefore, the specific objectives of the study are to determine the:

1. Effect of Scaffolding instructional strategy on student's achievement in circle-geometry.
2. Influence of gender on students' achievement in circle-geometry using Scaffolding instructional strategy.

Statement of the Hypotheses

Based on the objectives of the study the following null hypotheses were formulated and tested at $\alpha = 0.05$

- H01:** There is no significance difference in the mean achievement scores of students taught circle geometry using Scaffolding instructional strategy and those taught using conventional method.
- H02:** There is no significance difference in the mean achievement scores of male and female students taught circle-geometry using Scaffolding instructional strategy.

RESEARCH METHODOLOGY

This study utilized a quasi-experimental research design characterized by a pre-test, post-test, non- equivalent, non-randomized control group approach. The population consisted of 1,027 (612 male and 415 female) Senior Secondary II students. From the population, a sample of 47 students' (24 male and 23 female) was selected. The primary instrument for data collection was the Circle Geometry Achievement Test (CGAT). This instrument was validated by three experts: two in Mathematics Education, National Open University Abuja, and one in Measurement and Evaluation, Nasarawa State University, Keffi. The average rating from these three validators resulted in a logical validity index of 0.79, indicating that the instrument was suitable for data collection. For data analysis with a reliability index of 0.82 using Kuder-Richardson formula 21 (K-R21), descriptive statistics (mean and standard deviation) were employed to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

RESULTS

Research Question 1: What are the mean achievement scores of students taught circle-geometry using Scaffolding instructional strategy and those taught using conventional method?

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Table 1: Mean Achievement Scores and Standard Deviation of Secondary Students' taught Circle-Geometry in Experimental and Control Groups

Strategies	N	Pretest		Posttest	
		MEAN	SD	MEAN	SD
Scaffolding	47	11.81	2.071	23.46	1.843
Conventional Method	45	13.02	1.889	19.47	1.878
TOTAL	92				

Table 1 showed that the pretest mean achievement score and standard deviation of students in scaffolding group was (11.81, 2.071) and posttest mean achievement score and standard deviation was (23.68, 1.843), while the pretest and posttest mean achievement scores and standard deviation of their counterparts taught using conventional method was (13.02, 1.889) and (19.47, 1.878).

Hypothesis 1

HO1: There is no significance difference in the mean achievement scores of students taught circle-geometry using Scaffolding instructional strategy and those taught using Conventional method.

Table 2: ANCOVA Results on Secondary Students' Achievements Scores of Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	370.932 ^a	2	185.466	48.540	.000
Intercept	928.985	1	928.985	243.134	.000
Pretest		2.8451	2.845	.745	.391
Strategies	354.482	1	354.482	92.775	.000
Error	340.057	89	3.821		
Total	43281.000	92			
Corrected Total	710.989	91			

a. R Squared = .522 (Adjusted R Squared = .511)

Table 2. Shows an F - ratio of 92.775 was obtained with associated exact probability value of 0.000. ($F(2, 92) = 92.775$; $P = .000 < .05$) since the associated probability (.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the SIS produced a significant effect on the post-test achievement scores of students when covariate effect (pre-test) was controlled. This reveals a significant

difference in the mean achievement scores of mathematics students exposed to SIS and CM Hence, there was a significant difference between the two groups.

Research Question 2: What are the mean achievement scores of male and female students taught circle-geometry using Scaffolding instructional strategy?

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Table 3: Mean Achievement Scores and Standard Deviation of Students' taught Circle Geometry using Scaffolding Instructional Strategy Based on Gender

Gender	N	Pretest		Posttest	
		MEAN	SD	MEAN	SD
Male	24	11.79	2.000	23.79	1.909
Female	23	11.83	2.188	23.43	1.779
TOTAL	47				

Table 3: showed the pretest and posttest mean achievement score and standard deviation of students taught circle geometry using Scaffolding strategy in terms of gender, male was (11.79, 2.00) and (23.79, 1.909) and female was (11.83, 2.188) and (23.43, 1.779).

Hypothesis 2

HO2: There is no significance difference in the mean achievement scores of male and female students taught circle-geometry using Scaffolding instructional strategy.

Table 4: Results of ANCOVA on SSII Students' Achievement on CGAT and SIS on Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	18.242 ^a	2	9.121	2.909	.065	.117
Intercept	569.464	1	569.464	181.607	.000	.805
Pretest	15.515	1	15.515	4.948	.031	.101
GenderScaff	2.837	1	2.837	.905	.347	.020
Error	137.970	44	3.136			
Total	26513.000	47				
Corrected Total	156.213	46				

a. R Squared = .117 (Adjusted R Squared = .077)

Table 4 shows an F – ratio = 0.905 with associated exact probability value of 0.347 which is greater than the bench mark probability value of 0.05 ($F(1, 44) = 0.905; P = .347 > .05$). This indicates that there was no significant difference in the mean achievement scores of male and female students exposed to SIS. The null hypothesis was therefore not rejected.

DISCUSSION OF FINDINGS

The findings of this study revealed that the Scaffolding Instructional Strategy (SIS) significantly improves the teaching and learning of circle geometry. Specifically, there was a notable difference in academic performance between students taught using SIS and those taught through conventional methods, with SIS proving to be more effective. These results are consistent with earlier studies by Onukwube and Ebele (2022), Iroko and Olaoye (2022), and Kayode, Yahaya, Francis, and Taiye (2024),

which found that students taught subjects such as Mathematics, Chemistry, Biology, Physics, and Basic Science using SIS achieved better results compared to those taught with traditional methods. The enhanced performance in the treatment groups can be attributed to a well-structured instructional approach, a supportive learning environment that encouraged collaboration, and increased student engagement in learning activities. The SIS approach empowered students to take ownership of their learning, promoting cognitive development. This aligns with Vygotsky's (1978) theory that knowledge is constructed through social interactions and active participation in the learning process.

Additionally, the study found no statistically significant differences in achievement between male and female students within the SIS group. This finding is consistent with the research of Uchenna and Ekwutosi (2022) and Uduafemhe

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(2015), who also reported no significant gender-based differences in achievement. However, it contrasts with the findings of Akani (2015), who observed that male students outperformed female students when taught using scaffolding instruction.

The absence of significant gender differences in achievement within the SIS group further supports the effectiveness of this strategy in promoting equitable learning outcomes. This finding aligns with the works of Uchenna and Ekwutosi (2022) and Uduafemhe (2015), who found no significant gender disparity in academic performance. However, it diverges from Akani's (2015) conclusion that male students achieved better results than female students under scaffolding instruction.

CONCLUSION

The implementation of the Scaffolding Instructional Strategy in teaching circle geometry has shown a positive impact on both gender inclusivity and academic achievement among students in Keffi, Nasarawa State, Nigeria. This highlights the importance of adopting innovative teaching strategies in the classroom to cater to the diverse learning needs of students. By fostering an environment that encourages active participation, collaboration, and student-centered learning, educators can significantly enhance learning outcomes and bridge gaps in academic performance. The study underscores the potential of SIS as a transformative tool in mathematics education, particularly in challenging topics like circle geometry.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made.

1. Implementation of Scaffolding Instructional Strategy: Educators in Keffi, Nasarawa State, and similar settings should consider adopting SIS as a means to improve academic outcomes in mathematics particularly in topics like circle geometry.
2. Teacher Training: Continuous professional development programmes should be

organized to train teachers on how to effectively implement scaffolding strategies in their classrooms. This will ensure that they can maximize the benefits of this instructional approach.

3. Gender-Sensitive: while this study found no significant gender differences in achievement, educators should continue to employ gender-sensitive teaching methods to ensure that both male and female students' benefits equally from instructional strategies like scaffolding.
4. Curriculum Development: Educational policymakers and curriculum developers should incorporate scaffolding instructional strategy into mathematics curriculum, ensuring that this technique is part of the standard teaching practice.
5. Further Research: Additional research should be conducted to explore the long-term effect of scaffolding instructional strategy on student achievement across different subjects and educational levels. This would help to generalize the effectiveness of this approach in various academic contexts.

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