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Effect of 7es Instructional Strategy on the Academic Achievement and Retention of Secondary School Students in Mathematics in Niger State, Nigeria

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Abstract

The study examined the effect of the 7Es instructional strategy on the academic achievement and retention of secondary school students in Mathematics in Niger State, Nigeria. The study was guided by three specific objectives with corresponding research questions and hypotheses. The design for the study was a quasi-experimental pre-test, post-test, non-equivalent control group design. The population comprised SS II Mathematics students in public secondary schools in Niger state. Two intact classes were purposively sampled and randomly assigned to experimental and control groups. The experimental group was taught using the 7Es instructional strategy, while the control group was taught using the conventional teacher-centered method. The instrument for data collection were the Mathematics Achievement Test (MAT) and Mathematics Retention Test (MRT). Data were analyzed using descriptive statistics to answer the research questions while independent sample t-test was used to test the null hypothesis at 0.05 level of significance. Findings revealed no significant difference in the pre-test scores, indicating baseline parity. However, the post-test and retention results showed that students taught with the 7Es strategy significantly outperformed those in the control group. The study concluded that the 7Es strategy is a potent tool for enhancing performance and long-term memory in Mathematics. It was recommended that Mathematics teachers in Niger State should move away from the over-reliance on conventional lecture methods and adopt the 7Es instructional strategy to improve students' performance and retention.

Keywords: **Home** Effect, 7Es Instructional Strategy, Achievement, Retention, Mathematics

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INTRODUCTION

In the Nigerian secondary school curriculum, Mathematics is one of the core subjects to all the students and academic subject essential for scientific, technological, and socio-economic advancement. The Federal Government of Nigeria (2014) in the National Policy on Education stated that the objectives of mathematics education are to provide students with skills required for self-reliance, promote national security, and provide students' knowledge and skills required for critical thinking and creativity for economic growth. Despite these national goals, academic achievement in Mathematics has remained consistently low in public secondary schools in Niger State. According to Chief Examiners' reports from WAEC and NECO, average credit pass rates between 2020 and 2025 remained below 45%. Local investigations by researchers in the state further reveal a downward trend in performance, specifically showing a decline from 45% in 2021 to 39% in 2023. These alarming trends pose a threat to the academic career of secondary school students in the state. Empirical evidence from scholars such as Damina, Bapeto, and Ibrahim (2026) suggests that a major factor contributing to this decline is the continued over-reliance on conventional teacher-centered instructional strategies. It was also reported by Aliyu, Adamu, and Bashir (2021) that the traditional method usually used in teaching students across secondary schools in Nigeria is often encourage rote memorization while stifling student engagement and failing to accommodate diverse cognitive learning styles. Scholars like Adamu, Bashir, and Haruna (2015) also argue that such approaches discourage meaningful learning and are inadequate for the complexities of modern Mathematics. Consequently, there is an urgent need to transition toward student-centered, innovative pedagogical models like the 7Es strategy (Bybee, 2015). The 7Es instructional strategy is an evolution of the learning cycle model that emphasizes active participation through seven phases: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. Bybee (2015) stated that 7Es instructional model allows students to bridge the gap between prior knowledge and new scientific concepts, preventing misconceptions from persisting. The study conducted by Balta and Sarac (2016), a meta-analysis shows that students taught via the 7Es strategy consistently outperformed those in teacher-centered classrooms with a large effect size. Despite this global success, there is a dearth of empirical data specifically focusing on the public secondary schools of Niger State. Furthermore, while the model has been tested in Biology, a subject-specific gap exists regarding its application to Senior Secondary Mathematics in the Nigerian context. This study, therefore, sought to provide the empirical proof needed to justify a pedagogical shift in the state. Specifically, the study sought (1) determine the pre-test mean achievement scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method to establish baseline parity; (2) ascertain the difference in the post-test mean achievement scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method; and (3) determine the difference in the mean retention scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in the pre-test mean achievement scores of students in the experimental group (7Es) and the control group (conventional method)?
2. What is the difference in the post-test mean achievement scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method?
3. What is the difference in the mean retention scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method?

Research Hypotheses

The following null hypotheses were formulated and will be tested at a 0.05 level of significance:

1. There is no significant difference in the pre-test mean achievement scores of students in the experimental and control groups.
2. There is no significant difference in the post-test mean achievement scores of students taught Mathematics using the 7Es instructional strategy and those taught using the conventional method.
3. There is no significant difference in the mean retention scores of students taught Mathematics using the 7Es instructional strategy and those taught using the conventional method.

METHODOLOGY

The study adopted a quasi-experimental research design utilizing pre-test, post-test, and non-equivalent control groups. This design was deemed appropriate by the researchers for evaluating the causal effects of the 7Es strategy in a real-world classroom setting where full randomization is not feasible. The study was conducted in public secondary schools in Niger State, Nigeria. The target population consisted of all the SS II students offering Mathematics in the 2024/2025 academic year in Niger state. Following the sampling technique used by Damina et al. (2026), two intact classes totaling 116 students were purposively selected, with 57 students assigned to the experimental group and 59 to the control group. The instrument used for data collection was the Mathematics Achievement Test (MAT), a 25-item multiple-choice test adopted from standardized WAEC and NECO past examinations to ensure validity. For the measurement of retention, the Mathematics Retention Test (MRT) was administered, consisting of the same items as the MAT but with reshuffled options. The data collection followed a structured procedure similar to that described by Aliyu et al. (2021). Pre-tests were administered to both groups to establish baseline parity, followed by a four-week treatment period. During this period, the experimental group was taught using the 7Es instructional cycle, while the control group was taught using conventional teacher-centered methods. The post-test was administered immediately after the treatment to measure immediate achievement, while the retention test followed two weeks later. According to the methodological framework, the same teacher administered the content in each group to minimize teacher-variable bias. The data collected were analyzed using descriptive statistics to answer research questions. As specified by Damina et al. (2026), independent samples t-tests were used for the first two hypotheses, while a paired samples t-test evaluated internal progress and retention. All hypotheses were tested at a 0.05 level of significance. The analysis was done using the Statistical Package for Social Science (SPSS) version 23.

RESULTS

Research Question One: What is the difference in the pre-test mean achievement scores of students in the experimental group (7Es) and the control group (conventional method)?

Table 1: Difference in the pre-test mean achievement scores of students in the experimental group and the control group

Group	N	Mean	Std. Deviation	Mean difference
Experimental	57	29.46	15.72	.951
Control	59	30.41	15.023	

The results of the data used to answer on the difference in the pre-test mean achievement scores of students in the experimental group and the control group, the results in Table 1 reveal that the experimental group (N=57) had a mean score of 29.46 with a standard deviation of 15.72, while the control group (N=59) had a mean score of 30.41 with a standard deviation of 15.023. This resulted in a mean difference of 0.95 in favor of the control group. This very narrow margin suggests that before the commencement of the treatment, students in both groups possessed nearly identical entry-level knowledge and baseline academic proficiency in Mathematics.

Research Question Two: What is the difference in the post-test mean achievement scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method?

Table 2: Difference in the post-test mean achievement scores of students in the experimental group and the control group

Group	N	Mean	Std. Deviation	Mean difference
Experimental	57	50.72	16.09	-18.84
Control	59	31.88	18.123	

The descriptive statistics for research question two in Table 2 which examined the difference in the post-test mean achievement scores after the intervention, Table 2 indicates that the experimental group taught using the 7Es strategy achieved a mean score of 50.72 with a standard deviation of 16.09. In contrast, the control group taught using the conventional method recorded a mean score of 31.88 with a standard deviation of 18.123. The resulting mean difference of 18.84 in favor of the experimental group suggests that the 7Es instructional strategy had a substantial impact on students' immediate academic performance compared to the traditional teacher-centered approach.

Research Question Three: What is the difference in the mean retention scores of students taught Mathematics using the 7Es strategy and those taught using the conventional method?

The results of research question three presented in Table 4 which focused on the difference in mean retention scores, the data show that the experimental group maintained a mean score of 48.89 with a standard deviation of 15.01, while the control group recorded a mean score of 29.01. This yielded a mean difference of 19.88. This result indicates that students exposed to the 7Es strategy were able to retain mathematical concepts much more effectively over time than those in the control group, who showed a significant decline in their scores during the retention period.

Table 3: Difference in the retention mean achievement scores of students in the experimental group and the control group

Group	N	Mean	Std. Deviation	Mean difference
Experimental	57	48.89	18.900	19.81
Control	59	29.01	18.900	

Hypothesis One: There is no significant difference in the pre-test mean achievement scores of students in the experimental and control groups.

The independent sample t-test in Table 4 shows that there was no significant difference in the pre-test mean achievement scores of students in the experimental and control groups, was tested using an independent samples t-test. The analysis disclosed the t-value of 0.333 at 114 degrees of freedom yielded a p-value of .740. Since the p-value is greater than the 0.05 level of significance, the null hypothesis was accepted. The conclusion drawn is that the difference in the baseline performance of the two groups was not significant, confirming that the groups were academically equivalent at the start of the study.

Table 4: Independent T-Test in The Pre-test Mean Achievement Scores of Students in the Experimental Group and the Control Group

Group	N	Mean	Std. Deviation	df	t	P-value
Experimental	57	29.46	15.72	114	.333	.740
Control	59	30.41	15.023			

Hypothesis Two: There is no significant difference in the post-test mean achievement scores of students taught Mathematics using the 7Es instructional strategy and those taught using the conventional method.

The test of null hypothesis two documented in Table 5 disclosed that there was significant difference in the post-test mean achievement scores between the two groups, was also subjected to an independent t-

test. Table 5 shows a t-value of -5.925 at 114 degrees of freedom with a p-value of .000. Because the p-value is less than the 0.05 alpha level, the null hypothesis is **rejected**. This signifies a statistically significant difference in achievement, with the 7Es group performing remarkably better. The magnitude of this difference was significant, indicating that the 7Es strategy is a highly effective pedagogical tool for enhancing Mathematics achievement in Niger State.

Table 5: Independent T-test in the Post-test Mean Achievement Scores of Students in the Experimental Group and the Control Group

Group	N	Mean	Std. Deviation	Df	t	P-value
Experimental	57	50.72	16.09	114	-5.925	.000
Control	59	31.88	18.123			

Hypothesis Three: There is no significant difference in the mean retention scores of students taught Mathematics using the 7Es instructional strategy and those taught using the conventional method.

Table 6: Independent T-test in the Retention Mean Achievement Scores of Students in the Experimental Group and the Control Group

Group	N	Mean	Std. Deviation	Df	t	P-value
Experimental	57	48.89	15.01	114	-6.283	.000
Control	59	29.01				

The outcome for the test of null hypothesis three suggested that there was no significant difference in the mean retention scores of students taught via the 7Es strategy and those taught using the conventional method, was tested as well. The results in Table 6 show a t-value of -6.283 at 114 degrees of freedom and a p-value of .000. Since the p-value is significantly lower than 0.05, the null hypothesis was rejected. The findings reveal that the difference in retention was significant, proving that the 7Es instructional strategy significantly improves long-term memory and conceptual stability in Mathematics. Therefore, the strategy is not only effective for immediate learning but also essential for ensuring that students retain what they have been taught.

DISCUSSION

The results of research question one and the test of corresponding null hypothesis one showed that there were trivial differences in the pre-test mean academic achievement of students in the experimental and control groups. This was statistically confirmed as the p-value of .740 was greater than the 0.05 level of significance, leading to the acceptance of the null hypothesis. This finding implies that the two groups of students were academically equivalent in their mathematical knowledge prior to the treatment. This finding concurred with that of Aliyu, Adamu, and Bashir (2021), who found no significant difference in the pre-test mean scores of students in their study on instructional strategies in North-Western Nigeria. Similarly, Mustapha and Aminu (2023) reported baseline parity in their research on secondary school chemistry students. Furthermore, Umate (2018) observed that pre-testing is essential to confirm that any later gains are due to the treatment rather than pre-existing differences. Finally, Damina, Bapeto, and Ibrahim (2026) corroborated this by showing that students in public secondary schools often share similar baseline challenges in science-related subjects. The results of research question two and the test of null hypothesis two revealed a significant difference in the post-test mean achievement scores between the students taught with the 7Es strategy and those taught using the conventional method. With a p-value of .000, the null hypothesis was rejected, indicating that the 7Es strategy is a highly effective pedagogical tool for enhancing Mathematics achievement. This finding is consistent with the work of Balta and Sarac (2016), whose meta-analysis established that the 7E learning cycle significantly boosts instruction and academic performance. It also aligns with Bybee (2015), who argued that the 7Es model creates "teachable moments" that lead to superior mastery of content. In the Nigerian context, Aliyu et al. (2021) also found that student-centered learning cycles lead to higher achievement in quantitative subjects compared to lecture methods. Sibel and Sabiha (2016) further supported this by demonstrating that active learning models provide a structured path to academic excellence.

Additionally, Adamu, Bashir, and Haruna (2015) found that cooperative and constructivist strategies are more effective in engaging Nigerian students in complex problem-solving tasks. The results of research question three and the test of null hypothesis three showed that the experimental group achieved a significantly higher mean retention score compared to the control group. The rejection of the null hypothesis ($p<0.05$) proves that the 7Es strategy significantly improves long-term memory and conceptual stability. This finding is supported by Umate (2018), who asserted that the "Extend" and "Elaborate" phases of the 7Es model are critical for strengthening cognitive retention. Mustapha and Aminu (2023) also reported that students exposed to active application techniques retain information longer than those in teacher-centered environments. Similarly, Obinna and Adebayo (2021) found that the constructivist approach leads to deeper cognitive engagement, which is essential for knowledge sustainability. Alhadaybeh and Ambusaedy (2016) highlighted that reflective thinking and active exploration inherent in the 7Es lead to better retention of science concepts. Osama, Fahad, and Ayman (2016) concluded that innovative learning models significantly improve students' attitudes and memory regarding quantitative concepts.

CONCLUSION

Based on the findings of this study, it is concluded that the 7Es instructional strategy is effective method for improving the academic achievement and retention of secondary school students in Mathematics in Niger State than the conventional teacher-centered approach. While students began with similar academic proficiencies, the 7Es strategy facilitated a very large improvement in both immediate academic achievement and long-term retention of mathematical concepts. The strategy succeeds because it encourages students to elicit prior knowledge and extend their learning to new contexts, thereby addressing the alarming failure rates in the state and providing a meaningful learning.

RECOMMENDATIONS

Based on the findings and conclusion of this study, the following recommendations are made:

1. Mathematics teachers in Niger State should move away from the over-reliance on conventional lecture methods and adopt the 7Es instructional strategy to improve students' performance and retention.
2. The Niger State Ministry of Education and other stakeholders should organize intensive training workshops and seminars to equip Mathematics teachers with the necessary skills to implement the 7Es instructional strategy effectively.
3. Curriculum planners and school administrators should encourage the development of Mathematics lesson plans and textbooks that are structured around the 7Es learning cycle to promote active student participation and sustainable learning.

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