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Effect of Mind-Mapping Instructional Strategy on Students' Achievement in Mathematics in Ogun State, Nigeria.

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Abstract

Several studies have shown that using mind mapping as an approach to teaching Mathematics has a more positive impact on student achievement than traditional approaches. However, these studies did not address the effect of mind mapping in other countries, such as Nigeria, at a secondary school level; they focused more on digital mind–mapping for pre-service teachers. This study examined how students' mathematics achievement in Ogun State, Nigeria, was affected by the mind mapping instructional technique. Non-randomized pre-test post-test control group design, or quasi-experimental non-equivalent group research design, was used. A simple random sample technique was used to assign one school to the experimental group and another school to the control group. The data required for the study was collected using the Mathematics Achievement Test, which has a reliability coefficient of 0.87 according to the Kuder-Richardson formula 20 (KR20). Four hypotheses were tested at the 0.05 significant level of significance using independent sample t-test analysis. The analysis's findings showed that there is a significant improvement in achievement of students and no gender difference when mind-mapping was used as strategy. Since the mind-mapping teaching strategy was the key factor in students' improved achievement, we may conclude from the study that using it by mathematics teachers can raise students' mathematics achievement.

Keywords: Mind-mapping, Strategy, achievement, mathematics.

INTRODUCTION

Mathematics serves as a model for problem-solving, scientific structure development, conclusion-making, and thought processes [1]. Perhaps the fact that mathematics is now required in secondary schools is a reflection of its significance. However, Mathematics is one of the subjects that students less favor, and students do not perform well in this subject due to several factors. Numerous elements, such as instructional methods, motivation, and attitude, are linked to students' subpar performance in mathematics [2]. [3] Further noted that the underachievement witnessed among most of the learners in various subjects is usually associated with the use of various teaching methods that are considered ineffective such as lecture methods. Thus, teachers need to be acquainted with instructional strategies that enhance students' achievement.

While modern methods of learning mathematics encourage the process of exchanging ideas and incorporating those of others, traditional methods of learning mathematics focused on the teacher-centered approach, in which teachers would typically provide input and students would primarily absorb and memorize the knowledge. Though there is no assurance that knowledge will be retained, traditional teaching techniques like lecturing or using a chalkboard are among the best ways to impart knowledge to students. According to [2] mathematics instruction still follows the traditional pattern, which has been deemed insufficient and a significant contributing factor to pupils' subpar performance in the subject. According to [4], mind maps and other visual teaching techniques may improve student learning. In light of this, the current study examined how the mind-mapping technique affected the mathematical achievement of students in Ogun State, Nigeria.

According to [5] a mind map is a diagram in which information is arranged visually and sequentially. The main tenet of mind mapping is that by utilizing all of our visual and sensory resources, we may comprehend and recall information more readily. Our learning toolkit includes images, sounds, color, and even touch and smell, which help us retain information for extended periods of time [6]. The key is to create mind maps that maximize these factors, enhancing each person's creativity, critical thinking, and ability to connect concepts that are already present in their own thoughts. Recent research indicates that information conveyed through graph charts has a powerful mental impact. In light of this, educators must to make an effort to illustrate ideas and show them to their pupils [7]. Learner-centered teaching methods are more effective and are strongly recommended since they appear to support the concept of discovery learning, according to [8]. In fact, the majority of educators today appear to employ learner-centered strategies, which are linked to increased student motivation, engagement, contentment, and critical thinking as well as improved academic performance [9].

In the thematic field of educational research, the effectiveness of instructional practices on students' learning has consistently generated significant interest [10]. Modern technology is now included into the majority of instructional strategy, and this has been linked to improvements in the learning environment. The primary goal of instruction at all educational levels is to significantly alter students' behavior in right direction. Learner performance is adversely affected by these ineffective techniques. Furthermore, a significant body of research indicates that teachers' teaching strategy typically influence students' performance in a given subject [3]. Therefore, the researchers suggested that teachers should choose instructional strategies that are most appropriate for the subject being studied in order to bring about the desired positive changes in students.

In several nations, there has been evidence of a widening gender difference in educational attainment during the past few decades. Inequalities in curriculum, subject disciplines, enrolment, opportunity, and access are all caused by gender prejudice in education. According to a study of research, there are differences between the performance of male and female pupils on mathematical achievement tests and public exams. Prior research found that male students outperformed female students in mathematics [11]. Additionally, results from other research indicate that there are no appreciable disparities in math exam scores between male and female students. Achor, [12] discovered that female students outperformed male students in mathematics, which runs counter to these reports. Due to the interplay of masculinity and femininity given to mathematics, gender is also acknowledged to have a significant influence on students' comprehension of mathematical topics when taught using a variety of teaching methodologies [13], [14]. Interactions between

learners' physical, psychological, and physiological characteristics, especially their learning style, have been connected to gender disparities in academic attainment in a number of research areas [6]. Therefore, the researchers believed it was essential to investigate the relationship between secondary school students' academic success in mathematics and teachers' use of the mind mapping instructional strategy. Notwithstanding the numerous assertions and rebuttals made by mathematic researchers regarding the method, the feasibility of the mind-mapping approach in math classrooms has not been extensively empirically verified, despite the fact that it has been widely supported and used in the social sciences, arts, and sciences. Therefore, it is necessary to conduct an empirical investigation on the viability of these approaches in the teaching and learning of mathematics in Nigerian senior secondary schools.

The following hypotheses serve as the basis for this study: (i) There is no significant difference between the experimental and control groups' academic performance of the students before the intervention (ii) After the intervention, there is no significant difference between the experimental and control groups' academic performance of the students (iii) There is no significant difference between the experimental and control groups' academic performance of male and female students before the intervention. (iv) There is no significant difference between the experimental and control groups' academic performance of male and female students after the intervention.

MATERIALS AND METHODS

Research design

The design of this study is quasi-experimental design of non-equivalent pretest, posttest, control design.

Table 1: Matrix design of the study

Groups	Pre-test	Intervention	Post-test
Mind-mapping	P1	X*	P2
Conventional	P1	X**	P2

Where P1 stands for the experimental and control group's pre-test.
The post-test for the experimental and control groups is P2.
X* is the experimental group's treatment.
X* is the control group's treatment
The researchers manipulated the independent variable; that is teaching strategy and observe the effect on the students' achievement and gender.

Population of the study

All senior secondary two (SS 2) mathematics students in Ogun-East Senatorial District, Ogun State, Nigeria, made up the study's population.

Sample and sampling technique

The study's sample consists of sixty (60) SSS2 students selected from two (2) different schools. A multi-stage sampling approach was used because the sample was done in phases. First, two secondary schools from

Ogun State, Nigeria's Ogun-East Senatorial District were chosen using a purposive sample technique. A stream of SSS2 classes was chosen from each of the two schools using a random selection technique. The Random Sampling Technique was used to choose thirty students for the experimental and control groups. There were thirty (30) male and thirty (30) female that took part in the study. One intact class from each sampling school was split into experimental and control groups at random. While the control group was exposed to a traditional teaching style based on a conventional approach, the treatment group was exposed to a mind mapping strategy.

Instrument for Data Collection

The researchers employed the Mathematics Achievement Test (MAT) as the instrument for gathering data. The MAT was utilized as an achievement test to gauge pupils' mathematical proficiency. The MAT had four (4) alternatives and fifty (50) multiple-choice questions. The researchers created a test blueprint, or table of specifications, to assist the test development process for building MAT. Using the SSS2 curriculum standards as a basis, the table of specifications was created. Experts in mathematics education, measurement, and evaluation validated Mathematics Achievement Test. Two classes of SSS2 students from a school in Ogun-East Senatorial District of Ogun State, Nigeria, who were not included in the sample, were utilized by the researchers to trial test the instrument in order to assess its reliability. The Kuder Richardson formula 20 (K-R20), which has a coefficient of 0.87, was used to determine the reliability of MAT. Descriptive statistics (mean and standard deviation) and inferential statistics (independent sample t-test) were used to examine the data at the 0.05 level of significance.

RESULTS AND DISCUSSION

Results

Hypothesis one: There is no significant difference between the experimental and control groups' academic performance of the students before the intervention.

Table 2: Independent sample t-test analysis comparing the achievement of the students in the mind-mapping and traditional method of teaching before the intervention.

Test	Strategies	N0	Mean	Std. dev	Mean Diff	Df	95% confidence Interval of the difference		T	P-value
							Lower	Upper		
Pre-Test	Mind-mapping	30	19.43	3.664	.567	58	-1.344	2.478	.594	.555
	Traditional	30	18.87	3.730			-1.344	2.478		

Prior to the intervention, the mathematics achievement of the experimental class (mean = 19.43; standard deviation = 3.664) was quite similar to that of the class taught using the regular technique (mean = 18.87; standard deviation = 3.730). Furthermore, the mean difference in the class following the two groups'

intervention is 0.567. For the experimental and conventional teaching methods, the 95% CIs were [-1.344 to 2.478] and [-1.344 to 2.478], respectively. Before the intervention, there was no significant difference in the students' level of mathematical achievement, according to Table 2 data (p-value < 0.555, df = 58, p < 0.05).

Hypothesis two: There is no significant difference between the experimental and control groups' academic performance of the students after the intervention

Table 3: Independent sample t-test analysis comparing the achievement of the students in the mind-mapping and traditional method of teaching after the intervention.

Test	Strategies	N0	Mean	Std. dev	Mean Diff	Df	95% confidence Interval of the difference		T	P-value
							Lower	Upper		
Post-Test	Mind-mapping	30	26.00	4.533	6.300	58	4.390	8.210	6.602	.000
	Traditional	30	19.70	2.602			4.379	8.221		

Following the intervention, students in the experimental class performed significantly better in mathematics (mean = 26.00; standard deviation = 4.533) than those in the usual teaching method class (mean = 19.70; standard deviation = 2.602). Furthermore, there is a 6.300 mean difference in the class following the two groups' intervention. 95% CI [4.390 to 8.210] for the experimental approach and 95% CI [4.379 to 8.221] for the conventional approach. The results of Table 3 showed that the students' level of mathematical achievement changed significantly following the intervention (p-value < 0.000, df = 58, p < 0.05).

Hypothesis three: There is no significant difference between the experimental and control groups' academic performance of male and female students before the intervention**.**

Table 4: Independent sample t-test analysis comparing the achievement of the students in experimental group in terms of gender before the intervention.

Test	Strategies	N0	Mean	Std. dev	Mean Diff	Df	95% confidence Interval of the difference		T	P-value
							Lower	Upper		

Pre-Test	Male	14	20.00	4.523	1.06	58	-3.828	1.703	.787	.438
	Female	16	18.94	2.768			-3.960	1.855		

Prior to the intervention, the achievement of the male students (mean = 20.00; standard deviation = 4.53) was quite similar to that of the female students (mean = 18.94; standard deviation = 2.768). Furthermore, the gender mean difference in the class is 1.06. For males, the 95% CI was [-3.828 to 1.703], and for females, it was [-3.960 to 1.855]. Prior to the intervention, there was no discernible difference in student accomplishment between the male and female genders, according to Table 4 data (P-value <.438, df = 58, p < 0.05).

Hypothesis four: There is no significant difference between the experimental and control groups' academic performance of male and female students after the intervention**.**

Table 5: Independent sample t-test analysis comparing the achievement of the students in experimental group terms of gender after the intervention.

Test	Strategies	N0	Mean	Std. dev	Mean Diff	Df	95% confidence Interval of the difference		T	P-value
							Lower	Upper		
Post-Test	Male	14	26.43	5.302	.804	58	-4.248	2.641	.478	.636
	Female	16	25.63	3.879			-4.351	2.744		

Following the intervention, the achievement of the male students (mean = 26.43; standard deviation = 5.302) was quite similar to that of the female students (mean = 25.63; standard deviation = 3.679). Furthermore, following the intervention, the mean difference between the two genders in the class is.804. between 95% CIs [-4.248 and 2.641] for male and [-4.351 and 2.744] for female. The results of Table 5 (P-value <.636, df = 58, p < 0.05) showed that, following the intervention, there was no discernible difference in student achievement between male and female genders.

Discussion and Implications

The study's conclusions showed that students' mathematical achievement was significantly affected by the mind-mapping teaching method. Table 3 indicates that following the intervention, the experimental group's mean achievement score was higher (26.00) than that of the control group (19.50). By indicating a statistically significant influence of mind mapping on students' mathematical achievement, the results in Table 3 further supported this conclusion. As evidence of the outcome, the observed probability value of 0.026 was significant at the.05 level of significance. This suggests that the mind map teaching strategy is more effective than the traditional approach at improving and facilitating students' learning of mathematics. Likewise, it is clear from the current study's results that the mind-mapping approach to teaching is more effective than the traditional approach at raising students' math proficiency. This could be explained by the

fact that mind mapping is an activity-based, student-centered teaching approach as opposed to teacher-centered learning. The results of this study support those of [15] who claim that the mind-mapping teaching method improved student achievement. The results of this study support those of [16] who found that student-oriented teaching strategies improve math proficiency. The results also align with those of [17], [18], [19] and [20] who all found that the mind-mapping technique improved students' performance in the sciences.

According to the results in table 5, male students outperformed their female counterparts in terms of post-test mean achievement score, with a higher score of 26.43 compared to 25.63 of the female students. The data also showed that, following the intervention, there was no significant difference in the academic performance of male and female students. The strategy's ability to accommodate different learning styles and guarantee that both male and female students gain equally from the teaching may be the cause of this outcome. His results support those of [6] who found no discernible relationship between gender and mathematics achievement. In other words, teaching strategy—rather than gender—should be the focus for improved mathematics achievement. Given that all student categories are anticipated to gain from this teaching approach, this is quite important. [21] supports this conclusion by stating that general intelligence, not a specific sex, coincides with the cognitive resources required for mathematical aptitude. The outcome, however, contradicts the findings of [22] who argued that male students outperformed female students in physics. According to [23] gender has a positive impact on female performance.

The study has sample limitation which may not be representative of the entire population of students in Ijebu-ode and beyond. Additionally, the quasi-experimental design used in this study may be prone to selection bias, where the groups may be differed in characteristics that affect the outcome. Hence, future studies should aim to address these limitations by using larger and more diverse samples. By applying mind mapping techniques in classroom, the teachers and instructors can improve their productivity, critical thinking, creativity, and effectiveness in classroom. The curriculum planners should incorporate mind-mapping into mathematics curriculum, develop mind mapping skills across the Nigeria secondary schools.

CONCLUSIONS

This study concludes that if a mathematics teacher uses the mind mapping instructional strategy to teach mathematical concepts in the classroom, it will improve students' achievement in mathematics because the mean difference between students taught statistics using the strategy and students taught statistics using conventional methods is statistically significant after the intervention. From this study, we may conclude that teachers can raise their students' math achievement by implementing the mind mapping instructional technique.

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CONFLICT OF INTEREST

We declare no conflict of interest in this article

AUTHOR CONTRIBUTION

Abiodun, T. O: Conceptualization, Methodology, Software. **Chinaka, T.W.**: Data collection, Writing original draft. **Asanre, A. A**: Visualization, Investigation. **Siphokazi V.**: Supervision, Software, Validation, Writing. **Adediran, F.B.**: Reviewing and Editing

DATA AVAILABILITY

All data generated or analyzed during this study are included in this published article.

DECLARATION OF GENERATIVE AI

Not applicable.

ETHICS

Not applicable.

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