

**EFFECT OF THINKING PAIR INSTRUCTIONAL STRATEGY ON
STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN OGOJA
EDUCATION ZONE OF CROSS RIVER STATE**

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Abstract

This study investigated effect of thinking pair instructional strategy on students' academic achievement in Mathematics in Ogoja Education Zone of Cross River State. Two research questions were posed and two null hypotheses were formulated to guide the study. Quasi experimental design was used for this study. One hundred and twelve (112) Mathematics students in two intact SS2 classes from the drawn public secondary schools were used for this study. The one hundred and twelve (112) Mathematics students in two intact Senior Secondary Two (SS2) classes comprised of thirty-two (32) female and twenty-eight (28) male students from school A and twenty-four (24) female and twenty-eight (28) male students from school B. The Mathematics Achievement Test (MAT) drawn from three weeks learning package on algebra was used for data collection in this study. It consisted of 30 multiple choice test items constructed by the researcher. To establish the reliability of the MAT, The instrument was administered to 20 mathematics students in a Secondary School that is not part of the sample. The responses obtained was be analysed using the Kuder-Richardson 21 formula method. The reliability coefficient of 0.87 was obtained, Research questions were analyzed using mean and standard deviation whiles the research hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Results obtained from the study showed that: there was a significant difference in the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method with those taught using thinking pair instructional strategy having a higher mean gain. The mean scores of male and female students taught Mathematics using thinking pair instructional strategy differs with the female students having a higher mean gain than the male students. It was recommended among others that Mathematics teachers should be encouraged to adopt the thinking pair instructional strategy as a regular part of their instructional delivery. Its active and collaborative nature enhances students' comprehension and overall academic performance.

INTRODUCTION

Mathematics is a foundational subject essential for the development of logical reasoning, critical thinking, and problem-solving skills. It plays a central role in various fields such as science, technology, engineering, economics, and everyday life. Despite its importance, students' academic achievement in Mathematics at the secondary school

level in Nigeria continues to be unsatisfactory (Eze & Obi, 2020). Reports from the West African Examinations Council (WAEC) have consistently shown that a large proportion of students perform poorly in Mathematics, citing factors such as poor teaching methods, lack of motivation, and fear of the subject as major contributors (Okeke & Emeka, 2019). This challenge has prompted education stakeholders to explore innovative instructional strategies that can enhance students' learning experiences and improve academic outcomes in Mathematics.

One such strategy is the Thinking Pair Instructional Strategy (TPIS) a cooperative learning approach that encourages active student engagement through individual thinking, peer collaboration, and shared discussion. In this method, students are first required to think individually about a problem, then pair up with a partner to discuss their thoughts, and finally share their ideas with the larger class. This interactive learning model has been lauded for promoting reflective thinking, mutual learning, and increased participation (Adebisi & Falade, 2019). Thinking Pair Strategy offers an alternative to the traditional teacher-centered approach by placing learners at the center of the instructional process.

Several researchers have affirmed the effectiveness of TPIS in improving students' academic achievement in Mathematics. For instance, Udo and Okon (2021) found that students taught with TPIS demonstrated a higher level of understanding and retention compared to those exposed to conventional teaching methods. The researchers attributed this to the active mental processing and interpersonal communication inherent in pair discussions. Similarly, Onyema and Eze (2022) reported that TPIS enhances problem-solving abilities and reduces Mathematics anxiety, particularly among low-achieving students.

TPIS also promotes collaborative learning and communication skills, which are vital for the mastery of abstract mathematical concepts. By working with peers, students clarify misconceptions, justify their reasoning, and reinforce their understanding, thus achieving deeper learning (Adeyemi & Yusuf, 2020). In a study conducted by Fagbemi and Olaitan (2019), it was observed that TPIS significantly improved students' <https://journals.unizik.edu.ng/jtese>

performance in topics such as algebra and geometry by encouraging critical analysis and feedback from peers. Furthermore, TPIS has been shown to foster positive attitudes toward Mathematics, leading to increased confidence and motivation among students (Mba & Okafor, 2021).

However, despite its documented benefits, the implementation of TPIS in Nigerian secondary schools faces challenges such as large class sizes, limited instructional time, and teachers' unfamiliarity with cooperative learning strategies (Omole & Adebayo, 2020). Many teachers in rural and semi-urban schools continue to rely on lecture-based teaching due to lack of professional training and instructional support. This gap has raised concerns about the sustainability and scalability of TPIS in improving Mathematics achievement across diverse educational settings.

In Cross River State, particularly in Ogoja Education Zone, persistent poor performance in Mathematics has been a major concern for educators and policymakers. Schools in the area face infrastructural deficits, overcrowded classrooms, and low teacher-student engagement, all of which affect students' academic outcomes. The need to adopt learner-centered approaches such as Thinking Pair Strategy is therefore critical in addressing these challenges. While studies have explored the effect of various teaching methods on Mathematics achievement in other regions, empirical research on the use of TPIS in the Ogoja Education Zone remains scarce.

Academic achievement, in this context, refers to students' measurable performance in Mathematics based on standardized tests and classroom assessments. It is influenced by numerous factors including teaching strategies, students' attitudes, instructional resources, and socio-demographic variables such as gender. Gender disparity in Mathematics has continued to attract attention in educational research, with findings indicating varying levels of achievement between male and female students. While some studies suggest that male students tend to outperform their female counterparts due to higher confidence and societal expectations, others argue that effective instructional methods can bridge this performance gap (Okon & Effiong, 2022).

In light of the foregoing, this study seeks to investigate the effect of Thinking Pair Instructional Strategy on students' academic achievement in Mathematics **in the** Ogoja Education Zone of Cross River State. The findings are expected to provide evidence-based insights that will inform the adoption of innovative, learner-centered teaching strategies to improve Mathematics instruction and academic performance.

Statement of the Problem

Mathematics remains a core subject in secondary school education due to its role in developing students' critical thinking, problem-solving skills, and logical reasoning. Despite its relevance to national development and individual career success, students' performance in Mathematics at the secondary school level has consistently been poor. Many students struggle to understand abstract mathematical concepts, and this has been attributed in part to ineffective teaching methods, lack of motivation, and classroom anxiety.

Traditional teacher-centered instructional approaches often fail to actively engage students, limiting their ability to internalize mathematical concepts and apply them effectively. In response to this challenge, educationists have proposed learner-centered strategies such as the Thinking Pair Instructional Strategy (TPIS), which emphasizes collaboration, active participation, and shared learning experiences. TPIS encourages students to think independently, work with a partner to discuss their ideas, and engage in class-wide discussions, thereby promoting deeper understanding and greater retention of content.

Although research has shown that TPIS can improve students' academic achievement, most of these studies have been conducted in urban or better-resourced educational settings. In Ogoja Education Zone of Cross River State, students continue to perform poorly in Mathematics, and teaching methods have remained largely traditional. There is a lack of empirical evidence on the effectiveness of TPIS within this local context, where schools often face challenges such as overcrowded classrooms, limited instructional materials, and insufficient teacher training.

Furthermore, gender-related differences in academic achievement in Mathematics remain a concern, raising questions about whether TPIS can bridge the performance gap between male and female students. It is therefore necessary to examine whether the Thinking Pair Instructional Strategy can significantly improve students' academic achievement in Mathematics in Ogoja Education Zone and whether gender has any influence on its effectiveness. This study is designed to address these gaps and provide practical insights for improving Mathematics teaching and learning in the area.

Purpose of the study

The general objective of this study is to examine the effect of thinking pair instructional strategy on students' academic achievement in Mathematics in secondary schools in Mathematics in Ogoja Education Zone of Cross River State. Specifically, the study sought to:

1. determine how the mean achievement scores of students taught Mathematics using thinking pair instructional strategy differ from the mean achievement scores of those taught using conventional method
2. find out how the students taught Mathematics using thinking pair instructional strategy differ in their academic achievement based on their gender

Research Questions

The following research questions guided this study.

1. What is the difference between the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught with conventional method?
2. What is the difference between the mean achievement scores of male and female students taught Mathematics using thinking pair instructional strategy?

Hypotheses

The following null hypotheses were formulated to guide this study and are tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method.
2. There is no significant difference between the mean achievement scores of male and female students taught Mathematics using thinking pair instructional strategy

Methods

Quasi-experimental research design with non-equivalent pre-test, post-test control group design was used since the classes of students that were used had already been organized into intact classes to provided for stability and avoid disruption of class lessons and class arrangement. According to Nworgu (2015) quasi-experimental research design can only be used where the researcher cannot randomly sampled and assign his/her subjects to groups. The only difference, between the two groups is their learning format is that the experimental group learned with thinking pair instructional strategy while the control group learned with conventional method format. The effects of the methods were then compared. The design is presented in the table 1

Table 1: Design Matrix

Group	Pre-test	Treatment	Post-test
Experimental	O ₁	X _E	O ₂
Control	O ₃	X _C	O ₄

Where, O₁= pre-test of thinking pair instructional strategy group; O₂= Post-test of thinking pair instructional strategy group; O₃= Pre-test of conventional method group; O₄= Post-test of conventional method group; X_E= Treatment with thinking pair instructional strategy; X_C= Treatment with conventional method (Control). The study was carried out in Ogoja Education Zone of Cross River State, Nigeria. The population of the study comprised of all Senior Secondary Two (SS2) Mathematics students in Ogoja Education Zone of Cross River State. SS2 students were used for the study because they had already been taught several core Mathematics topics and were readily available for

participation, as they were not preparing for any external examinations at the time of the study. A simple random sampling technique was used to draw two public secondary schools from the Ogoja Education Zone. A total of one hundred and twelve (112) Mathematics students in two intact SS2 classes from the drawn public secondary schools were used for this study. The one hundred and twelve (112) Mathematics students in two intact SS2 classes comprised of thirty two (32) female and twenty eight (28) male students making a total of sixty (60) students from school A and twenty four (24) female and twenty eight (28) male students making a total of fifty two (52) students from school B.

The Mathematics Achievement Test (MAT) drawn from a three weeks learning package on algebra was used for data collection in this study. The Mathematics achievement test (MAT) consisted of 30 multiple choice test items constructed by the researcher. To establish the reliability of the MAT, The instrument was administered to 20 mathematics students in a Secondary School that is not part of the sample. The responses obtained was be analysed using the Kuder-Richardson 21 formula method. The rationale behind this method is that it is appropriate for objective test items that are homogenous and dichotomously scored. The reliability coefficient of 0.87 was obtained

Treatment Procedure

A. Training of Research Assistants for both Experimental and Control Group

Two research assistants (Teachers from the sampled schools) were trained by the researcher. One teacher was trained by the researcher on how to implement the thinking pair instructional strategy (Experimental Group) while the other one was trained how to implement the conventional method (Control Group). Only the pre-prepared lesson note was given to ensure that the experimental and control groups were exposed to same content. The training lasted for three days.

B. Actual Treatment

The SS2 intact class B was randomly drawn for the thinking pair instructional strategy group (Experimental Group). The other intact SS2 class A was taught using lecture method group (Control Group). Both the experimental and control groups was exposed to the same mathematics content for three weeks. Two days before the

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commencement of treatment, the experimental and control groups was given pre-tested with the aid of the mathematics achievement test (MAT). This was done to determine the equivalence of the groups before treatment and be sure that any noticed change later was due to the treatment. At the end of the three weeks lesson, both the experimental and control groups were presented with post-test with the serial number of the MAT (Mathematics achievement test) questions interchanged. The research questions were answered using mean and standard deviation while the null hypotheses were tested using Analysis of Covariant (ANCOVA) at 0.05 level of significance

RESULTS

Research Question 1: What is the difference between the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught with conventional method?

Table 1: Mean and Standard deviation of pre-test and post-test scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method.

Variable	Pre-test			Post-test		Mean gain
	N	\bar{x}	SD	\bar{x}	SD	
Thinking pair instructional strategy	52	11.53	2.52	26.05	3.27	14.52
Conventional Method	60	11.45	2.10	20.64	2.64	9.19

Results in table 1 show that the group taught Mathematics using thinking pair instructional strategy had a pre-test mean of 11.53 with a standard deviation of 2.52 and a post-test mean of 26.05 with a standard deviation of 3.27. The difference between the pre-test and post-test mean was 14.52. The group taught Mathematics using conventional method had a pre-test mean of 11.45 with a standard deviation of 2.10 and a post-test mean of 20.64 with a standard deviation of 2.64. The difference between the pre-test and post-test mean was 9.19. However, for each of the groups, the post-test means was greater

than the pre-test means with the group taught using thinking pair instructional strategy having a higher mean gain. This is an indication that thinking pair instructional strategy has more effect on students' achievement in Mathematics than the conventional method.

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught with conventional method.

Table 2: Analysis of Covariance (ANCOVA) of the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1193.979 ^a	2	596.990	31.794	.000
Intercept	1350.724	1	1350.724	71.935	.000
Pre-test	196.332	1	196.332	10.456	.002
Interaction	207.734	1	207.734	11.063	.001
Error	2046.736	109	18.777		
Total	64530.000	112			
Corrected Total	3240.714	111			

The results in table 2 showed that the significant difference in the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method. Results show that with respect to the groups taught Mathematics using thinking pair instructional strategy and those taught using conventional method, an F-ratio of 11.063 was obtained with associated probability value of 0.001. Since the associated probability value of 0.00 was less than 0.05 set as level of significance, the null hypothesis (H_{01}) which stated that there is no significant difference in the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught with conventional method is rejected. Thus, inference drawn therefore is that there was a significant difference in the mean

achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught with conventional method with those taught using thinking pair instructional strategy having a higher mean gain. This shows that thinking pair instructional strategy has more effect on students' achievement in Mathematics than the conventional method.

Research Question 2: What is the difference between the mean achievement scores of male and female students taught Mathematics using thinking pair instructional strategy?

Table 3: Mean and Standard deviation of pre-test and post-test scores of male and female students taught Mathematics using thinking pair instructional strategy

Gender	N	Pre-test		Post-test		Mean gain
		\bar{x}	SD	\bar{x}	SD	
Male	28	11.27	2.72	25.03	3.62	12.76
Female	24	11.79	2.32	27.07	2.92	15.28

Results in 3 showed that male under thinking pair instructional strategy had a pre-test mean of 11.27 with a standard deviation of 2.72 and a post-test mean of 25.03 with a standard deviation of 3.62. The difference between the pre-test and post-test mean was 12.76. The female students under thinking pair instructional strategy had a pre-test mean of 11.79 with a standard deviation of 2.32 and a post-test mean of 27.07 with a standard deviation of 2.92. The difference between the pre-test and post-test mean for the female students was 15.28. For each of the groups, the post-test means were greater than the pre-test means with the female students having a higher mean gain than the male students. This is an indication that students' gender has influences on the methods used in teaching Mathematics.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students in Mathematics using thinking pair instructional strategy

Table 4: Analysis of Covariance (ANCOVA) of the mean achievement scores of male and female students taught Mathematics using Thinking pair instructional strategy

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	157.765 ^a	2	78.883	8.763	.000
Intercept	1018.442	1	1018.442	113.135	.000
Pre-test	100.642	1	100.642	11.180	.001
Gender	94.694	1	94.694	10.519	.001
Error	441.077	49	9.002		
Total	39287.000	52			
Corrected Total	598.842	51			

The results in table 4 showed that with respect to the mean scores of male and female students taught Mathematics using thinking pair instructional strategy, an F-ratio of 10.519 was obtained with associated probability value of 0.001. Since the associated probability value of 0.00 was less than 0.05 set as level of significance, the null hypothesis (H_{02}) which stated that there is no significant difference in the mean achievement scores of male and female students in Mathematics using thinking pair instructional strategy is rejected. Thus, inference drawn therefore is that the mean scores of male and female students differ significantly when taught Mathematics using thinking pair instructional strategy. This means that gender is a significant factor in determining students' achievement in Mathematics.

Discussion of Findings

Thinking pair instructional Strategy and Students' Academic Achievement in Mathematics

The results in table 1 and 2 showed that there was a significant difference in the mean achievement scores of students taught Mathematics using thinking pair instructional strategy and those taught using conventional method with those taught using thinking pair instructional strategy having a higher mean gain. This shows that thinking pair

instructional strategy has higher effect on students' achievement in Mathematics than the conventional method. This result agree with the finding of Yusuf and Afolabi (2019), the study compared cooperative learning strategies, including the think-pair-share (TPS) strategy, with conventional teaching methods in secondary school mathematics classes in Nigeria. Findings revealed that students taught using the TPS strategy performed significantly better than their counterparts in the conventional group. The authors attributed the improved achievement to increased student engagement and peer interaction. Similarly, Iroha and Okafor (2021) in their quasi-experimental study examined the effect of think-pair-share strategy on students' mathematics performance in Enugu State. Results showed that students taught with TPS outperformed those in the traditional lecture-based group. The researchers concluded that the strategy enhances conceptual understanding and collaborative learning.

Contradictory, Oloyede and Ayeni (2020) found no significant difference in mathematics achievement between students taught using TPS and those taught with conventional methods in a Lagos public school. The authors noted that improper implementation, classroom overcrowding, and time constraints may have influenced the outcome. Also, Onwuakpa and Uche (2018) explored multiple active learning methods including TPS, but found that for complex mathematical concepts, the conventional approach yielded slightly better performance. They suggested that students might need stronger foundational knowledge before benefitting from peer-led strategies.

Gender and Students' Academic Achievement in Mathematics

The results in table 3 and 4 showed that the mean scores of male and female students taught Mathematics using thinking pair instructional strategy differs with the female students having a higher mean gain than the male students. Also, the mean scores of male and female students differ significantly when taught Mathematics using thinking pair instructional strategy. This means that gender is a significant factor in determining students' achievement in Mathematics. This finding is in line with Nwachukwu and Adediran (2020) the study investigated the interaction effect of gender and instructional strategy on students' achievement in mathematics. Findings revealed that female students

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taught using TPS significantly outperformed males. The researchers linked this to girls' higher responsiveness to collaborative settings. Similarly, Ede and Okonkwo (2021) found that female students exposed to TPS showed better performance and engagement than their male counterparts. The study concluded that collaborative strategies may cater better to female learning styles in mathematics.

On the contradictory Studies Adeoye and Fashola (2019) in their study found no significant gender difference in the performance of students taught mathematics using think-pair-share strategy. They concluded that the effectiveness of TPS was uniform across genders, suggesting gender neutrality in its application. Also, Olaniyan and Adetoro (2022) found male students slightly outperformed females when taught using TPS in mathematics. The authors speculated that males were more assertive in pair interactions and dominated decision-making during peer tasks.

Conclusions

Based on the findings of this study, several key conclusions were reached. First, the Thinking Pair Instructional Strategy (TPIS) was found to be significantly more effective in improving students' achievement in Mathematics than the conventional method of teaching. Students who were taught using TPIS demonstrated higher mean achievement scores, indicating that interactive and student-centered instructional strategies can greatly enhance students' understanding, engagement, and retention of mathematical concepts.

Secondly, the study revealed that female students outperformed their male counterparts in terms of mean achievement scores. This outcome suggests that female students may be more positively influenced by collaborative and interactive learning environments, such as those created through the use of TPIS, and may respond more favorably to instructional approaches that emphasize communication and cooperation.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Mathematics teachers should be encouraged to adopt the thinking pair instructional strategy as a regular part of their instructional delivery. Its active and collaborative nature enhances students' comprehension and overall academic performance.
2. Curriculum planners and educational policymakers should integrate TPIS and similar learner-centered approaches into Mathematics teacher education and professional development programmes, ensuring that teachers are adequately trained in their use.
3. Gender-sensitive instructional strategies should be developed and applied, particularly in subjects like Mathematics where gender differences in achievement persist. Teachers should be aware of how male and female students interact and respond differently to peer-based instruction and tailor their methods accordingly.
4. Schools and educational stakeholders should provide supportive classroom environments and resources that promote the effective implementation of thinking pair and other cooperative strategies, such as adequate student seating arrangements, lesson time adjustments, and reduced student-teacher ratios.

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