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Effects of Think-Pair-Share Teaching Strategy on Senior Secondary Two Mathematics Students' Achievement in Biu Local Government Area Borno State, Nigeria

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Abstract

The study investigated the effects of think- pair-share instructional strategy teaching strategy on senior secondary two mathematics students' achievement in Mathematics. The total population of 1,230 senior secondary school students from the total of 16 public secondary schools in Biu, Local Government Areas of Borno State. A simple random sampling technique was used in selecting 105 SS2 students from the two senior secondary schools. Purposive sampling technique was used to select the two secondary schools because the schools are coeducational with uniform curriculum in Biu government area. The study addresses two research questions. Data was collected using mathematics performance test, (MPT). The data for the study collected were analyzed and the research questions answered using descriptive statistics of mean and standard deviation. It was discovered from the findings of the study that students achieve higher in mathematics when exposed to TPS teaching strategy than those taught using the lecture method. Furthermore the findings also indicates that male students slightly outperformed their female counterparts even in the pre-test and post-test in mathematics when exposed to TPS teaching strategy. The study therefore recommends that: Mathematics teachers should be encouraged to learn how to the conduct the Think-Pair-Share teaching strategy since the method enhances achievement and has the potentials of developing team work through collaboration for students to benefit from each other's experiences and also TPS is gender inclusive

Key words: Effects, Achievement, Think, Pair, Share, Senior Secondary Schools, Gender, and Mathematics Students.

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Introduction

The importance of mathematics in solving personal and societal problems cannot be over emphasized. Mathematics is an imperative body of knowledge for any nation craving for technological breakthrough for national development. This is because the modern world is being technologically driven such that the success of all field of science and technology depends on the application of mathematics. It could be stated that the mathematics knowledge is applied on daily bases consciously or unconsciously by individuals especially the used of approximations and estimation to mention few in cooking, commerce, farming, tailoring and many varied domain. Because of the relevance of mathematics for individual and national development. Federal Government of Nigeria (FGN, 2014), has made it compulsory for all learners from Primary up to Secondary school levels of education (NPE, 2004). Mathematics therefore, is one of the subjects made compulsory for pursuing courses in higher institutions of learning in Nigeria and other countries of the world. The pivotal element for secondary schools achievement in certificate examination in Nigeria is based on the candidates' attainment of requirements for admission into university, which includes a pass at credit grade in mathematics. Examination bodies like West African Examination Council (WAEC), the National Examination Council (NECO) and the National Business and Technical Examinations (NABTEB) made mathematics as mandatory for all candidates. Mathematics was also made obligatory by Joint Admission and Matriculation Board (JAMB) for all candidates wish to register for science based and social science courses in higher institutions of learning in Nigeria.

In spite of all the emphasis placed on mathematics as an instrument for excellent academic attainment including its application in all aspect of life, students has a continual declining interest in the subject. Some of the reasons highlighted as responsible for the diminishing interest in mathematics includes: poor teaching methods that were used by teachers, none commitment to motivational teaching, difficult nature of mathematics and mathematics anxiety (Anigbo, 2016).

The conventional (lecture) method of teaching is one of the oldest and most widely used instructional methods, particularly in higher education and secondary schools. It is characterized by teacher-centered instruction and rote memorization, where the instructor delivers information verbally to learners, often with little direct student participation. According to Abimbola and Abolade (2017), the lecture method is effective for covering large volumes of content within a limited time and for addressing large groups of students simultaneously. The lecture method remains valuable for introducing concepts and providing structured explanations. However, critics argue that it may limit learners' active participation, critical thinking, and problem-solving skills compared to student-centered methods. Recent studies examines the influence of conventional method on students' interest and achievement when compared with modern interactive and student-centered approaches like the Think-pair-share teaching strategy (TPS).

TPS provides a safe and structured environment for students to articulate their ideas and listen to others' perspectives. Research indicates that this process enhances critical thinking skills, communication competence, and confidence. By requiring students to discuss in pairs before sharing with the whole class, TPS reduces anxiety and supports more inclusive participation (Gillies, 2016). It is designed to promote student engagement and critical thinking through structured interaction. The strategy involves three steps: Think: Students are given a question or problem and allowed time to think about their response individually. Pair: Students then pair up with a partner to discuss their ideas and thoughts. Share: Finally, the pair shares their discussion or conclusions with the larger group or class. TPS encourages all students to participate, enhances comprehension, and fosters collaborative learning irrespective of gender differences.

The issue of gender difference in educational attainment cut across all discipline and has been inconclusive. For instance, gender difference in behavior, skills and cognitive abilities are determined by biological factors like brain organization, hormones and genetics, these biological factors determine the differences in behavior and abilities in educational achievement (Darmaji *et al.*, 2022). This is because males are good in abstract thinking while ladies are good in reasoning correlation. Gender disparity in mathematics at the secondary stage of education has the possibility to create disparity between men and women who will study course requiring mathematics in tertiary institution. This therefore, has a great repercussion for producing professional in science, technology, engineering and mathematics (STEM) fields. Efforts are being made globally to achieve gender balance in mathematics and science in general.

Teaching of mathematics require necessary provisions for students' active participation in the learning process for students to be able to connect mathematical concepts and theories to real life situations and practices in the world in which they live. Considering the high rate of students' diminished interest in mathematics in both internal and external examination, it becomes necessary to conduct a research on other instructional methods that can possibly improve students' interest and performance in mathematics, that is an alternative to the conventional (lecture) chalk board method. It could be stated that one of the neglected variables in the teaching - learning process is the TPS Instructional strategy.

Problem Statement

Studies have shown that students' poor attitudes towards the learning of Mathematics was mostly hampered as a result of unengaged teaching methods and students' negative attitudes towards mathematics. For many years, because students' performance in mathematics have been unsteady when compared to other subjects in schools and examination bodies in Nigeria and other countries of the world. Despite the huge amount government spends on the educational sector for the training and retraining of teachers, on the importance of interactive and Activity-Based Instructional Strategy (ABIS) in mathematics learning, students' performance is below anticipation. It is hoped that with the use of Think-Pair-Share instructional strategy, students' academic performance would be improved. For this reason the study wish to

investigate the effects of Think-Pair-Share instructional strategy on students' academic performance in Biu Local Government area of Borno State.

Objective(s) of the Study

The objectives of the study was to:

1. Examine the extent to which students' achievement in mathematics differs when taught using TPS compared to conventional method.
2. Established the relationship between the achievement scores of male and female students taught using TPS.

Research Questions

1. What are the difference in achievement scores of students in mathematics when taught using Think-Pair-share instructional strategy compared to conventional method?
2. What is the extent of difference between the achievement scores of male and female students taught using Think-Pair-Share instructional strategy.

Literature Review

The study is based on Vygotsky's theory of socio-cognitive development. Vygotsky's theory of socio-cognitive development states that cognitive development comes from social interaction and guided learning within the Zone of proximal development of children and their partners constructed knowledge (Vygotsky, 1978). According to Vygotsky (1978), much important learning by the child occurs through social interaction with skillful group members or knowledgeable others. The zone of proximal development is a region of child's immediate potential for cognitive growth which is bounded on lower end by that which the child can accomplish on his own and on the upper end so that the child can accomplish with the help of a more knowledgeable others (Vygotsky, 1978). Think-Pair-Share strategy aligns with this theory as it encourages peer collaboration through thinking individually then Pairing with colleagues to discuss their views and then sharing their views or findings of a particular problem with their class members in mathematics classroom.

Think-Pair-Share is a cooperative learning technique developed to promote students active engagement and critical thinking through structured interaction. The strategy involves three steps: Think: Students are given a question or problem and allowed time to think about their response individually. Then Pair: Students then pair up with a partner to discuss their ideas and thoughts. Finally Share: Here the pair shares their discussion or conclusions with the larger group or class. TPS encourages all students to participate, enhances comprehension, and fosters collaborative learning.

Benefits of TPS

TPS promotes active learning such that all students are required to process and express ideas. It also enhances verbal communication by encouraging students to articulate thoughts clearly as well as shy or reluctant learners: The pairing format also reduces performance anxiety among learners especially the slow learners and thereby improves retention and understanding of materials learnt. The discussion among the learners solidifies comprehension, facilitates formative assessment as a result teachers gain insight into students understanding (Fank Layman, 1981).

Steps in Implementation of TPS

Implementation Process of TPS in classrooms typically follows the steps like:

1. Teacher poses a question (often open-ended or analytical).
2. Students think individually (1-3 minutes) to formulate a response.
3. Students pair up to discuss their thoughts (2-5 minutes).
4. Pairs share their ideas with the whole class, fostering collective learning and feedback (Fank Layman, 1981).

The only limitations with the implementation of TPS is that it may require careful classroom management because it is time-consuming if not well-structured as a result, some students may dominate discussions if not properly guided. Recent studies confirm that TPS remains a relevant and effective teaching strategy in modern classrooms. Its application spans diverse learning environments, including face-to-face, blended, and online modalities. TPS has been widely acknowledged for improving student engagement. According to Ahmad and Majid (2022), using TPS in secondary science classrooms resulted in significantly higher participation rates. Similarly, Mustafa (2021) also found that the TPS strategy was particularly effective in encouraging active participation in English language classrooms.

Alabi and Sanni (2021) study the "Effects of Think- Pair-Share instructional strategy on students learning achievement in Secondary school mathematics in Badagry, Lagos State". The study was a quasi-experimental research design of a pre-test and a post-test control group 2x3x2 factorial. The instrument used for the study was Mathematics Achievement Test (MAT) which was subjected to face and content validity with the help of some colleagues and an expert in the field of research study. Kuder- Richardson formula 21 (KR, 21) method was used to determine the reliability of the instrument and the process returns reliability coefficients of 0.85. The study contained 6 research questions and five hypotheses. The study samples involve two SS2 students of public schools in the Badagry Local Government Area.

In analyzing the data, inferential statistics (ANCOVA) was used for testing the hypotheses at the 0.05 alpha level of significance while mean and standard deviation was used to answer the research questions. H02, H03, H04, H05 and H06 were not rejected. It was concluded that the learning achievements of the think-pair-share classroom are better than those of the conventional classroom and also gender was not found not to be significant. It was however recommended that the use of the think-pair-share strategy should be known by all the school teachers. The structure of TPS is effective in Promoting higher-order thinking that supports cognitive engagement by requiring students to process information deeply before sharing. Another study by Pratiwi *et al.*, (2023) revealed that TPS significantly enhanced students' mathematical problem-solving abilities, particularly their reasoning and analysis skills.

The application of TPS cut across all disciplines and all levels of education such that TPS is not limited to a specific subject. It has been applied successfully in language learning (Astuti, 2022), science education, and higher education (Rahman *et al.*, 2021). These studies show TPS as a flexible method that adapts to varying academic contexts. TPS can also be integrated into digital learning. This is because TPS has also been adapted to online platforms, and maintained its collaborative essence in digital classrooms. Kurniawan *et al.*, (2023) demonstrated that TPS could effectively foster student interaction and communication in virtual settings using breakout rooms and online tools.

Materials and Methods

This study adopted quasi-experimental design which involves pre-test, post-test non-equivalent control group design, as intact class were used as no sampling of subject were carried out Sambo (2005).

The design is represented symbolically as follows:

Groups

Experimental (E_1)	01	X	02
Control (C_2)	03		04

01 and 03 represents the pre-test scores while 02, 04 represents the post-test of all the groups, X is the treatment or the experimental group taught using TPS, the blank space represent no treatment to the control group taught using conventional (lecture) method.

Description of the Study Area/Site

The area of the study is Biu Local Government Area of Borno State. Borno state was founded in 1976 in the north eastern part of Nigeria with a population exceeding a million by then with an area of 57,799 km¹³ by 2006 having sixteen (16) local government areas. Borno Sate has a boundary with Niger and chad republic to the north, Cameroon to the east Adamawa and Gombe State to south and Yobe State to the west. Borno State has a temperature of 39°C to 40°C with a mean annual rainfall of 800 mm but Less than 500mm in the northern part of Borno State.

Population/ Subjects

The subjects/ target population for the study consisted of 1,230 SS11 students. Purposive sampling technique was used to choose two secondary schools where the sample for study was drawn from two intact classes randomly selected from the two senior secondary schools to participate in the study in Biu Local Government Area Borno State. Mathematics Performance Test (MPT) was be used at the beginning of the study for the pre-test and post-test using two trained research assistants recruited by the researcher. The descriptive statistics was used to answer all the research questions using SPSS version 22. The data was analyzed using mean, standard deviation

Instrument for Data Collection

The instrument used for data collection was Mathematics Performance Test (MPT) adapted by the researcher from senior secondary schools two (SS11) mathematics syllabus of the West African Examinations Council (WAEC), 2022-2024. The MPT consisted of 40 items multiple choice objective tests. The MPT items was drawn from four topics. The topics were Basic concepts in trigonometry, angles, Pythagoras theorem and triangles problems which was taught by two recruited research assistants trained by the researcher in order to participate in the study.

Data Collection and Analysis

The data for the study was collected using (MPT) which was used at the beginning of the experiment for the pre-test and post-test using two trained research assistants recruited by the researcher to take charge of teaching the experimental or control group, in their respective schools. The study was conducted in six weeks' time. The purpose of pre-test was to ascertain the students' base line on the topics taught and also ascertain that the groups are equivalent at the beginning of the study irrespective of gender or background before the experimental group was be subjected to treatment using TPS while the control group was taught using the conventional method. The topics were broken down in to teachable units of instruction. The Lessons plan was written in two different forms one of the Lesson plans was used for the TPS

while the other lesson plan for the conventional classroom for the control group. The research assistants delivered the lessons under the constant supervision by the researcher.

The data for the study was analyzed using descriptive statistics. Mean and standard deviation was used to determine all the two research objectives using SPSS version 22. Thus a sample of 105 SSII students from two senior secondary schools were used for the study in Biu LGA. The experimental group consists of 34 boys and 21 girls from Government Day Secondary School Biu representing (School A) while the control group (School B) from Government Community Day Secondary School Biu consisting 38 boys and 12 girls. The instruments used for the study was mathematics Performance test. The MPT is 40 items multiple objective test adopted by the researcher from the contents of SSII mathematics Curriculum used for the pretest and posttest. Both the face and content validity was established for the instrument. For the reliability of the instruments, test retest method was used. The test was administered to two intact classes in Government Senior Science Secondary Schools Biu in the stipulated population but outside the sample size of the research. The scores gathered was recoded and after two weeks the test was repeated on the same group, where the result was collated, recorded and correlated. The reliability coefficient of 0.84 obtained was accepted by the researcher which proved the reliability of the MPT.

Results and Discussion

Research Question one

1. What is the difference in the achievement scores of students in mathematics when taught using Think-Pair-share instructional strategy compared to conventional method?

Table 1, revealed the pretest and the posttest achievement scores of students taught mathematics using Think-Pair-Share teaching strategies and those taught using the lecture method. The result of the experimental groups indicates that the posttest mean scores ($\bar{x} = 67.84$, $SD = 16.51$) was higher than the pre-test mean score ($\bar{x} = 37.41$, $SD = 12.74$) with the mean gain of 30.43, meaning that there was an improvement in the achievement after the treatment. Also for the control group the mean scores was ($\bar{x} = 34.27$, $SD = 10.34$) at the pre-test. However, in the post test, the mean scores of students increased to ($\bar{x} = 38.41$, $SD = 14.72$). The findings showed that students in the experimental group had a higher mean score (67.84) after exposure to T P S teaching strategy, than those in the control group with ($\bar{x} = 38.41$) who were not exposed to treatment. Having the mean difference of 26.29. Relatively the pre-test for both the experimental and control groups were low. But after the treatment the experimental groups outperformed the control group. This means that the intervention of TPS teaching strategy improved students' achievement in mathematics.

Research Question Two

1. What is the extent of difference between the achievement scores of male and female students taught using Think-Pair-Share instructional strategy.

Table 2, showed the result of the pretest and the posttest achievement scores of the male and female students. The pretest mean scores for the male students was ($\bar{x} = 35.81$) with the Standard deviation ($SD = 12.94$) for the male students while the female students had the mean scores $\bar{x} = (41.68)$, with standard deviation ($SD = 13.71$) before the intervention. The table recorded the posttest mean scores of ($\bar{x} = 68.75$) with standard deviation ($SD = 16.82$). Results indicates that the mean gain score of the male students was $\bar{x} = 32.94$ and that of the female students was $\bar{x} = 21.27$ having the mean difference of 11.67, which implies that male students swiftly outperformed their female counterparts in mathematics when taught using the TPS strategy.

Summary and Discussion of Major Findings

Table 1. Students have showed significant improvement in their performances in mathematics after the intervention with Think-Pair-Share teaching strategy as presented in Table 1, since the mean scores of the students at the post-test is significantly better than their mean scores at the pre-test based on the descriptive statistics results. Students taught mathematics using the Think-Pair-Share teaching strategy performs better than those taught using lecture method with the Post-test mean scores of 67.84 and standard deviation of 16.51 while the mean scores of mathematics students in the control group is 38.41 with standard deviation of 14.72 favoring the experimental group.

Table 2 result showed that the achievement of male and female students in mathematics in the experimental group. At the pretest the female got higher mean scores of 41.68 with standard deviation of 13.71 while the male students got the mean scores of 35.81 with the standard deviation of 12.94. The posttest mean scores of the male indicated 68.75 as well as higher standard deviation of 16.82 scored better than their female counterpart who got the mean scores of 62.95, with the standard deviation of 16.09. Although both the mean scores and standard deviation at the pretest the female score higher than the male students but after intervention with TPS teaching strategy the male students' recorded higher mean score and higher standard deviation than the female students. This implies that male students slightly outperformed their female counterparts in mathematics when taught using TPS teaching strategy.

This findings is in line with that of Ahmad and Majid (2022), who found that using TPS in secondary science classrooms resulted in significantly higher participation rates than those taught by conventional method. Also in terms of

gender the study corresponds to that of Astalini, (2023) that males are intrinsically and genetically superior to females in cognitive abilities which determine excellence particularly for physical sciences. Also in terms of gender the study corresponds to that of Astalini, (2023) Males are intrinsically and genetically superior to females in cognitive abilities which determine excellence particularly for physical sciences. Finally, the findings is also in line with the study conducted by Alabi and Sanni (2021), the learning achievements of the think-pair-share classroom are better than those of the conventional classroom and also gender was found not to be significant. And furthermore recommended that the use of the think-pair-share strategy should be known by all the school teachers.

Conclusion and Recommendation

From the findings of the study, it was discovered that students achieve better in mathematics when exposed to TPS teaching strategy in Biu local Government Area. Furthermore the findings also indicates that male students slightly outperformed their female counterparts even in the pretest in mathematics when exposed to TPS teaching strategy. The study concluded that teaching mathematics using TPS teaching strategy is an effective method because students achieve higher than those taught by conventional teaching method. The TPS strategy has no effect on gender difference in other words TPS is gender inclusive

1. Mathematics teachers should be encouraged to learn how to the conduct the Think-Pair-Share teaching strategy since the method enhances achievement and has the potentials of developing team work through collaboration and to benefit from each other's experiences.
2. Government should increase resources in order to implement the Think-Pair-Share teaching strategy successfully as the approach requires excessive, worksheets and other stationaries.

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Tables

Table 1: The Pretest and Posttest Mean Achievement Scores of Mathematics Students for the Experimental and Control Groups

Group 1: *Think-Pair-Share*, Group 2: *Conventional method*

Group	N	Pre-test		Post- test		Mean Gain	$\bar{x}$ diff.
		Mean($\bar{x}$)	SD	Mean($\bar{x}$)	SD		
Group 1	55	37.41	12.74	67.84	16.51	30.43	26.29
Group 2	50	34.27	10.34	38.41	14.72	4.14	

Table 2: Result of the Pretest and Posttest achievement scores of male and female students in mathematics for the experimental group.

Group	N	Gender	Pretest		Posttest		Mean ($\bar{x}$) Gain	($\bar{x}$) Diff.
			Mean	SD	Mean	SD		
Experimental	34	Male	35.81	12.94	68.75	16.82	32.94	11.67
	21	Female	41.68	13.71	62.95	16.09	21.27	