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Thinking, Pairing, and Sharing in the Classroom – A Pathway to Enhancing Students' Contributions and Academic Achievement in Mathematics

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A B S T R A C T

Students' contributions had severely gone unnoticed in most mathematics classrooms as evident in their academic achievement which informed the conduct of this study. The study employed a mixed method design. The population was drawn from all Lagos State public senior secondary schools Two (grade 11) with samples consisting of 114 students (60 treatment group and 54 control group) conveniently selected from two schools. Face and content validity were used to validate the Mathematics Achievement Test. A reliability coefficient of 0.85 was obtained for quantitative aspect using the Kuder-Richardson formula 21 method while the qualitative aspect involved consensus coding of inter-rater reliability. For quantitative data, the research design was quasi-experimental while qualitative data was a case study. The results showed that students in Think-Pair-Share classes contribute more significantly to class activities than those in the control group. There is a significant difference between the academic achievement of students in a think-pair-share mathematics classroom and those in a conventional classroom [F (1,113) =39.69; p<0.05] in favour of the think-pair-share group. it was concluded that the quality of students' contributions is directly proportional to academic achievement in mathematics classrooms.

1. Introduction

Students often learn mathematics in senior secondary school in order to be prepared for postsecondary education and careers requiring a high degree of analytical and problem-solving skills. It is a required and contingent component of man's daily activities (Author & Author, 2019). As a result of the conceptual comprehension and the application of mathematics knowledge to solve complex issues, teachers most time employ instructional strategies that actively engage students and encourage deep learning. One such approach is the Think-Pair-Share (TPS) strategy, a cooperative learning technique that has gained widespread attention for its positive impact on student engagement and academic performance.

Three steps make up the Think-Pair-Share method: THINK, in which students consider a topic or question on their own; PAIR, in which they discuss their ideas with a peer; and SHARE, in which they present their answers to the class or wider group (Zhang & Wang, 2021). This approach places a strong emphasis on peer interaction, reflective thinking, and active student participation, all of which support deeper learning and better academic results (Liu et al., 2020). Students were more excited to learn mathematics as a result of this heightened sense of involvement since they felt more comfortable sharing their ideas and participating in conversations.

Students' contributions, which range from speaking out during class discussions to participating in group projects and peer-assisted learning, help students build their critical thinking, problem-solving, and teamwork skills in addition to their knowledge. (Johnson, Johnson & Smith 2020). The focus on self-directed learning and preparing students for postsecondary education or career training necessitates active engagement with the curriculum, peers, and teachers in senior secondary school. Although there is ample evidence that student interaction affects academic performance in a variety of educational contexts, attention must be paid to the unique dynamics that exist in senior secondary schools. Lack of learning resources will interfere with the learning process. People can learn more effectively if the learning resources are more comprehensive (Khatimah, 2021).

Notwithstanding the adoption of the TPS teaching strategy by several academics, the yearly WAEC Chief Examiner Report (2018, 2019, 2020, 2021) on students' mathematical achievement still faces several challenges in the mathematics discourse. In senior secondary school mathematics, sequences and series are frequently thought of as some of the most difficult subjects. Due to their abstract character and the complex thinking needed to comprehend them, these ideas which deal with ordered lists of numbers (sequences) and their summation (series) can be challenging for pupils. Sequences and series are essential to higher mathematics but applying them to real-world issues calls for a degree of conceptual knowledge and analytical abilities that many students find difficult (Nwigboji & Olo, 2017). This implies that TPS has only been used to substitute conventional teaching techniques, with no regard for the students' contributions.

While it is clear that students' active contributions in the learning process can significantly impact their academic achievement, there is a gap in understanding the specific ways in which these contributions translate into academic achievement in senior secondary schools. Furthermore, studies have predominantly focused on the teacher's role in fostering classroom interaction (Akinwumi, & Kazeem, 2020; Fadipe, & Adeleke, 2021; Ibrahim, & Obasi, 2021; Ogunyemi, & Oladipupo, 2022; Author & Author, 2021), but limited attention has been paid to how students' individual contributions such as asking questions, offering answers, participating in discussions, and collaborating with peers affect their academic achievement.

By focusing on the various ways in which students contribute to their learning environment, the research aims to identify the most influential forms of contribution that can be promoted within the classroom setting. It is within this context that the researchers investigated the impact of students' contribution in TPS classes and how it relates to students' academic achievement.

Theoretical framework

This framework was analysed in the context of contemporary theories that support the methodology used in this investigation. The researchers examine two pertinent theoretical viewpoints for the conduct of this study out of the numerous theoretical perspectives found in the literature. Author (2008) attributed the combination of two or more theoretical perspectives as a means of supporting more robust theoretical foundations that also result in a better understanding of every activity taking place in the mathematics classroom and therefore advised the selection of these theoretical perspectives. Author goes on to say that each viewpoint has advantages and disadvantages that must be considered in order for the advantages of one perspective to outweigh the drawbacks of the other perspectives. The researchers use the theoretical perspectives of constructivism and cognition to do this.

Constructivism holds that knowledge is actively created by students via interaction with their surroundings and social context, especially as expressed by Piaget (1976) and Vygotsky (1978). This theory holds that students learn best when they actively participate in their education and add to their knowledge through practical and purposeful activities. In order to promote learning and students' involvement in mathematics class, it is important to address their wrong answers carefully (Abiade, 2023). This implies that in senior secondary education, students' contributions in any form, improve their learning outcomes when they discuss and work together to engage with new ideas.

Analytical framework

The qualitative aspect of this study was guided with Brodie (2008) analytical framework among others. The framework examined instances in which teachers go beyond conventional instruction and actively engage with students' ideas to foster conversation, build conceptual connections, and enhance mathematical thinking. Students are frequently presented with a variety of contributions during these sessions. These contributions may be well-expressed or poorly expressed, accurate or partially accurate, pertinent or irrelevant to the topic. It could be helpful or detrimental to the advancement of mathematical knowledge and further discussion. The following categories apply to the students' contributions coding exercise as illustrated in figure 1:

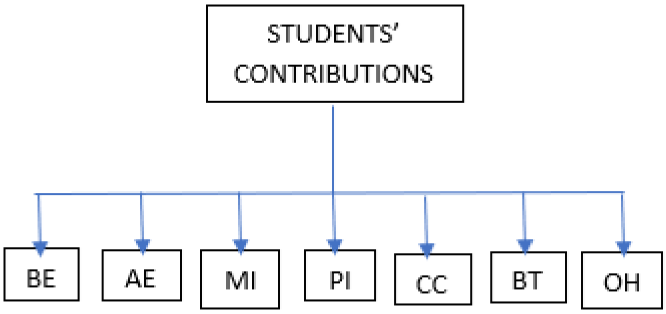

Figure 1. Brodie (2008) Framework's categorisation of student-contributions

- *Basic Error* (BE): Students' contributions to the teacher's speech in the classroom are what constitute an error that is not expected for the grade level.
- *Appropriate Error* (AE): It is the students' contributions to the teacher's utterances in the classroom that are deemed expected error for the grade level in relation to the task at hand.
- *Missing Information* (MI): It happens when a student delivers part of the information needed for the assignment but not all of it, and it is the students' contributions to the teacher's speech in the classroom as accurate but incomplete information.
- *Partial Insight* (PI): Students' contributions to the teacher's speech in class reveal how they are struggling with a significant concept; these contributions are not comprehensive nor accurate, but they do provide insight into the job at hand.
- *Complete Correct* (CC): Students' contributions to the teacher's speech in the classroom are what allow them to adequately respond to the work at hand.
- *Beyond Task* (BT): It is the students' contributions to the teacher's statements in the classroom that extend beyond the present job at hand and/or create some intriguing connections between concepts.
- *Other* (OH): It alludes to the contributions made by students that do not fall under the previously described categories.

Upon examining Brodie's (2008) analytical framework, it is evident that each student's contribution in mathematics classroom is being measured. All students' contributions are examined by Brodie's classification system. Brodie (2008) analytical framework examines the tone of the students' responses, whether positive or negative, that are connected to their learning outcomes in the mathematics classroom. Therefore, the above overview of analytical framework requires the researchers to choose an analytical framework for the study's classroom discussion.

Sequences and Series

In Nigerian senior secondary school education, mathematics is taught in six branches: Number and Numeration; Geometry and Mensuration; Everyday

Statistics; Algebra and Word Problems; Probability and Trigonometry for Senior Secondary School Mathematics. In senior secondary school, arithmetic and geometric sequences and series are two of the most prevalent kinds that are presented to pupils. An arithmetic sequence is characterized by a constant difference between consecutive terms, while a geometric sequence follows a constant ratio between successive terms. Students who comprehend these two fundamental sequence types are better equipped to tackle problems involving development and decay, financial computations, and even specific physical phenomena (Nwigboji & Olo, 2017).

The study however generated the following research questions: (i) how do the contributions made by students in a think-pair-share mathematics classroom differ from those in a conventional classroom setting? (ii) is there any mean difference on the students' academic achievement in think-pair-share Mathematics classroom and those in the conventional classroom? The study also formulates one hypothesis which states that there is no significant difference in the students' academic achievements in think-pair-share Mathematics classroom and those in the conventional classroom.

Study Context

This study involved two groups' (treatment and control classrooms) with distinct strategies. The treatment group was taught using TPS strategy and the classroom observations were carried out during the course of the intervention which were videotaped and then transcribed. The students in the treatment group were instructed to think and come up with solutions to mathematical problems. They were then invited to talk in pairs to reach a consensus before presenting each pair's findings to the class as a whole.

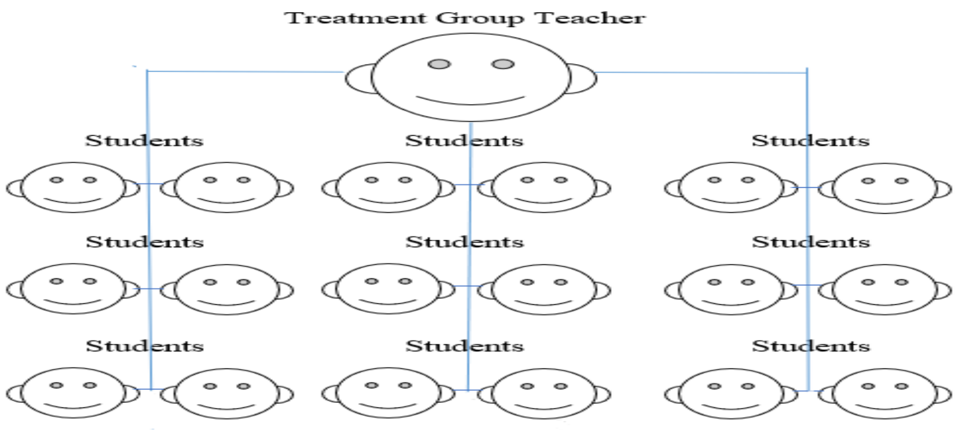

Figure 2. Seating Arrangement in the Treatment Group Classroom

Figure 2 shows the seating arrangement for the treatment group, where students are paired off to comply with TPS. In the control group, the research assistant who served as the facilitator was given the standard instructions that served as the foundation for the training program, together with instructional guide package. Two aspects of the data collection process were (i) Using videotape, the qualitative research data from the class delivery was captured as a transcript, and (ii) the Mathematics Achievement Test, which was administered both before and after treatment. Without any classroom interaction, questions were posed to the control group's students. As seen in figure 4, the control group was not given any guidance regarding seating arrangements.

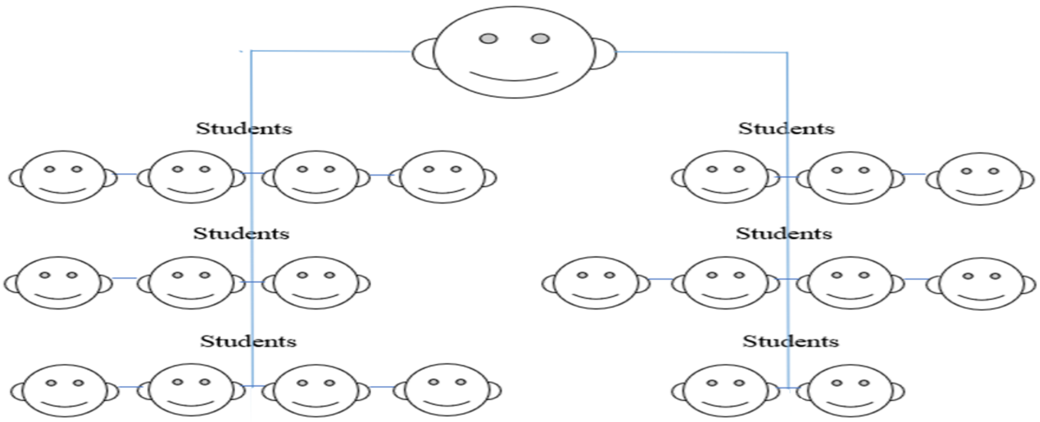

Figure 3. Seating Arrangement in the Control Group Classroom

Figure 3 shows the seating arrangement for the control group, in which students are not partnered. The desks are arranged such that two, three, or four students are seated in each of the classroom's rows and columns. This implies that, in accordance with the traditional method in the control group, the students are sitting whatever they like.

2. Methodology

The researchers employed a mixed method, which combines qualitative and quantitative methods. Creswell and Creswell (2018) distinguished three core design of mixed methods research: convergent design, explanatory design, and exploratory design. The convergent design is used in parallel sequence in this work. The convergent parallel design in the study by Creswell and Plano-Clark (2011) is depicted in the figure 4.

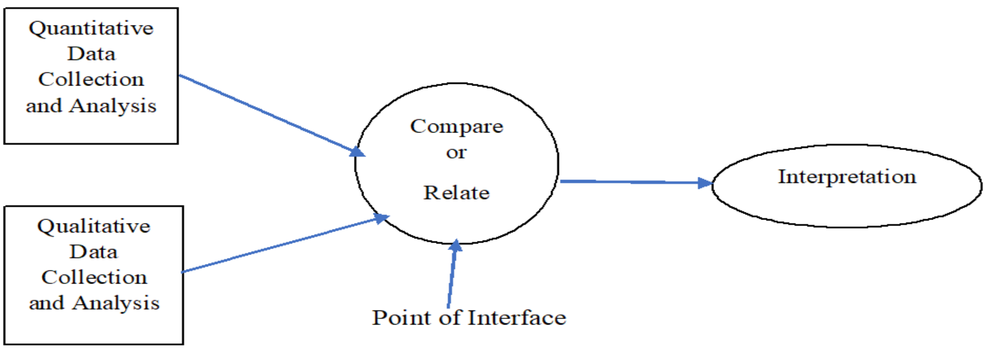

Figure 4. Convergent parallel design (Creswell & Plano-Clark 2011: p. 69)

In search of a suitable method for the qualitative aspect, the researchers examined ways to add to a body of knowledge that are comparable to the case study approach described in McAninch's (2015) literature, which is commonly employed to add to an individual's or group's body of knowledge (Yin, 2003). In essence, qualitative research design was an inquiry-based study method that guarantees a thorough understanding of a phenomenon. Using the quasi-experimental design was based on this selection procedure. A non-randomised pre-test and post-test on Sequence and Series in Mathematics is administered before and at the end of the treatment lasting for six weeks.

Population, Sample and Sampling Technique

The study population is domiciled in Lagos State which is one of the 36 states in Nigeria. The State was created in 1967 and is organised into six educational districts, each of which is in charge of overseeing and coordinating public schools in particular regions of the state. Based on the Lagos State Government Ministry of Education (2019) for annual public-school census, the study's population comprises 74,339 Senior Secondary Two (SS2) students enrolled in Lagos State's public secondary schools. The SS2 population was chosen for the study because the students' chosen topic was found in their scheme of work. Educational district V is conveniently selected which include Ajeromi Ifelodun; Amuwo Odofin; Badagry and Ojo. The study sample consists of two non-equivalent (intact) classes of students who attend public schools in the district, as treatment and control groups.

The sample was chosen to make sure the phenomena of interest were present and visible, not to represent the study's larger population. The researchers believed that the data collected from the two samples was sufficient to investigate how students' contributions to the mathematics classroom relate to their academic achievement. Since the lessons and exercises were videotaped for the aim of gathering qualitative data, the same sampling method was applied to both the qualitative and quantitative designs. In order to observe and videotape these subjects during their classes, the sample size was maintained small. The researchers made certain that the topic matter accurately reflected the concepts of the SS2 (grade-11) students.

Instrumentation

The Mathematics Achievement Test (MAT) was the instrument used in this study. The MAT included five essay questions and 25 multiple-choice questions drawn from the ideas of geometric progression and arithmetic progression. With the intervention in between, the MAT was given as a pretest and a post-test. It was validated by face and content validity with the assistance of some colleagues and a research study expert who carefully reviews it and makes structural corrections, adjustments, and suggestions to improve the instrument before it is finally finalized for administration.

The researchers used Kuder- Richardson formula 21 (K-R 21) method to determine the reliability of the items which returned the reliability coefficient of 0.85. Apart from the instrument mentioned above, the data collection in the study also includes the classroom observation which was video recorded and transcribed. The qualitative aspect involved consensus coding of inter-rater reliability (IRR) which implies the degree of agreement between different researchers (or coders) when analysing the data. A better IRR was achieved by training research assistants and making sure they comprehend the coding scheme.

Data collection

The volunteered teacher for each school served as a facilitator after being trained for two weeks. The researchers gave the pre-test to both treatment and control groups of the selected school prior to intervention in order to gauge their involvement in the six-week study. The pretest was administered in the first week, followed by the first lesson in the second week, the second lesson in the third describe the instruments in detail week, the third lesson in the fourth week, the fourth lesson in the fifth week, and the post-test in the sixth week. A total of eight lessons (four for each school) were recorded throughout the study. All of the exercises were videotaped for classroom observation, and the recordings were transcribed and coded using the Brodie (2008) analytical framework. The control group received instruction using conventional method, whereas the treatment group underwent a step-by-step implementation of TPS as shown in figure 5.

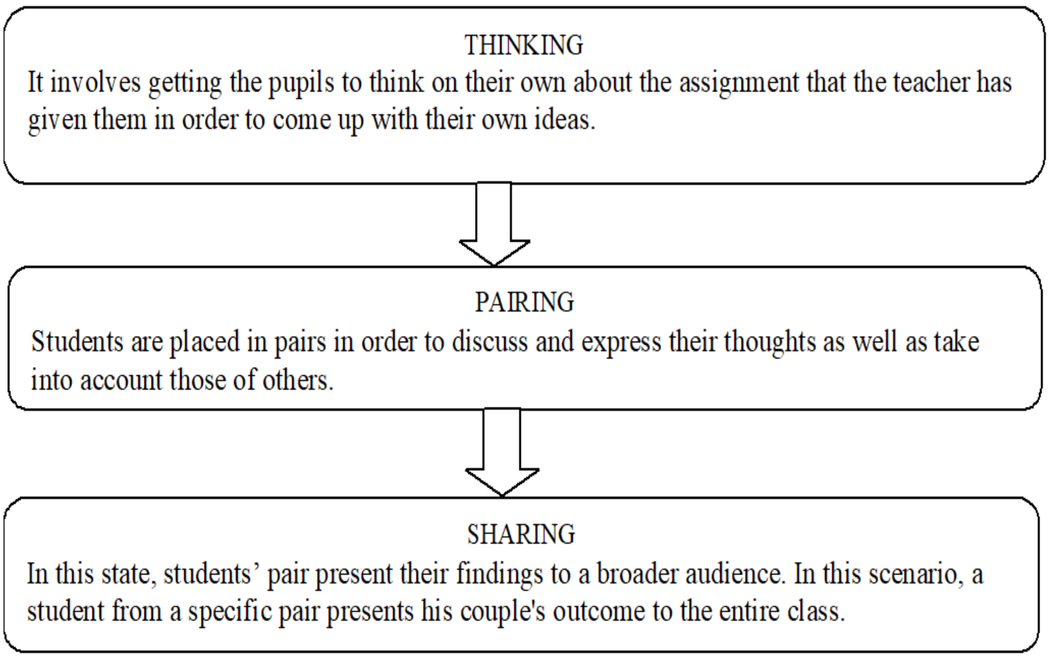

Figure 5. Steps illustration of Think-Pair-Share strategy

Step 1: Thinking

By providing them a set amount of time, the facilitator invited the students to address the problem or issue presented to them on their own, giving them the chance to contribute to the learning process in the classroom. They might respond to the question with some writing (Karnasih & Sinaga, 2014). Decisively, the facilitator gives the students a chance to evaluate a particular subject on their own.

Step 2: Pairing

This stage gives the facilitator the opportunity to ask the class to divide into pairs and debate their thoughts on the given question. Every student would be able to talk about and share the conclusions drawn from the thinking phase with his peers as a result. They also share thoughts and opinions in order to come up with a shared response for a subsequent presentation (Christine, 2001).

Step 3: Sharing

As the students shared their opinions and right responses, the facilitator would get the entire class talking about the subject. This entails a lengthy class discussion in which each pair will lead the conversation to identify parallels or divergences in the responses or viewpoints of different pairs (Tint & Nyunt, 2015). This step goes without saying that asking the students to evaluate or comment on the responses that the pairs would provide to aid in their development as critical thinkers.

Data analysis

The data was analysed in a methodical manner, starting with the parametric assumptions being evaluated and then moving on to the inferential statistics. Both groups had positive findings from the Shapiro-Wilk's test of normality: the treatment group ($N = 60$) = 0.96, $p > 0.05$, and the control group ($N = 54$) = 0.96, $p > 0.05$. The data is said to have a normal distribution if the Shapiro-Wilk Test's significance value (Sig.) is greater than 0.05 (Nguyen & Le, 2020; Olafsson, & Thoroddsen, 2022). Further confirming that there were no significant differences between the two groups was the Levene's test, which looked at their homogeneity ($F = 2.17$; $P > 0.05$). The equality of variance assumption is satisfied if the Levene's test significance value is higher than 0.05 (Choi, & Lee, 2021; Park, & Kwon, 2022).

The study participants were not randomly assigned to groups. Once these presumptions were satisfied, the students' achievement scores in both groups were analysed using the Analysis of covariance (ANCOVA) statistics at 0.05 significance level for the quantitative part while descriptive statistics (bar chart and percentage count) were used for the qualitative aspect of the study. For the ANCOVA, the pretest results were used as the covariate, the teaching strategies were regarded as the fixed factor, and the achievement scores were the dependent variable. Since the students were not randomly assigned to groups, the researchers had to apply analysis of covariance to partially determine the impact of any initial difference between the treatment and control groups, which could have distorted the conclusions of the data. IBM-SPSS version 23 was used to analyse the data that was gathered.

3. Results and Discussion

The contributions made by the students were the main emphasis of this study towards academic achievement when discussing in the classroom. To guide the researchers in this way, a research question was created at the beginning of the study. The Brodie's (2008) category earlier introduced are used to analyse the classroom data, that is, the video recordings of the lessons from the treatment and control groups in order to answer the first research question.

Students' Contributions in the Classroom

To respond to the first research question, which examined how do the contributions made by students in a think-pair-share mathematics classroom differ from those in a conventional classroom setting, the percentage bar chart is computed to show the difference in quality of the students' contributions in the treatment and control groups as shown in the Figure 6.

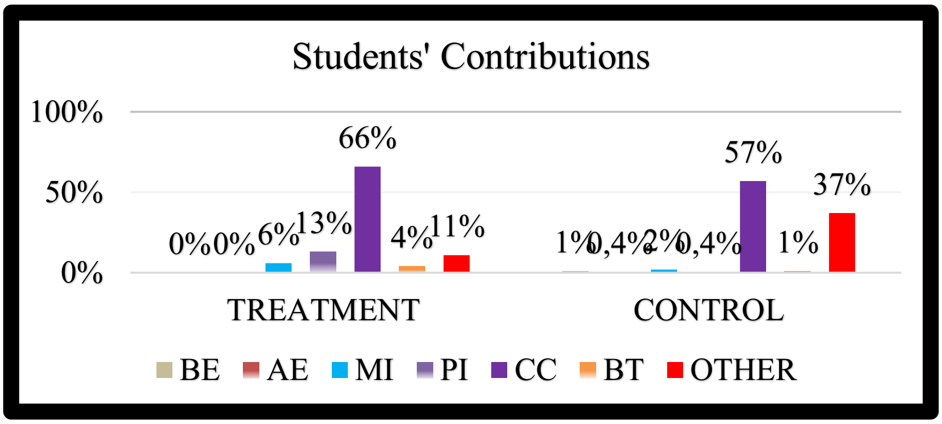

Figure 6. Students' contributions in the treatment and control groups

The bar chart displays the percentage value of the students' contributions, taking into account Figure 6 above, which depicts the categories of the students' contributions that defined the classroom contributions in both the treatment and control groups. This shows how much each student contributed to the delivery of every lesson in the treatment and control groups. The lessons in the treatment and control groups demonstrate that the majority of the students' contributions are in the form of CC. The students' responses to the task in both the treatment and control groups are reflected in the CC contribution.

The classroom is more engaged because students always contribute in proportion to the teacher's words in both the treatment and control groups. To this end, the researchers examine the CC contributions preponderance in one of the transcripts and consider the treatment group lesson one contributions extract as shown below:

26 Teacher: Well defined group is very important, well-defined group; very, very important.
27 Students: *Silence*

28 Teacher: This time around, we want to start up with a topic, Arithmetic Progression.
But before then, I want to give an example of a sequence. For instance when you write something like this (*pointing to 2, 4, 6, . . .*) blah, blah . . . is a what?
29 Chorus: Sequence
30 Teacher: Now when you have something like this *(pointing to 2 + 4 + 6 +, . . .)*
31 Chorus: Series.
32 Teacher: It is called a . . . .
33 Chorus: Series
34 Teacher: This a sequence (*pointing to 2, 4, 6, . . .on the board)*, this is a series *(pointing to 2 + 4 + 6 + . . .on the board).* Right now, we are going into a very topic, common series and sequence are *(not clear)* … lots of topic. We have arithmetic progression; we have the …
35 Chorus: Geometric Progression.
36 Teacher: But for this class, I want to quickly take a look at Arithmetic
37 Chorus: Progression.

The CC contribution is mostly used to characterize the quality of the students' contributions, as the accompanying excerpt suggests. This can be seen from the lines 29, 31, 33, 35 and 37, the students' contributions reflect their replies to the task. By doing this, the teacher gets positive feedback from the students, which motivate the teacher to share more expertise during class discussions. Conversely, the researchers examine the CC contributions preponderance in one of the transcripts and considers the control group lesson four contributions extract as shown below:
97 Teacher: Number of term.
97 Students: *Silence*
98 Teacher: Therefore, we have to …, our last *term* … a times r raises to power n Minus one. What is our last term?
99 Students: *Silence*
100 Teacher: One thousand, four hundred and fifty-eight equal to *(pause)*…, …a, give us what?
101 Chorus: Two.
102 Teacher: Multiply by …
103 Chorus: Three raise to power n minus one
104 Teacher: Divide both sides by two. This *(pointing 2 on the board)* will go; we are
having two in fourteen.
105 Chorus: Seven.

The CC contribution is mostly used to characterize the quality of the students' contributions, as the accompanying excerpt suggests. The lines 101, 103, and 105 clearly show the students' reactions to the challenge. This demonstrates how, for a certain amount of time during class discussions, the students' contributions are mostly linked to giving the right response and only sporadically linked to indecisive choices. By doing this, the teacher gets positive feedback from the students, which motivates the teacher to work harder and influence the classroom discussion. Generally, the distinction between the quality of students' contributions is evaluated by comparing their performance in think-pair-share and conventional classrooms.

First, the BE contribution is marginally reported in the control group but completely absent in the treatment group. The BE contribution difference between the treatment group and the control group is 1%. Second, the control group hardly ever records the AE contribution, but the treatment group does not. The control group outperformed the treatment group by 0.4% in terms of the AE contribution. Third, the treatment group records a higher MI contribution than the control group. The treatment group outperformed the control group by 4% in terms of the MI contribution. Fourth, the treatment group records a higher PI contribution than the control group.

The treatment group outperformed the control group by 13% in terms of the PI contribution. Fifth, compared to the treatment group, the control group's CC contribution is higher. The treatment group outperformed the control group by 9% in terms of the CC contribution. Sixth, the treatment group's BT contribution is higher than that of the control group. The treatment group outperformed the control group by 3% in terms of the BT contribution. Seventh, compared to the treatment group, the control group has more records for the OH contribution. The control group outperformed the treatment group by 26% in the OH contribution category.

Above all, this study part highlights various variations in the nature of the contributions made by the students in the treatment and control groups. It is noted that the CC and OH are used to describe the contributions made by the students in the treatment and control groups. Students are able to contribute more when the Think-Pair-Share method is used in the treatment group because of the strategy. The correct contributions (PI, CC, and BT contributions), which make up 83% of the students' contributions in the treatment group and 58% of the students' contributions in the control group, are mainly accurate.

Likewise, the percentage of incorrect contributions (BE, AE, and MI contributions) in the treatment and control groups are 6% and 3%, respectively. With percentages of 11% and 37% in the treatment and control groups respectively, the remaining contributions are noted under OH. As a result, the Think-Pair-Share classroom's students' contributions are recorded with more accurate answers than the control group, while the treatment group's other contributions are recorded with fewer errors than the control group.

Students' Academic Achievement

To respond to the second research question, which examined the mean difference on the students' academic achievement in think-pair-share Mathematics classroom and those in the conventional classroom, the table 1 shows the mean and standard deviation of the two groups.

Table 1. Mean and standard deviation of group performances in the pretest and the post-test

Index	**Statistics in the Pretest**		**Statistics in the Post-test**	
	Treatment	**Control**	**Treatment**	**Control**
Mean	14.60	16.59	24.02	20.52
SD	6.76	8.09	7.69	10.18

According to Table 1's analysis, the treatment group's mean post-test score was 24.02 points higher than its pretest score of 14.60. The treatment group's standard deviation number shows a similar pattern, with the post-test value of 7.69 being higher than the pretest value of 6.76. While the control group's mean post-test score was 20.52 points higher than its pretest score of 16.59. The control group's standard deviation number shows a similar pattern, with the post-test value of 10.18 being higher than the pretest value of 8.09.

Research Hypothesis: To respond to the research hypothesis, which says: there is no significant difference in the students' academic achievements in think-pair-share Mathematics classroom and those in the conventional classroom, the inferential statistics of this students' performance is analysed using the Analysis of Covariance (ANCOVA) as presented in the Table 2.

Table 2. The ANCOVA of the students' achievements in the treatment and control groups

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	5168.36[a]	2	2584.18	68.92	0.00	0.55
Intercept	1488.09	1	1488.09	39.69	0.00	0.26
Pretest	4820.57	1	4820.57	128.57	0.00	0.54
Group	772.31	1	772.31	20.60	0.00	0.16
Error	4161.89	111	37.50			
Total	66325.00	114				
Corrected Total	9330.25	113				

a. R Squared = .55 (Adjusted R Squared = .55)

The outcome demonstrates that the performance differences between the pupils in the treatment and control groups are statistically significant. Table 3 shows that the F-value for the pretest, [F (1,113) =128.57; p<0.05], is significant at 0.00. This suggests that, prior to the interventions, there was a substantial difference between the performance of the students in the think-pair-share classroom and the students in the conventional classroom. Following the interventions, the post-test F-value of [F (1,113) =39.69; p<0.05] is likewise significant at 0.00 for the achievement of the students in the think-pair-share classroom and those in the regular classroom. Meanwhile, table 1, shows that the treatment group over performed than control group after the intervention. As a result, hypothesis H_{01}, which states that there is no significant impact in the students' academic achievements in think-pair-share Mathematics classroom and those in the conventional classroom, is rejected.

Discussion of results

The first research question examines how the contributions made by students in a TPS mathematics classroom vary from those in a conventional classroom setting. The study's conclusions showed that students' contributions in TPS classes differed from those in conventional class. The majority of the students' contributions in TPS classes are CC. The responsive teacher's corresponding discussion in the classroom conversation, which is highly directive to the students, is discovered to be the reason for these high-quality students' contributions. This conclusion supports the view in the literature that the directing pattern of the teacher's speech to the students is responsible for the shift in the teacher's movements with a high percentage of the CC contributions in the classroom discourse (Hand, 2012; Brodie, 2008).

The contributions made by the appropriate students in the classroom are deemed to be sufficient responses to the teacher's utterances because the teacher's arguments predominate. This conclusion supports the idea in the literature that the directing pattern of the teacher's speech to the students is responsible for a shift in the teacher's movements with a high percentage of the CC contributions in the classroom discourse (Author, 2021; Author & Author, 2021b; Hand, 2012; Brodie, 2008). Decisively, the majority of the students in the treatment and control groups contributed CC in terms of giving a sufficient response to the assigned activity.

The second research question examine the mean difference on the students' academic achievement in TPS Mathematics classroom and those in the conventional classroom which also have an associated research hypothesis. The research hypothesis states that there is no significant difference in the students' academic achievements in TPS Mathematics classroom and those in the conventional classroom. This shows that the TPS classroom and the conventional classroom had a significant difference at 0.00 on the post-test and on the pretest. Also, both the pretest and post-test values for this study' inferential statistics show that students' academic achievement in Think-Pair-Share classrooms are substantially higher than those in conventional classrooms.

In terms of the teaching method employed to convey the course materials, it also shows that students' achievement levels in TPS classrooms have significantly improved when compared to conventional classrooms. The TPS method allows students to express themselves freely in the classroom and has been shown by several researchers to have a greater impact on academic achievement in TPS classrooms than in conventional classrooms (Author & Author, 2021a; Hansuk, et al. 2024; Ogunyemi, et. al. 2020).

It is in this vein of the effectiveness of TPS strategy for improving academic achievements as Hamdan (2017) opines that Think-Pair-Share strategy is one of the active group conversation strategies used as a method of learning collaborative and falling within the curved structure. In another context, The TPS method, according to Farrajallah (2017), transforms the classroom into a scientific, cultural, and entertainment arena that appeals to students' souls and conveys knowledge in an engaging way.

The theory underlying the study by Piaget (1976), knowledge is constructed through interaction with the environment and cognitive development could be the explanation for the notable difference in achievement between the treatment and control groups in the TPS classroom. Students participate in active learning during the "Think" phase of TPS, where they individually consider a mathematical topic. According to constructivism, students actively create meaning through social interaction and introspection (Vygotsky, 1978).

Their participation in TPS enables people to work together to develop knowledge, overcome cognitive issues, and provide support. They develop a deeper level of comprehension by building on prior information and cognitive processes (Piaget, 1976). The focus of cognitive theory is on how students' contributions are influenced by mental processes like memory retrieval, cognitive load, and problem-solving. Working together in TPS improves comprehension and problem-solving skills by lowering cognitive load and encouraging metacognition.

Essentially, during the intervention, it was noted that students in the TPS classroom were more at ease asking questions, relating to others, and participating in class discussions in both the treatment and control groups. With the exception of a few student contributions that are seen, all learning activities in the control group are conducted by the teacher. Additionally, compared to the conventional classroom, the treatment group's students' contributions have greater significance. This contributes to the notable distinction between the learning outcomes in the TPS classroom and the traditional classroom. This sums up the general conclusions on the academic achievements.

Limitations

Inability of the researchers' to randomise the classroom as a result of school administration prohibited. The involvement of different classroom teachers for the two groups because they have distinct teaching philosophies and various backgrounds. Inability to record all of the behind-the-scenes exchanges or activities on multiple video tapes. Additionally, as part of the study limits, the school activities that were originally planned in the program have been modified to make room for additional events like sports and cultural days. Above all, the researchers had taken every precaution to guarantee that the study's importance was unaffected by the aforementioned constraints.

4. Conclusion

The study examined the difference between students' contributions in think-pair-share mathematics lessons and academic achievement in senior secondary school. The results of the study indicate that academic success is associated with the quality of students' contributions, which are believed to have a greater impact in Think-Pair-Share classes than in conventional classrooms. The academic results of the TPS classroom are perhaps better than those of the conventional classroom because of the approach that allows for full student participation.

Research has repeatedly shown how crucial peer interaction is for developing a deeper comprehension and improving mathematical problem-solving skills (Zhang & Wang, 2021). Students' academic engagement and accomplishment are greatly enhanced by the use of TPS in the classroom, particularly in disciplines like mathematics where it can be difficult for students to understand complicated ideas. Since students are encouraged to explain their thoughts and gain insight from the viewpoints of their peers, the active participation that TPS strategy offer fosters a sense of ownership over learning.

Ultimately, integrating TPS into mathematics lessons helps students succeed academically as well as develop critical thinking, communication, and teamwork skills all of which are critical for success in the classroom and beyond (Stewart, 2022). To further understand how these tactics affect teaching methods and student outcomes, future studies should concentrate on their long-term consequences, especially in different classroom environments. Thus, it is observed that the students relate to one another without prejudice or fear in TPS classroom.

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