EFFECTS OF LESSON STUDY AND THINK-PAIR-SHARE INSTRUCTIONAL STRATEGIES ON STUDENTS' ACADEMIC PERFORMANCE IN CIRCLE GEOMETRY

By

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Abstract

Students' appalling achievement in both internal and external examinations in Mathematics has been worrisome to stakeholders in education. Studies have attributed this to the use of traditional teaching methods that is still rampant in the 21st century classrooms and advocated for paradigm shifts to contemporary teaching methods. This study therefore investigated the effectiveness of teacher's lesson study and Think-Pair-Share instructional strategies on students' performance in circle geometry. It also examined the interactive effect of cooperative learning strategy, teacher's lesson study and gender on students' performance in circle geometry. Stratified random sampling technique was used to select 184 Senior Secondary Two (SS II) students from the intact classes of three selected secondary schools from the three senatorial districts of Ekiti state, Nigeria. Circle Geometry Performance Test (CGPT, r=0.84) was used for the study. The four hypotheses were tested at 0.05 level of significance. The data gathered were analysed using Analysis of covariance (ANCOVA) and the Bonferroni post hoc test was carried out to reveal the specific means that differed. The result of the study revealed significant effect of teacher's lesson study ($F_{(1,127)}=237.70$; $p=0.00<0.05$) and cooperative learning strategy ($F_{(1,112)}=174.27$; $p=0.00<0.05$) on the performance of students in circle geometry. It also showed teacher's lesson study and cooperative learning strategy are comparatively different in their effectiveness on the performance of students in circle geometry ($F_{(2,180)}=154.08$; $p=0.00<0.05$). The findings revealed no interactive effect of instructional strategies and gender on students' performance in circle geometry ($F_{(2,177)}=2.35$; $p=0.10>0.05$). The finding also point to the fact that teacher's lesson study is more effective in improving students' performance in circle geometry. Based on the findings, it was recommended that teachers engage in lesson study and use cooperative learning strategy to improve their instructional practices and enhance the learning of circle geometry.

Key words: Cooperative Learning, Lesson Study, Think-Pair-Share, Performance, Circle Geometry.

Introduction

Learning geometry in Nigeria's primary and secondary schools is critical to the acquisition of general knowledge by the students as it enhances their logical reasoning and manipulative skills. Higher levels of scientific knowledge and the ability to operate in society need students to have a basic understanding of geometry. This aspect of Mathematics is taught in schools to help students become well-rounded problem solvers who can use their logical and manipulative skills in the real world situation. Despite its importance and wide range of applications in daily life, geometry is often seen as a challenging topic in the learning of Mathematics.

According to studies, both internal and external assessments show that students' performance in Mathematics at both levels is poor and inconsistent (Ajani & Olabode, 2018; Durojaiye, 2016; Unodiaku, 2018). The government, students, teachers and even parents have all placed blame on one another for the consistently dismal Mathematics scores of our nation's youth. The researchers have identified attitudes of students toward the subject, a lack of teaching experience, economic situations, a lack of proper pedagogical skills, and low motivation and attitudes among teachers and students as factors of poor academic performance in mathematics. Suffice to note that among the reasons leading to poor performance is the pedagogical aspect (Nyaumwe, 2011). Numerous variables affect the effectiveness of mathematics instruction, which is a very challenging task. The type and quality of instructional materials, the delivery of content, the pedagogical abilities of the teacher, the school environment, and the motivation of students are all crucial and must be considered in any attempt to guarantee the quality of mathematics teaching and learning. Likewise the Ministry of General Education embarked on STEM Education which advocates for a paradigm shift in the teaching of Mathematics from the ordinary traditional methods of teaching which is mostly lecture type and fails to equip students with skills and knowledge required for survival and Job Creation. The Traditional methods of teaching which mainly embrace deduction as opposed to induction are no longer adequate to meet the demands of modern mathematics Education and are responsible for high failure rate by the Grade 12 pupils (Alshafey & Aldosary, 2021). The quest to produce a learner that is critical, creative and analytical in thinking and able to relate thinking to real life situations lies in the way Mathematics is taught (Carmichael, 2017).

Ogwu (2019) ascribed tending towards 21st century methods of teaching to attaining quality and progress in educational sector. This corroborates the assertion of Mkpa, (2009) that remarked that a successful lesson is accountable with the method applied. These tell more of the fact that the method(s) of instruction employed by the teacher in the course of instruction are very germane in determining the success or otherwise of the lesson. Alison (2019) opines that instructional method ensures greater effectiveness and efficacy in the acquisition of knowledge or skill by learners.

However, it is appalling to still note that the use of traditional teaching methods by teachers are still rampant in the 21st century classrooms and this Akuakanwa (2017); Offorma and Obiefuna (2017) and Ogwu and Azor (2019) had attributed to the reason for students' poor

learning outcomes. It is therefore important to have paradigm shift from the orthodox method of teaching and apply the contemporary teaching methods in the teaching of school subjects in a developing country like Nigeria.

Besides, studies (Unodiaku, 2018; Ajani & Olabode, 2018; OnwuIji, Omenka & Akpan, 2018), have ascribed students' poor performance in Mathematics to students' pitiable performance in geometry, as geometry is so often the school Mathematics topic that students remember with unpleasantness and dread most.

Geometry is a core aspect of the Mathematics curriculum that is essential to the development of spatial awareness and geometric reasoning skills among students. Mathematical reasoning and reasoning skills may be developed and strengthened by studying geometry, which is like a tool for thinking logically. Geometric and productive thinking rely on the capacity to reason about connections inside and between geometric forms. As a result, students are required to engage in reasoning tasks and acquire particular geometric thinking abilities that will aid in their future study of geometry. The WAEC Chief Examiners' Reports from 2015 to 2018 has identified circle geometry as a difficult area in Mathematics for students. Durojaiye (2016) also identified it as one of the topics in Mathematics that was found to be difficult to complete properly when they were part of questions that had to be answered compulsorily, hence most students avoided them when they were optional. According to the 2016 WAEC Chief Examiners' report, students' poor performance in circle geometry may be linked back to issues relating to the teaching approaches and methods adopted by the teacher.

There have been several studies (Ajani & Olabode, 2018; Durojaiye, 2016; OnwuIji, Omenka & Akpan, 2018; Timayi, Bolaji & Kajuru, 2015; Unodiaku, 2018) pointing to the difficulties that students experience while studying circle geometry. Deductive reasoning and visual recognition of geometrical properties (theorems), difficulties in learning appropriate language for understanding and discussing geometric principles. Despite the fact that circle theorems are a basic and beautiful notion in geometry, students have found the different theorems they must memorise to be a serious struggle (Hissan & Ntow, 2021). Students having the knowledge of the core Mathematics curriculum see circle geometry as abstract and technical, making it one of the most difficult concepts to grasp. It is common for teachers to not correctly present the notion of circle theorems to students in order for them to comprehend it 'before advancing fast' toward its features and solving related problems (Ntow & Hissan, 2021).

Teachers adopting a teacher-centred method of teaching for teaching whereby the teacher remains active while the learners are passive throughout the lesson, this could made the lesson uninteresting and difficult for the students to learn. These ways of teaching has been described as being ineffective (Seweje & Jegede, 2005; Popoola, 2014; Falebita, 2019). There is a need for the adoption and usage of student-centred methods or strategies; methods and strategies that will make the teaching and learning of circle geometry fascinating and productive. Co-operative learning has been recognized as an important instructional strategy that enhances Mathematics learning and promotes social interaction (Falebita, 2019).

Cooperative learning allows the teacher to divide students into small different groups, and thus the students work together to assist each other understands academic content. The heterogeneous groups of students work together to tackle the assigned class tasks in a co-operative manner by combining their thoughts to find the best answer. 'Positive interdependence, positive interaction, individual accountability, teaching of interpersonal and social skills and quality of group processing' are the five basic element of cooperative learning as stated by Johnson and Johnson (1999). In cooperative learning, positive interdependence entails students working together as an interconnected group to achieve learning objectives (Johnson & Johnson, 1999).

Cooperative learning does not take place if students are placed in groups without a good interdependence among one another that is, learners in the group will ensure that they complete the given tasks and achieve the learning objectives together with their counterparts. Kolawole (2007) revealed that students taught with cooperative learning strategies perform better than their counterparts taught with competitive learning strategies and conventional method. Popoola and Adewumi (2013) also found out that cooperative learning strategies are more potent than individualistic learning strategies in improving students' performance in Mathematics. Gambari and Yusuf (2014) who examined three cooperative learning strategies and their effects on performance revealed that all the forms of cooperative learning strategies examined are effective in enhancing students' performance.

Various studies (Chianson, Kurumeh & Obida, 2010; Eniayeju, 2010; Falebita, 2019; Gambari, 2010; Johnson & Johnson, 1999; Kolawole, 2007; Ndubisi & Ekwueme, 2018; Okigbo & Ogoke, 2016) have found an appreciable impact of cooperative learning strategies on the cognitive, affective and psychomotor skill performance of students. This study would be considering Think-Pair-Share (TPS) as a cooperative learning strategy which could improve students' performance in circle geometry. TPS is an active learning technique that allows students to reason through a challenge, collaborate with a colleague in a group, and discuss solutions in the classroom. Using TPS in the classroom allows students to work together to solve issues or complete tasks assigned by the teacher.

Considering TPS as a form of cooperative learning which basically involves three stages: Thinking, Pairing and Sharing. The teacher presents the class with a task after brief discussion or introduction to the task. At the thinking stage, the teacher allows the students to think about the task and pen down personal ideas about the task presented to them, this last for 3 to 5mins. At the pairing stage, the teacher allows the students to form groups of twos and maximum of three where the number of students in the class is not even. This can be done by simply instructing students to turn to the person close to them to avoid wasting time. At this stage, the students within the groups compare the individual responses and agree on the best solution. At the sharing stage, representative from the groups are allowed to share their conclusions with the entire class. After this, the teacher summarizes and concludes the task (Falebita, 2019, Johnson & Johnson, 1999). Falebita and Olofin (2020) found a significant difference between students exposed to TPS, which is a form of cooperative learning strategy and their counterparts taught with conventional learning

strategy. Pichaya (2015) also revealed that TPS learning strategy significantly influence students' performance and disposition towards Mathematics.

Lesson Study instructional strategy is another instructional strategy found to aid students' Mathematical performance especially in geometry (Easton, 2009; Pektas, 2014; Dogo, 2017; Dogo, Kyeleve & Kurumeh, 2018). A professional development programme for teachers such as Lesson Study is an instance of this. A teacher's effectiveness in the classroom is evaluated in order to improve the next lesson's content and pedagogical levels. A colleague often does this evaluation through observation. The goal of lesson study is not to create and deliver the optimum lesson, but rather to enhance the teaching methods used by teachers and the knowledge gained by students. To enhance teaching and student learning, teachers engage in a teacher-directed professional development process known as lesson study (Yoshida, 2005). It is a paradigm of professional development intended to aid teachers in creating high-quality lesson plans and gaining a deeper knowledge of students' learning. Unlike other teacher professional development programmes, this one encourages teachers to take a more active role in their own development. Teachers in conventional professional development programmes tend to be passive, receiving a lot of knowledge but having little or no chance to express their own opinions and ideas. Lewis (2002) found that students' performance on mathematics achievement tests improved significantly when teachers engaged in lesson study. Teachers' lesson study, according to Popoola & Falebita (2016), has a considerable positive impact on students' academic performance and their own professional development as educators. A teacher's lesson study had no discernible effect on the academic performance of male or female students.

Lesson study originates from Japan. The Japanese educators participate in a process which was tagged "lesson study" as a means of professional development in which they critically analyse their teaching methods in order to improve such methods (Easton, 2009). Beginning in Japan's primary schools, lesson study has become a popular method for enhancing classroom instruction globally. The Lesson study of teacher are carried out in three stages; preparation, presentation and observation, and review. At the preparation stage, the lesson study group come together to plan the lesson. At this stage, they examine the topic, availability of lesson note, instructional objectives, instructional materials, instructional strategy and organization of content. This is collaboratively considered and workout by the teachers in the lesson study group and come up with the better content for presentation. The second stage is the presentation and observation; the presentation of the lesson in a sequential and logical manner takes place while observation by atleast two teachers from the lesson study group also goes on simultaneously. At this level the observing teachers examined the ability to organise his or her presentation, knowledge of subject matter, proper use of language and diction, skilled use of the blackboard, time management skills, questioning skills, class activities and interactions, the capacity to encourage students, use of teaching aids, assessment activities, class management, class arrangement, class organization, summary of lesson, alertness to class problem, follow-up assignments and student participation among others. Evaluation of lesson in terms of suitability of assessment is examined. Teacher's personality/professional attitudes and

values are another thing to be examined during the lesson study of teachers; this looked into teacher's appearance (dressing, neatness), willingness to teach, emotional stability, and confidence of the teacher. At the review stage that comes up at a scheduled time after the lesson or rather before the next lesson, all the observations made are analyzed and examined by all the group teachers. Suggestions and ideas on how to improve on the areas of weaknesses would be addressed. This always makes the teacher deliver a lesson with improved knowledge and skills. (Popoola and Falebita, 2016). This suggests that there could be great improvement in students' learning outcomes when teachers come together in the lesson study to solve problems related to the teaching and learning of Mathematics.
Gender may influence the performance of students in Mathematics. In terms of performance, Mathematics is often seen as a field in which males excel. In his study of the effects of cooperative and competitive learning on the academic achievement of students in Mathematics, Kolawole (2007) found that males outperformed girls in both learning techniques. Popoola (2014) found that female students are less effective in studying Mathematics owing to their lack of enthusiasm, confidence, and academic expectations. The gender difficulties related with the learning of Mathematics might be resolved by using a cooperative learning strategy and teacher's lesson study.
In the research conducted by Gambari and Yusuf (2014), Balfakih (2003), and Adeyemi (2008) on the impact of cooperative learning techniques on student performance, there was no significant difference in the performance of male and female students when taught using a cooperative learning approach. In contrast, Kolawole (2007) found that the performance of male and female students varied significantly. He emphasised that male students had superior cognitive, emotional, and psychomotor skill accomplishments than female students.

Statement of Problem

The problem of poor performance in Mathematics among students at both internal and external examinations has been harassing the educational system of the nation. In spite of all the efforts put together by stakeholders aimed at promoting the teaching and learning of Mathematics in schools, it seems the problem of poor performance in Mathematics in Nigeria secondary school remains worrisome. The WAEC Chief Examiners' Reports from 2015 to 2020 have shown that students tend to struggle with problems on circle geometry due to their mathematical skill. Studies revealed that, one of the topics in Mathematics that is perceived to be difficult by both students and teachers is circle geometry. According to the 2016 WAEC Chief Examiners' Report, the teaching strategy adopted for teaching may account for students' low performance in circle geometry. The methods teachers use to teach Mathematics, such as teacher-centered methods in which the teacher takes control of the classroom and leaves students inert and uninvolved. This has been shown to be inefficient and has not produced the anticipated outcomes. This study therefore examines the effectiveness of teachers' lesson study and Think-Pair-Share instructional strategies on students' academic performance in circle geometry.

Research Question

What is the effect of teacher's lesson study and Think-Pair-Share instructional strategies on students' performance in circle geometry?

Research Hypotheses

1. Teacher's lesson study has no significant effect on students' academic performance in circle geometry.
2. Think-Pair-Share strategy has no significant effect on students' academic performance in circle geometry.
3. Teacher's lesson study and Think-Pair-Share instructional strategies are not significantly different in their effectiveness on students' academic performance in circle geometry.
4. Gender and instructional strategies have no significant interactive effect on students' academic performance in circle geometry.

Methodology

Quasi-experimental design of the pre-test, post-test control group type was adopted for this study. Two experimental and one control groups were formed. The experimental groups were exposed to teacher's lesson study and cooperative learning strategies, while the control group was exposed to the conventional method of teaching Mathematics.

The population for the study consisted of Senior Secondary Two (SS II) students from the public secondary schools in Ekiti State. A sample of 184 SS II students was used. The students were selected from three secondary schools across the three senatorial districts (Ekiti North, Ekiti Central and Ekiti North) in Ekiti State using stratified random sampling technique. The intact classes of SS II classes of the selected participants were used for the study.

Mathematics Teaching Lesson notes were developed in the study to teach Circle Geometry based on each instructional strategy. Two sets of one hundred and fifth (150) parallel multiple choice objective tests were adapted from SSCE past questions on circle geometry and given to experts in educational evaluation and Mathematics education for review in terms of content, relevance, scope of coverage, language of presentation, clarity of expression and overall adequacy. Based on their comments, some of the items were modified while some were removed. One hundred and twenty-five (125) items survived scrutiny. The 125-item instruments were then administered to seventy five (75) SSII students in Osun state. The reliability coefficient of the instruments were calculated using Kuder Richardson 20 (KR-20) method and the instruments yielded a reliability index of 0.86, Twenty-five of the items with extreme (high or low) difficulty indices were removed leaving a total of 100 items on the tests with a reliability index of 0.84 and an average item difficulty value of 0.51. Items with difficulty level of 40% - 70% were selected, others with difficulty level above 70% and below 40% were discarded for being too easy or too difficult respectively. The first set of the instrument was presented as a pre-test to these groups in different classrooms but with equal learning environmental conditions. Their answer scripts were collected for marking and recording after the stipulated time. The students were informed to report at their different classrooms for lessons in a week time. With the help of the prepared lesson plans according to the strategy of the teaching, lessons were

delivered to each group for six weeks accordingly. The post-test was conducted to these students with the use of the second set of instrument. Their answer scripts were marked and recorded accordingly. The scores obtained from the experimental and control groups on the pre-test and post-test were analyzed using mean and standard deviation for descriptive analysis while ANCOVA was used for testing the hypotheses. All hypotheses were tested at 0.05 level of significance and the Bonferroni post hoc test was carried out to reveal the specific means that differed. It is believed that whatever findings that comes out of this study can be generalized as implying a reflection of the role of mode of instruction in teaching and learning of Geometry.

Results

The results of the study were provided in accordance with the research question and hypotheses below.

***Research Question*:** What is the effect of teacher's lesson study and Think-Pair-Share instructional strategies on students' performance in circle geometry?

Table 1: Performance Mean Scores and Standard Deviation of Students exposed to Think-Pair-Share, Lesson Study and Conventional Strategies

Group	N	Pretest		Posttest		Mean Gain	Rank
		Mean	S.D.	Mean	S.D.		
Think-Pair-Share	54	8.000	1.259	18.852	1.907	10.852	2nd
Lesson Study	69	7.783	1.187	19.754	2.323	11.971	1st
Conventional	61	7.492	1.120	12.754	2.743	5.262	3rd

Table 1 show that the pretest mean scores of students in the Think-Pair-Share, Lesson Study and Conventional Strategy groups are 8.000, 7.783 and 7.492 with the standard deviation of 1.259, 1.187 and 1.120 respectively. After being exposed to treatment, the students' posttest mean scores are 18.852, 19.754 and 12.754 with the standard deviation of 1.907, 2.323 and 2.743 for Think-Pair-Share, Lesson Study and Conventional Strategy groups respectively. The mean gains are 10.852, 11.971 and 5.262 for Think-Pair-Share, Lesson Study and Conventional Strategy groups respectively. It was also revealed from the table that based on the mean gain, lesson study had the highest effect followed by the Think-Pair-Share with the conventional group having the least effect. This is further revealed in figure 1.

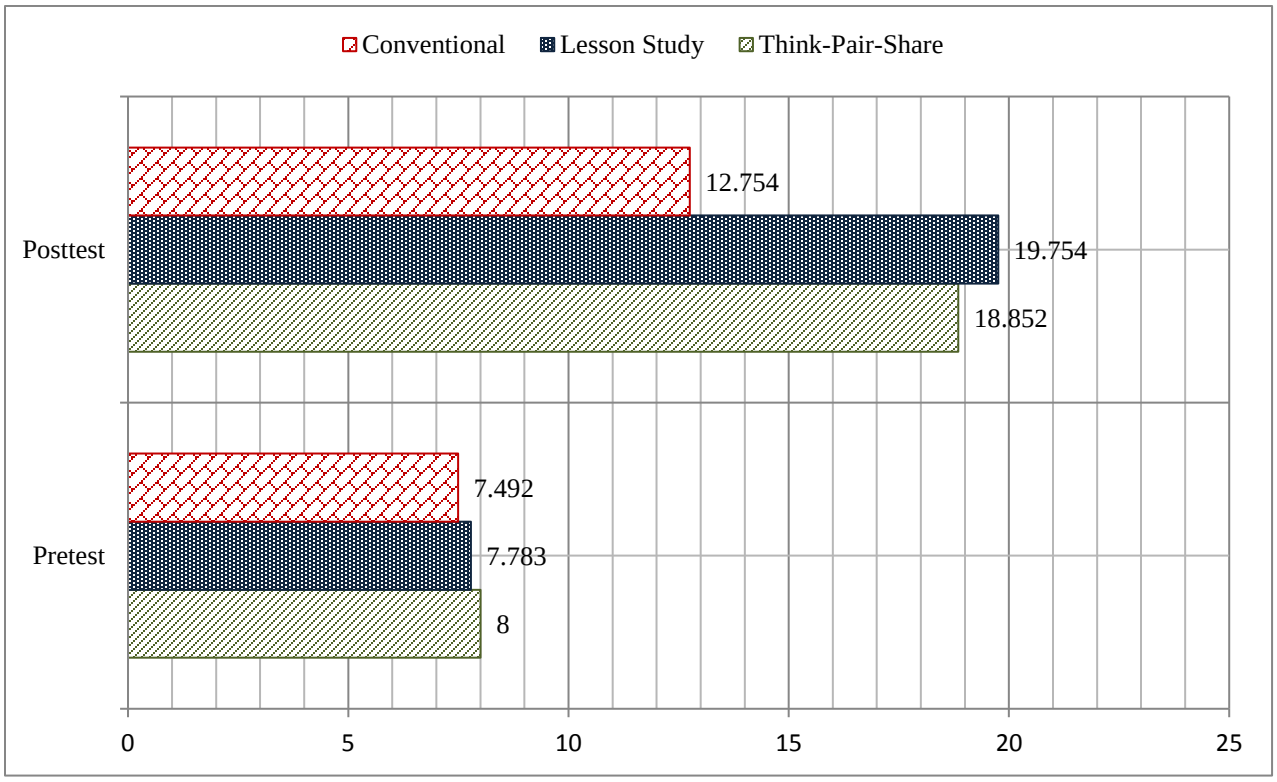

Figure 1: Bar chart showing the performance of students exposed to Lesson Study, Think-Pair-Share and conventional strategies in circle geometry

Hypotheses Testing

Hypothesis 1: Teacher's lesson study has no significant effect on students' academic performance in circle geometry.

Table 2: ANCOVA of the Performance of Students treated with teacher's lesson study and Conventional Learning Strategy

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1590.22[a]	2	795.11	124.03	0.00
Intercept	641.23	1	641.23	100.02	0.00
PRE_TEST	3.96	1	3.96	0.62	0.43
GROUP	1523.85	1	1523.85	237.70	0.00
Error	814.16	127	6.41		
Total	37665.00	130			
Corrected Total	2404.38	129			

a. R Squared =0 .66 (Adjusted R Squared =0 .66)

Table 2 shows that there is significant effect of treatment on the academic performance of students in circle geometry as ($F_{(1,127)} = 237.70$; $p = 0.00 < 0.05$). This implies that teacher's lesson study has no significant effect on students' academic performance in circle geometry. Therefore, hypothesis 1 is rejected. The adjusted R square on the table shows

that the treatment could be responsible for 66% difference in the performance. To determine the magnitude of the mean scores of students in the experimental and control groups, pairwise comparison analysis was used and the result is shown in Table 2.

Table 3: Bonferroni Post Hoc Test (Pairwise Comparisons) of teacher's lesson study and Conventional Learning Strategy

GROUP	N	MEAN	(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Err.	Sig.
L. STUDY	69	19.75	CONV.	L. STUDY	-6.95*	0.45	0.00
CONV.	61	12.75	L. STUDY	CONV.	6.95*	0.45	0.00

Table 3 shows that there is significant difference in the posttest mean scores of students taught with Lesson Study ($\bar{X}$ = 19.75) and those exposed to conventional method ($\bar{X}$ = 12.75). The posttest mean scores difference between the two group is 6.95 in favour of lesson study group and this is significant at $p=0.00<\alpha=0.05$.

Hypothesis 2: Cooperative learning strategy has no significant effect on students' academic performance in circle geometry.

Table 4: ANCOVA of the Performance of Students treated with cooperative learning strategy and Conventional Learning Strategy.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1065.05[a]	2	532.53	92.60	0.00
Intercept	630.29	1	630.29	109.60	0.00
PRE_TEST	0.01	1	0.01	0.00	0.96
GROUP	1002.23	1	1002.23	174.27	0.00
Error	644.11	112	5.75		
Total	29758.00	115			
Corrected Total	1709.17	114			

a. R Squared = 0.62 (Adjusted R Squared = 0.62)

From table 4, it is indicated that there is significant effect of treatment on the academic performance of students in circle geometry as ($F_{(1,112)} = 174.27$; $p= 0.00 < 0.05$). Hypothesis 2 is rejected; this implies that cooperative learning strategy has significant effect on students' academic performance in circle geometry. The adjusted R square on the table shows that the treatment is responsible for 62% of the improvement. To determine the magnitude of the mean scores of students in the experimental and control groups, pairwise comparison analysis was used and the result is shown in Table 5.

Table 5: Bonferroni Post Hoc Test (Pairwise Comparisons) of Cooperative Learning and Conventional Learning Strategy

GROUP	N	MEAN	(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Err.	Sig.

COOP	54	18.85	CONV	COOP	-6.09*	0.46	0.00
CONV	61	12.75	COOP	CONV	6.09*	0.46	0.00

Table 5 shows that there is significant difference in the posttest mean scores of students taught with cooperative learning ($\bar{X}$ = 18.85) and those exposed to conventional method ($\bar{X}$ = 12.75). The posttest mean scores difference between the two group is 6.093 in favour of cooperative learning group and this is significant at p=0.00<α=0.05.

Hypothesis 3: Teacher's lesson study and Cooperative learning strategy are not different in their effectiveness on students' academic performance in circle geometry.

Table 6: ANCOVA of the Performance of Students treated with cooperative learning strategy, teacher's lesson study and Conventional Learning Strategy.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1806.60[a]	3	602.20	107.62	0.00
Intercept	1070.76	1	1070.76	191.36	0.00
PRE_TEST	3.76	1	3.76	0.67	0.41
GROUP	1724.27	2	862.13	154.08	0.00
Error	1007.18	180	5.60		
Total	57049.00	184			
Corrected Total	2813.78	183			

a. R Squared =0 .64 (Adjusted R Squared =0 .64)

Table 6 indicates that there is significant difference in the effectiveness of treatments on the academic performance of students in circle geometry as ($F_{(2,180)}$ = 154.08; p = 0.00 < 0.05). Hypothesis 3 is rejected; this implies that teacher's lesson study and Cooperative learning strategy are different in their effectiveness on students' academic performance in circle geometry. The adjusted R square on the table shows that the treatment is responsible for 64% of the difference. To determine the magnitude of the mean scores of students in the experimental and control groups, pairwise comparisons analysis was used and the result is shown in Table 7.

Table 7: Bonferroni Post Hoc Test (Pairwise Comparisons) of teacher's lesson study, Cooperative Learning and Conventional Learning Strategy

GROUP	N	MEAN	(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.[b]
CONV.	61	12.75	CONV.	COOP	-6.03*	0.45	0.00
				L. STUDY	-6.96*	0.42	0.00
COOP	54	18.85	COOP	CONV.	6.03*	0.45	0.00
				L. STUDY	-0.93*	0.43	0.03
L. STUDY	69	19.75	L. STUDY	CONV.	6.96*	0.42	0.00

				COOP	0.93*	0.43	0.03

Table 7 shows that there is significant difference in the posttest mean scores of students taught with Lesson Study ($\bar{X}$ = 19.75), cooperative learning ($\bar{X}$ = 18.85) and those exposed to conventional method ($\bar{X}$ = 12.75). The posttest mean scores difference between the Lesson Study and cooperative learning group is 0.93 in favour of lesson study group.

Hypothesis 4: Gender and instructional strategies has no significant interactive effect on students' academic performance in circle geometry.

Table 8: ANCOVA of Group by Gender

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1842.92[a]	6	307.15	56.00	0.00
Intercept	1050.57	1	1050.57	191.53	0.00
PRE_TEST	4.94	1	4.94	0.90	0.34
GROUP	1719.24	2	859.62	156.72	0.00
GENDER	14.00	1	14.00	2.55	0.11
GROUP * GENDER	25.82	2	12.91	2.35	0.10
Error	970.86	177	5.49		
Total	57049.00	184			
Corrected Total	2813.78	183			

a. R Squared =0 .66 (Adjusted R Squared = 0.64)

Table 8 shows that there is no significant interaction effect of gender and treatments on the academic performance of students in circle geometry as ($F_{(2,177)}$ = 2.35; p = 0.10 > 0.05). Hypothesis 4 is not rejected; this implies that gender and instructional strategies has no significant interactive effect on students' academic performance in circle geometry. The adjusted R square on the table shows that the treatment is responsible for 64% of the effect. The figure 1 shows the direction of the interaction.

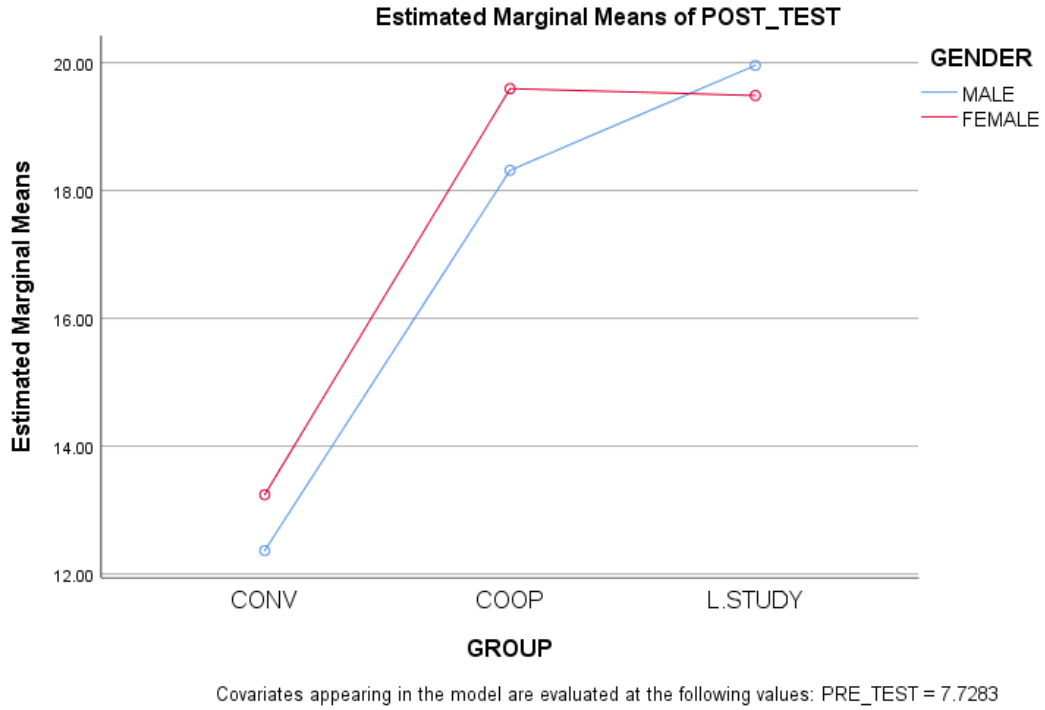

Figure 1: Interaction between gender and instructional strategies

Figure 1 above further showed that there is no significant interactive effect of cooperative learning strategy, teacher's lesson study, conventional learning strategy and gender on the performance of students in Mathematics. Though, a slight interaction is observed in the lesson study group. This is an indication that male students perform better than their female counterparts in circle geometry in the lesson study group.

Discussions

The finding of the study reveals that there is significant effect of teacher's lesson study on students' performance in circle geometry. The study's finding also revealed that cooperative learning strategy has effect on students' performance in circle geometry. The findings reveals that students exposed to cooperative learning strategy and teacher's lesson study had higher performance mean score than the students taught with conventional learning strategy. The findings also indicate that students whose teachers engaged in lesson study have higher performance mean score than the students taught with cooperative learning strategy. This indicates that cooperative learning strategy and teacher's lesson study are effective in improving the performance of students in circle geometry. The findings of the study also imply that teacher's lesson study provides improvement in students' performance in Mathematics than cooperative learning strategy.

The finding supported the opinion of Gambari and Yusuf (2014), Popoola and Adewumi (2013) and Kolawole (2007) who all submitted that students taught with cooperative learning strategies perform better than their counterparts taught with conventional learning strategies. It also agrees with the findings of Falebita and Olofin (2020) who found significant difference in the performance of students exposed to TPS which is a form of

cooperative learning strategy than their counterparts taught with conventional learning strategy. The finding of the study is also in line with the findings of Lewis (2002) who concluded that lesson study of teachers and teacher's variables respectively contributes significant improvements to students' performance in Mathematics. The advantage of teacher's lesson study over cooperative learning strategy could stem from the fact that the observations and suggestions made on preparation, selection of teaching methods, and presentation of lessons among others by observing teachers in the lesson study group were applied in the teaching-learning process.

The results also indicated that there is no significant interactive effect of teacher's lesson study, cooperative learning strategy and gender on the performance of students in circle geometry. The findings showed no significant difference between the performance of male and female students exposed to cooperative learning strategy, teacher's lesson study and conventional learning strategy. This implies that significant improvement in students' performance does not occur due to their gender. The findings agree with the earlier findings of Falebita (2019), Gambari and Yusuf (2014), Balfakih (2003) and Adeyemi (2008) who all found no significant difference between male and female students' performance when exposed to cooperative learning strategy. The finding is also in agreement with the findings of Popoola and Falebita (2016) who found no significant difference in the performance of male and female students when exposed to teacher's lesson study.

Conclusions

The study examined the comparative effectiveness of teacher's lesson study and cooperative learning strategy on the academic performance of students in circle geometry. From the findings it was concluded that teacher's lesson study and cooperative learning strategy are very effective in improving the performance of students in circle geometry. The findings point to the fact that teacher's lesson study is more effective in improving students' performance when compared with cooperative learning strategy in circle geometry. It was also found that male and female students do not differ in their performance in circle geometry when exposed to teacher's lesson study or cooperative learning strategy.

Recommendations

It is recommended that mathematics teachers should engage themselves in lesson study so that they can develop professionally and improve instructional practices. Teacher should utilise cooperative learning strategies in improving the performance of students in circle geometry and Mathematics and well encourage positive interdependence among students. Government, policy maker and organizations should regularly organize seminars, workshops and conferences in training teachers on the effective use of cooperative learning strategy and lesson study to improve their instructional practices and enhance students' performance in Mathematics. Government and school owners should encourage Mathematics teachers to attend seminars, workshops and conferences by sponsoring them and ensuring that they utilize cooperative learning strategy and lesson study in teaching Mathematics.

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