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Effect of Team-Pair-Solo Strategy on Senior Secondary School Students' Performance in Mathematics

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A B S T R A C T

Cooperative learning such as team-pair-solo strategy, gives teachers a framework to help students grasp scientific knowledge and cross-cutting mathematics ideas for enhanced performance..This study explored the effect of team-pair-solo strategy on senior secondary school students' performance in mathematics. It adopted quasi-experimental research design of pre-test, post-test non-equivalent control group of 2x2 factorial design.. Two public schools in Badagry zone of Education District V, Lagos State, Nigeria, with 139 students (60-experimental & 79-control groups) in two intact classes of Senior Secondary School two made up the study sample. Mean, standard deviation and Analysis of Covariance were employed using IBM-SPSS 23. Mathematics Achievement Test (MAT) with reliability index of 0.87 was employed. Results showed that students' performance in team-pair-solo is significantly better than those in conventional classroom [$F(1,138)=10.688;p<0.05$],no statistically significant gender differences in students' performances in either group [$F(1, 138) = 0.029; p>0.05$] and no significant interaction effect of treatment and gender on student performance in mathematics [$F(1, 138) = 0.095; p>0.05$. The study concluded that the adoption of team-pair-solo strategy significantly enhanced performance of students in mathematics and it is recommended that Mathematics educators publicize of the use of this strategy to enhance students' performance in Mathematics.

1. Introduction

Without prioritizing effective teaching and learning of mathematics, no society can attain sustainable scientific and technological advancement (Azuka, 2018). Teaching and learning of Mathematics is very important for any nation's self-reliant and development and should be given adequate attention in various levels of her education. The process of leaning mathematics enables one to develop good reasoning ability, think critically, creatively and analytically. For students to have

mastery of basic mathematics concepts, the teachers' strategies in impacting knowledge cannot be underestimated. Although, students' performance depends on different factors, teaching methods have essential role in the success of mathematics lessons (Byiringiro, 2023).

In most developed and developing countries, mathematics is compulsory for admission into tertiary institutions as well as appointment into certain positions especially in the civil services (Varaidzaimakondo & Makondo, 2020). Therefore, getting good grade in mathematic is crucial for students wishing to be admitted into universities as it is a strong pre-requisite, especially those who want to pursue degree program in STEM and those who want to work in research and development areas including science and technology (Banerjee, 2016). Over the past decade, the teaching of mathematics has been centred on conventional (lecture) method of teaching in Nigeria. Conventionally, mathematics teachers primarily focus on helping students to follow a set of rules and procedures required to solve questions correctly with very little justification on how and why the formula or theory or proof works (Borji et al., 2019).

Ahmed et al. (2021) observed that teachers tend to avoid more efficient activity-based teaching approaches, preferring the lecture method instead, which they identify as straightforward but unsuitable. Consequently, the conventional method of teaching may not stimulate interest and improve achievement much like cooperative learning strategies such as team-pair-solo, jigsaw, think pair share, and reciprocal teaching. These strategies allow greater interaction and group work among students (Van-Leeuwen et al., 2019). Thus, numerous studies (Akaazua et al., 2017; Ayaz & Sekerci, 2015; Ezeamagu et al., 2019; Salingay & Tan, 2018; Tay & Wonkyi, 2018; Yeo et al., 2019) have shown that interactive teaching strategies work better than other methods in teaching mathematics.

Cooperative learning strategy is a kind of learning approach in which students' study together and accomplish common goals in a team. It can be simply explained as small groups of students working together as a team to solve a problem, complete a task, or accomplish a common goal (Isaac et al., 2019). Cooperative learning begins with the formation of groups or teams of learners in the same grade and age bracket. It forms an environment where students can get help and support from other group members directly in a non-competitive learning environment. No wonder, Isaac et al. (2019) further asserted that cooperative learning strategy can be used to learn most of the topics in senior high school mathematics syllabus. Out of the various cooperative learning strategies, the study concentrated on team-pair-solo strategy for this study.

Team-Pair-Solo is a cooperative learning strategy in which students are grouped into teams to complete the same task or related task which could develop their character virtues in the framework of learning the standard curriculum (Macmillan & Alhamdu, 2020). In Team-Pair-Solo classroom, students worked together first as a team and then as pairs before solving similar problems on their own. When they are allowed to work on problems they could not do on their own, first as a team and then with a partner, they develop to a stage they can now solve the

problems alone without any help (Johnson & Johnson 2018). From the clarifications above, it could be concluded that Team-Pair-Solo is a strategy in which student learn and practice together in team, then in pairs, and finally on their own and this implies that the students are practicing cooperation, helpfulness, leadership, self-motivation, and self-confidence.

Despite a surge in research conducted on student performance in mathematics in recent years, its effects are not yet fully understood as existing studies yield conflicting results that warrant further investigations (Hillmayr et al., 2020). *Yahya (2024) revealed that causes of poor performance in mathematics among senior secondary school students are many-sided and could be attributed to personal status, beliefs, teaching methods, language proficiency, teaching and learning materials, parents and family members, school policies, society, infrastructures and government.* In recent West African Examination Council Examinations (2020), the Chief Examiner for Mathematics stated that candidates were unable to: show evidence of reading values from graphs; translate word problems into mathematical equations; solve problems on mensuration, geometry and cyclic quadrilaterals.

In view of these weaknesses, the WAEC Chief Examiner suggested in their various reports the following as remedies: emphasis should be placed on showing evidence from graphs, algebraic concepts should be explained meticulously to help candidates translate word problems into mathematical equations, teachers should encourage group work among candidates using geometrical figures to enable them solve questions on mensuration and geometry.

These are clearly teaching strategies and classroom interaction concerns suggesting that research in mathematics education needs to focus more on teaching strategies together with conversation and interaction in mathematics classrooms. To bridge this gap, we chose circle geometry as topic in this study while the study explored effect of team-pair-solo strategy on senior secondary school students' performance in mathematics.

Gender issues have raised a lot of deliberations among researchers in recent times. Okoye (2009) asserts that there are numerous biological differences in human gender which has led to a notion that either of the gender may have a learning edge over the other. This is also in compliance with the study of Musimenta et al. (2020) on gender and performance disparity in mathematics at South Western Uganda that found out that variation in Mathematics performance cannot be attributable to gender. On the contrary, in the study of Mutai (2016) on gender differences in mathematics performance among secondary school students in Bureti sub-country, Kericho country Kenya, it was deduced that gender was strongly associated with student performance in mathematics where boys have a stronger affinity towards mathematics. This is in line with the findings of Oluyemo et al. (2020) whose study on gender differences in mathematics interest and achievement among junior secondary school students in Niger State, Nigeria, revealed that male students excel in mathematics more than their female counterparts.

Interaction in Mathematics Classroom

Classroom interaction has a major effect on teaching and learning. It is part of the effort a person takes to understand a phenomenon, concept or something, that is why cooperative learning helps students to interact very well in the classroom. When students interact with one another in the learning process, it helps them to ask several questions that ordinarily they would not have been able to ask the teacher and this aids good understanding of the concept (Erath 2017; Erath et al. (2018); Ingram, 2021). It is through interaction that students solve problems, generate and build upon ideas, make connections and develop understanding.

Sanni and Alabi (2021) asserted that classroom conversation is the interchanging commitment of language within the classroom setting and its interactions in either positive or negative statements. This is why, active participation in mathematical conversation is essential for the development of the students' mathematical understanding by explaining what they have done and benefited from listening to other students and describing how they approach a problem. More importantly, students' ideas and thinking need to be visible for a robust Mathematics lesson to take place. For this reason, the pattern of interaction in the classroom cannot be overlooked.

The classroom interaction pattern is the most consistent way for students to engage in the classroom activities which is connected to the teaching strategy employed by the teacher. The way information is effectively conveyed in the classroom between the teacher and the students to accomplish instructional objectives is known as the classroom interaction pattern (Nnorom & Erhabor, 2019). The four basic categories of the classroom interaction patterns are teacher-student interaction pattern, student-student interaction pattern, teacher-material interaction pattern, and student-material interaction patterns (Osakwe et al., 2019).

The use of team-pair-solo strategy in mathematics classroom encourages student-student interaction pattern (a long-term dialogue) that allows critical thinking and improves students' learning, because it brings about students' collaboration. (Osakwe et al., 2019). Against these conditions, it becomes obvious that interactions in classroom should be focused on the collaborative construction of knowledge which can be achieved through team–pair-solo strategy.

Studies on Effectiveness of Team-Pair-Solo Strategy on students' achievement

This section offers the empirical review of related literature in team-pair-solo strategy. To start with, a study by Chiakwelu and Okigbo (2020) on effects of jigsaw, team-pair-solo and reciprocal teaching strategies on mathematics achievement among secondary school students' achievement in mathematics in Onitsha education zone, revealed significant difference in performance, with the jigsaw strategy yielding the highest scores, followed by think-pair-share and reciprocal strategies all of which outperformed the conventional method. Similarly, the research work of Macmillan and Alhamdu (2020) on the effects of team-pair-solo cooperative learning strategy on senior secondary two students'

achievement in physics in Jos metropolis, Nigeria, the findings from the study showed that students taught using team-pair-solo strategy achieved higher in physics than those taught using conventional lecture method of instruction.

However, Reyes (2019) used Team-Pair-Solo in an experimental study to teach random variables and discrete probability distributions and discovered that there was no significant difference between the pre-test result of both control and experimental groups in random variables and discrete random probability distribution. The researcher also found that team pair solo approach was more effective. in teaching random variables and discrete probability distributions but team pair solo approach was more effective. The findings also showed that there was significant improvement in performance of both male and female students in team-pair-solo classroom over the conventional classroom. In this study, the researcher discovered that team-pair-solo strategy gave the students ability to express themselves with confidence in classroom illustrations and discussions which promoted their cognitive performance and social interaction.

Students' Academic Performance in Mathematics

Academic performance is the capability of students to produce knowledge and skills that have been learnt in the classroom through solving, writing or by oral communication (Ohanyelu, 2021). Academic performance is usually labelled by grades or marks allocated by teachers or the examination board, e.g. the West African Examination council, based on determined standards. In most cases, the benchmark to measure the quality of education is basically centred on the academic performance of the students. Students' academic performance in mathematics plays an important role in producing the best quality graduates that will become great assets for the country, thus responsible for the country's economic and social development (Agwuma et al., 2018)

The underperformance of learners in mathematics which is one of the five core subjects and a prerequisite for admission into any Nigerian University has become a source of worry to educational researchers, policymakers, parents, and other stakeholders. This poor performance of learners in mathematics especially in state and national examinations are clear indications that there are deficiencies with respect to the method of teaching within public secondary schools. Various national and international bodies such as the International Mathematics Union (IMU) report that "primary and secondary level mathematics education is weak in most African countries, decreasing the possible population of talented students who choose mathematics majors at university level" (IMU, 2020).

Recently, the poor performance of secondary school students in mathematics has many contributing factors elucidated in a model established by Wahab.et al (2022). This model was developed in the research work of Wahab et.al. (2022) tagged determinant of students' academic performance (see figure 1).

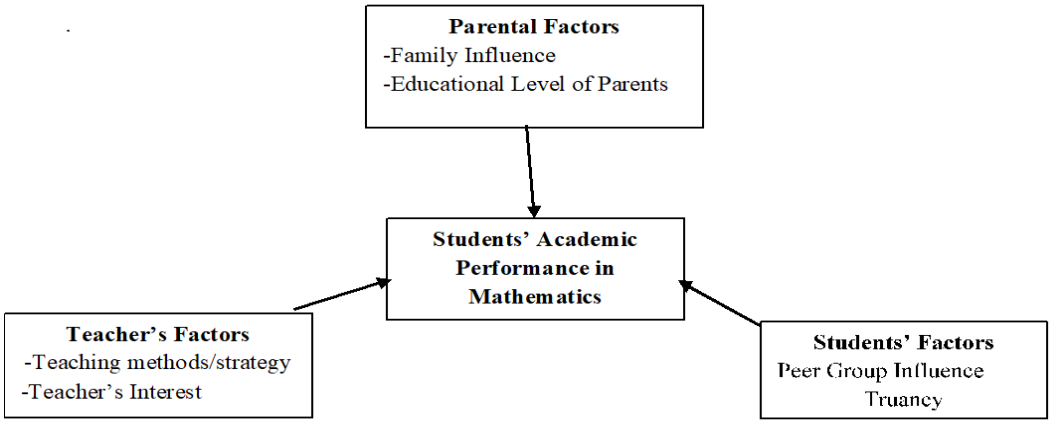

Figure 1. Determinants of Students' Academic Performance (Wahab et al. 2022)

Figure 1 described model of factors that contributes to students' academic performance in mathematics. Parental factors like family influence and educational level of the parents are contributing factors to students' academic performance; teacher's factors like teaching methods or strategy and teacher's interest to teaching profession contribute to students' academic performance in mathematics. Peer group influence, truancy and learners' interest to learning are some of the students' factors contributing to students' academic performance in mathematics.

Consequently, from Wahab.et al, (2022), the poor performance of students can be linked to the teaching method and strategies explored in the classroom. Most teachers prefer the conventional teacher-centred teaching methods because it makes it easy to reach large population of students at the same time as well as cover large content areas within a short time. However, such teaching strategies as reported by Gull and Shehzad (2015); Van-Leeuwen et.al (2019) may not improve student performance in mathematics greatly like cooperative learning strategies such as team-pair-solo, reciprocal teaching, jigsaw, think pair share etc. that allow for better class interaction as recommended by the WAEC Chief Examiners (2020). In this vein, the researchers explored the effect of team-pair-solo strategy on senior secondary school students' performance in mathematics**.** The researchers we formulated three research question and three null hypotheses to guide this study:

1. Is there any difference in Students' performance in team-pair-solo strategy Mathematics classroom and those in the conventional classroom?
2. Is there any gender difference in Students' performance in team-pair-solo strategy Mathematics classroom and those in the conventional classroom?

H_{01}: There is no significant effect of team-pair-solo strategy on students' performance in Mathematics.

H_{02}: There is no significant gender influence of team-pair-solo strategy on students' performance in Mathematics.

H_{03}: There is no significant interaction effect of the gender and teaching strategy on student performance in the Mathematics.

Theoretical Framework

Heale and Noble (2019) highlighted the importance of connecting the theoretical framework to all facets of the research. In this study, we considered the Vygotsky's social cultural theory on teaching and learning strategy. This serves as support for more vigorous research that bring about improved understanding of every activity going on in the classroom (Sanni, 2008; Heale & Noble 2019). The Vygotsky's sociocultural learning theory underscores the gap between the learning a student can attain unassisted, compared with the learning achieved with teacher's assistance (Murphy & Martin, 2015).

This theory is described as one in which educators in an exposed environment can enhance notable learning through group support, site teaching, adapted support, and unconventional instruction by using the zone of proximal development (ZPD). Vygotsky's (1978) sociocultural theory suggests that students who receive support from adults and peers finish tasks that may be too problematic to complete independently. Equally, a teacher can help a small group of students whereby they work together and learn from one another.

The roots of the team-pair-solo strategy goes back to Lev Vygotsky, who believed in social interaction as an integral part of learning. One of the basic foundations is the zone of proximal development as the basis for educational pillars. The ZPD has been described as the area in which learning occurs when a student is helped to learn a concept in the classroom. Within this learning scope, many educators and theorists have verified Vygotsky's works through proofs that learning actually occurs in the region mentioned by Vygotsky, namely, the very moment the student receives the educational supports (Powell & Kalian, 2009; Khairy et.al., 2021). Vygotsky's developmental region highlights the continuity of changing behavior, where learners progress with external help, including team pairing.

2. Methodology

Research Design

This study adopted quasi-experimental research design of pre-test, post-test non-equivalent control group of 2x2 factorial design consisting of team-pair-solo and lecture method, and gender (Male & Female). The study was conducted in Lagos State, Nigeria, specifically in two randomly selected public senior secondary schools in Badagry zone of Education District V, Lagos. The target population for the study comprised all public Senior Secondary School Two (SS2) students. The choice of SS2 (grade 11) as population for the study was because the selected concept for students was on SS2 scheme of work. It involved two non-equivalent groups in accordance with the restriction that require the researchers to work with

intact classes. There were 79 students in the control group while the treatment classroom consists of 60 students.

Instrumentation

In this study, Mathematics Achievement Test (MAT) was employed. We developed the Mathematics Achievement Test (MAT) on circle geometry concepts which was used as a pre-test and later as a post-test. The MAT consists of 30 multiple choice items and five essay questions that were selected from the concepts of circle geometry. The MAT was administered as both pretest and posttest with treatments in between the experimental group. The Pearson Product Moment was used to determine the reliability of the items with coefficient of 0.87.

The treatment procedure was mainly on two groups. The treatment group was exposed to team- pair-solo approach of teaching circle geometry concepts in mathematics while the control group was treated with the conventional method of teaching the same concept. The mathematics teachers served as lesson instructors after being trained by the researchers for two weeks on the presentation of the lessons... The treatment in the experimental group was done in three strategic steps which include: Team, Pair and Solo steps. The following were the modified stages used as the instructional guide:

A. TEAM:

a. The facilitator forms several groups of four students
b. The facilitator poses questions to each group and allow them to work for few minutes
c. Students make decision by agreement
d. Students contribute ideas and suggestions together

B. PAIR:

a. The facilitator pairs students in each group (group of two)
b. The facilitator allows them to work in pair.
c. They complete assignments together

C. SOLO:

a. The facilitator now separates them to work independently
b. Each student then shares their result with the classroom
c. The facilitator makes general contributions and corrections.

This strategy was helped students to learn circle geometry. Before the lesson, the facilitator allocated students to group categories containing only four students according to their scores in the pretest. The groups were arranged such that, those with varying scores met in the same group. The facilitator allotted groups to the students, paired them and gave individual exercises during the lesson. Before each lesson, the facilitator directed the students to seat according to their groups. In the lesson, after the facilitator had worked out the solution to a task as an example, he later gave the students similar problems to solve as a group activity. The students

in each group cooperatively solved the problems and ensured that all the members of the groups learnt the required procedure to arriving at the solution.

The control group: The control group was taught the same concepts using conventional method. The class was taught by a facilitator who exposed the students to the concept of circle geometry and posed questions on the same concepts in Mathematics without involving any group activity. The students paid attention to the facilitator without interaction with other students but sought for help from the facilitator only in the learning process.

Ethical Considerations

Ethical consideration is important as it involves the process to take in gaining access to research sites and the dealings of the researchers in the field of work. Access to research sites is not a right but a privilege which is subject to negotiation that leads to deliberate and careful considerations of ethical issues (Sanni, 2008b). The researchers sought and got permission from the appropriate authorities to gain access to the sites. At the sites, the researchers also sought an informed consent of the participants, both teachers and students for voluntary participation, after providing details of the research and the expected levels of participation. Since the permission was given for voluntary participation, an undertaking to keep the identities and information from all the participants as well as their schools, was given to the participants. The volunteered teacher of each school was engaged as facilitator. The researchers later familiarized with the subjects before administering the pre-test which was followed by the treatment in the same vein sought for their willingness and participation in the study for six weeks.

Method of Data analysis

A step-by-step procedure was followed in analyzing the data, there was evaluation of parametric assumptions that led to the application the ANCOVA statistics. The results of the Shapiro-Wilk's test of normality were satisfactory for both groups: control group ($N = 79$) = 0.38; $p > 0.05$, for the experimental group: ($N = 60$) = 0.15; $p > 0.0$ 5. When the significance value of the Shapiro–Wilk Test is greater than 0.05, it indicates that the data follows a normal distribution (Tim, 2024). The homogeneity of the two group was tested through the Levene's test, which confirmed that there were no significant differences between them ($F = 2.764$; $P=0.324$, $P > .05$). When the significance value for Levene's test is exceeds 0.05, it indicates that the equality of variance assumption is met (Zach, 2022). Also, the sample was not randomized because the researchers used intact classes. Since these assumptions were met, ANCOVA was applied to analyze students' performance scores in both groups using IBM SPSS version 23.

3. Results and Discussion

Research question one: Is there any difference in students' mathematics performance in team-pair-solo classroom and those in the conventional classroom?

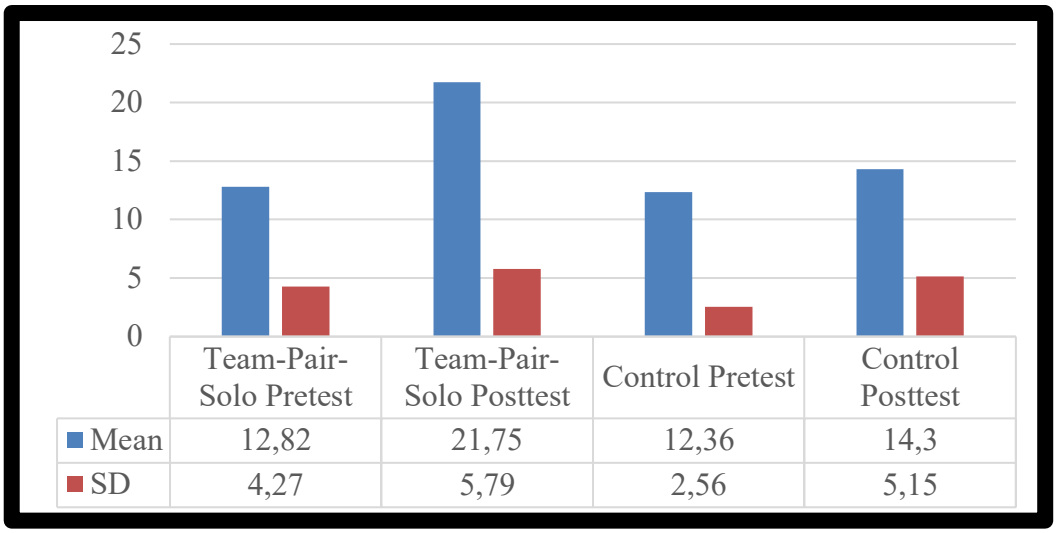

Figure 2. Mean scores of Students Performance in Mathematics based on strategies

Figure 2 above indicates that the mean score of the students in the Team-pair-solo group in posttest which was 21.75 is higher than the pretest value of 12.82. This mean score is higher than the mean score of students in the control group with pretest value of 12.36 and posttest value of 14.30 respectively. So the student in the Team-Pair-Solo group performs better than the control group. 1. Research question two: Is there any gender difference in Students' performance in team-pair-solo strategy Mathematics classroom and those in the conventional classroom?

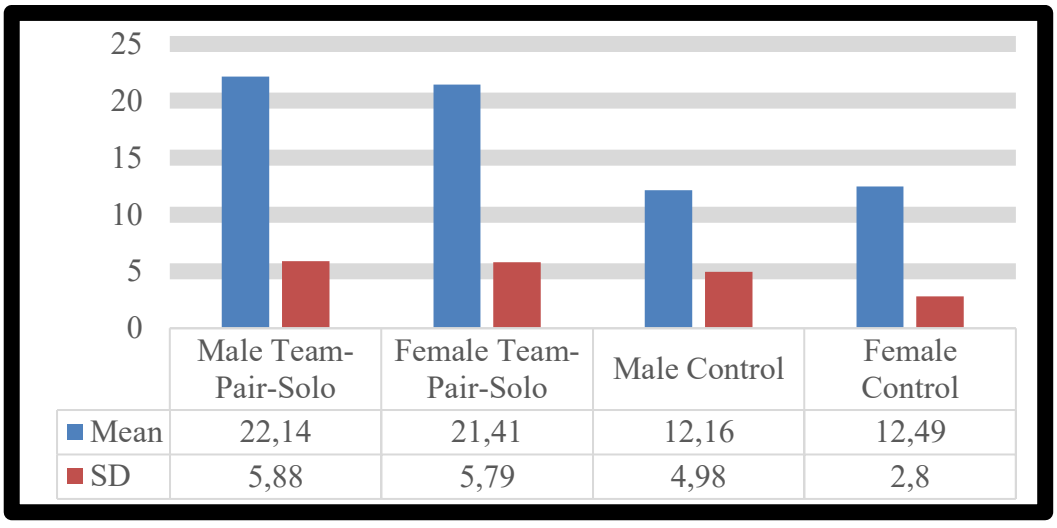

Figure 3. Mean scores of Students Performance in Mathematics based on gender

Figure 3 indicates that the male students in the Team-Pair-Solo group had a mean value of 22.14 which is higher than the female counterpart with mean value of 21.41. That shows that the male students perform better than the female student in the treatment group but female students perform better than their male counterpart in the control group with mean value of 12.49 and 12.16 respectively. To establish the certainty of the observed comparable influence, the data was subjected to inferential testing.

H_{01}: There is no significant effect of team-pair-solo strategy on students' performance in Mathematics.

Table 1. The ANCOVA of the students' performance in the Treatment and Control group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	2118.381	1	2118.381	75.909	.000
Group	1448.171	1	1448.171	51.893	.000
Total	44391.000	139			
Corrected Total	7090.791	138			

The result contained in Table 1 shows that there is statistically significant effect of Team-Pair-Solo strategy on students' performance in mathematics. In table 1, the F-value of [$F(1,138)=51.89$; $p<0.05$] is significant at 0.000. This indicates that there is a significant effect in students' performance in team-pair-solo classroom. Therefore, hypothesis one that states that there is no significant effect of team-pair-solo strategy on students' performance in Mathematics is thereby rejected.

H_{02}: There is no significant gender influence of team-pair-solo strategy on students' performance in Mathematics.

Table 2. The ANCOVA of gender influence in students' performance in the Treatment and Control group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	2118.381	1	2118.381	75.909	.000
Gender	.818	1	.818	.029	.864
Total	44391.000	139			
Corrected Total	7090.791	138			

From table 2, the gender value of [$F(1, 138) = 0.029$; $p>0.05$] is not significant at 0.864 Hence, the hypothesis that states that there is no significant gender influence of team-pair-solo strategy on students' performance in Mathematics is thereby not rejected, that is, H_{02} is not rejected. So, there are no gender influences of team-pair-solo strategy on students' performance in Mathematics.

H_{03}: There is no significant interaction effect of the gender and teaching strategy on student performance in the mathematics.

Table 3. The ANCOVA of interaction effect of treatment and gender on students' performance in the Treatment and Control group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	2118.381	1	2118.381	75.909	.000
Gender * Group	2.652	1	2.652	.095	.758
Total	44391.000	139			
Corrected Total	7090.791	138			

The result in table 3 reveals no significant interaction effect of the treatment and gender on student performance in mathematics [F (1, 138) = 0.095; p>0.05] is not significant at 0.758. Hence, the hypothesis that states that there is no significant interaction effect of the gender and teaching strategy in the mathematics classrooms is thereby not rejected, that is, H_{03} is not rejected. This shows that there is no interaction effect of gender and teaching strategies on students' performance using team-pair-solo and in the conventional classroom.

C. Discussion of findings

The findings from hypothesis one revealed that the students' performance was significantly better in team-pair-solo classroom than the conventional classroom as supported by the results in table 1 and figure 2. This finding is in conformity with the study of Chiakwelu and Okigbo (2020) who reported significant effects of team-pair-solo and reciprocal teaching strategies on secondary school students' achievement in mathematics. This showed that students thought using the team-pair-solo strategy had better understanding of the mathematical concept that contributed to their improved performance.

However, the result of the study agrees with that of Reyes (2019) who submitted that students taught random variables and discrete probability distributions with the aid of Team-Pair-Solo did not differ significantly at pre-test in both control and experimental groups but differ significantly thereafter. It obviously showed that there was a significant improvement in performance of the students in team-pair-solo classroom over the conventional classroom due to the teaching strategies used in delivering the course contents. In this study, we discovered that team-pair-solo strategy offered the students ability to express themselves with confidence in classroom illustrations and discussions which promoted their cognitive performance and social interaction (Sanni & Sojinu, 2020; Zhang & Cui 2018).

Evidently, during the intervention in both the treatment and control groups, it was observed in team-pair-solo classroom that students were calm to ask questions, relate and contribute to the classroom discussion. However, in the control group, every learning activity was based on the teacher but occasionally few contributions from the students were observed. Also, the students' contributions were more meaningful in the treatment groups than in the conventional classroom. The result of hypothesis two showed that there is no significant gender influence of team-pair-solo strategy on students' performance in Mathematics. This result is in compliance with the study of Musimenta et al. (2020) on gender and performance disparity in mathematics that found out that variation in Mathematics

performance cannot be attributable to gender. It is also in line with the findings of Oluyemo et al. (2020) study on gender differences in mathematics interest and achievement among junior secondary school students in Niger State, Nigeria, which revealed that male students excel in mathematics more than their female counterparts.

On the contrary, the study of Mutai (2016) on gender differences in mathematics performance among secondary school students revealed that gender was strongly associated with student performance in mathematics where boys have a stronger affinity towards mathematics. It is essential to recall that, during the lessons of the treatment group, students' sitting arrangement was predefined at every lesson in team-pair-solo classrooms but not in control group. Even though the students solved problems in groups in team-pair-solo classroom but the teacher evenly asked questions without special interest on gender. The findings from hypothesis three revealed that there is no interaction effect of gender and teaching strategies on performance in mathematics. This finding is in agreement with the study of Chiakwelu and Okigbo (2020) that saw no significant interaction effect of teaching strategies and gender on students' performances for both treatment and control groups. This shows that the study is not gender biased.

4. Conclusion

The findings of this study showed that students' performance in team-pair-solo mathematics classrooms is better than those of the conventional classrooms as a result of the strategy adopted that allowed the high students classroom interaction to take place. It is also noted that the students related with each other without any fear. It is important to relate the findings of this study to the reviewed literature in order to point out some implications of the study. Team-pair-solo strategy gave room for students' collaboration in the mathematics classroom and challenge them to take responsibility of their study.

Team-pair-solo is one of the collaborative teaching and learning strategies that promote students' cognitive performance, social interaction and positive learning behavior (Zhang & Cui, 2018). The findings in this study also showed no significant gender difference of students' performance in team-pair-solo and in the conventional classroom. This is an indication that the strategy is not being influenced in any way as gender should not be a barrier to the students' performance in the mathematics classroom. In this vein, since the aim of curriculum planner is to always improve the quality of education, then, the importance of the use of team-pair-solo strategy must be taken into cognizance as learning has ultimately shifted from the teacher-centred approach to the learner-centred approach.

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