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Collaborative Learning Strategy and Students' Academic Achievement in Algebraic Word Problems in Mathematics in Kosofe, Lagos State

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Abstract

Mathematics is widely recognized as a foundational discipline that provides a framework for both theoretical reasoning and practical applications in science, technology and engineering. Despite its relevance in the Nigerian secondary school curriculum, students' performance in Mathematics word problems especially in algebra steers concerns among stakeholders. This study therefore investigated the effect of the collaborative learning strategy on students' academic achievement in Algebraic word problems in Mathematics in Kosofe, Lagos State. The study adopted 2×2 quasi-experimental research design in a population of 658 Senior Secondary School 2 (SSS II) students where 157 students selected through multistage and simple random sampling techniques participated. Guided by three hypotheses, validated researcher made Algebraic Word Problem Achievement Test (AWPAT) with reliability coefficient of 0.70 using Kuder- Richardson (KR-20). The data collected was analyzed using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The result: ($F_{(2; 150)} = 60.150$, $p < 0.001$, partial $\eta^2 = 0.448$) showed a significant effect of collaborative learning strategy on students' academic achievement in Algebraic word problems on Senior Secondary School (SS2) Students. The study concluded that collaborative learning strategy had effect on students' academic achievement compared to those taught using the traditional learning method. Based on the results, it was recommended that teachers implementing collaborative learning should closely monitor group dynamics to ensure improved achievement of both male and female students in Mathematics Word Problems, especially in Algebra.

Keywords: Collaborative Learning Strategy; Algebraic Word Problems Students' Academic Achievement; Senior Secondary School Students.

Introduction

Mathematics has long been regarded as one of the foundational subjects in education, crucial for fostering critical thinking, problem-solving, and analytical skills. In Nigeria, it plays a significant role in determining the academic success of students across various levels of education. Despite its importance, students' academic achievement in mathematics has consistently been a challenge, with many secondary school students struggling to achieve satisfactory results. Central to mathematics is conceptual understanding, which refers to the grasp of underlying ideas such as number relations, functions, and spatial properties, rather than merely memorizing steps. Research reveals that strong conceptual foundations support deeper learning, improve procedural fluency, and enhance the transfer of knowledge to novel problems. In other words, students who understand why

procedures work can adapt more readily when faced with new challenges (Asanre, Sondlo & Abiodun, 2024)

The performance of students in mathematics is measured by their ability to understand mathematical concepts, solve problems, and apply these concepts in various real-life situations. A key aspect of conceptual understanding is the ability to engage with multiple representations, such as symbols, diagrams, graphs, physical models, and verbal explanations, as different representations of the same concepts. Being able to shift between these representations promotes higher-order thinking, enabling learners to discern relationships, generalize ideas, and construct coherent arguments. For example, representing an algebraic equation using a diagram or a real-life scenario helps learners concretize abstract notions and improve their understanding of relationships (Meremikwu, Ekwueme & Opoh, 2023).



Scholars in Mathematics have consistently emphasized the iterative relationship between conceptual and procedural knowledge. Enhancing procedural skills through practice can reinforce conceptual clarity, just as strong conceptual understanding can improve the effective use of procedures.

Students' academic achievement encompasses the level at which learners attain educational objectives, as evidenced by measurable outcomes such as grades, standardized test scores, and cumulative performance indicators like Grade Point Average. It is a multifaceted construct that integrates cognitive outcomes including knowledge acquisition, conceptual understanding, and procedural fluency with non-cognitive elements such as motivation, self-regulation, interest, and attitude toward learning (Okigbo & Maderegbonam, 2025). Academic achievement is frequently operationalized in research through quantifiable measures such as test results, classroom assessments, and performance in high-stakes examinations like the West Africa Senior Secondary Certificate Examination (WASSCE), National Examinations Council (NECO) and other standardized examinations. These metrics reflect both immediate competence and longer-term academic development (Omolafe, Okikiayo & Eyiemi, 2024).

Student academic achievement in Mathematics often masks a critical challenge: performance specifically in word problems. Word problems require not just computational skill but logical reasoning, linguistic comprehension, and strategic problem-solving (Popoola, Adekayo-Shittabey & Adewale, 2025). Though overall exam scores may appear reasonable, closer inspection reveals disproportionately low achievement on word-problem items. This discrepancy has significant implications in West African educational assessments such as West African Senior Secondary Certificate Examinations (WASSCE), where word problems contribute a substantial portion of total Mathematics marks. Analyses of WAEC and WASSCE examinations from 2020 to 2023 show persistently poor performance on word-problem components. For instance, a report analyzing West African Senior School Certificate Examination results across Nigeria from 2020–2023 found that only 31.3 % of candidates obtained credits (C6 or better) in Mathematics, with over two-thirds failing overall which is a trend exacerbated by word-problem difficulty. Chief Examiners' reports have consistently noted that candidates struggle with word problems especially three-set problem contexts and transformation of verbal statements into algebraic expressions reflecting weak conceptual and linguistic foundations (WAEC, 2022; 2023; 2024).

These reports indicated that, despite general improvements in computation, word-problem success remains low, pulling down overall achievement. The reports of WAEC examinations data further illustrate this phenomenon indicated that 76.36 % of candidates obtained credit (C6 or better) in Mathematics, yet aggregated reports showed much lower achievement on structured Mathematics assessments, suggesting that word-problem performance continues to significantly lag (WAEC, 2022; 2023; 2024; Ogbu, 2025).

This gap reinforces that high-level achievement in routine computation does not translate to competence in word problems. Empirical studies on word-problem achievement in Nigeria support this assessment. A study investigated difficulties secondary students face when translating algebraic word problems into equations and found high failure rates across multiple difficulty areas, including variable representation, equation formulation, and reasoning chain which over 50 % of students struggled with key translation steps (Ojetokun & Omale, 2024).

WAEC Chief Examiners' reports also note that word-problems sections are often abandoned or answered incorrectly due to incomplete reasoning or failure to translate verbal descriptions into workable algebraic setups, further emphasizing the need for strategic competence, not just computational fluency (WAEC, 2022; 2023; 2024 Popoola, Adekayo-Shittabey & Adewale, 2025). International research reinforces the importance of strategic, scaffolded instruction for word-problems success. A further- analyses indicated that direct instruction in schema-based strategies teaches students to classify problem types and apply structured heuristics significantly improves word-problem performance above general instruction. Given that private schools exhibit varied resource levels and teacher quality, it is not just student ability driving word-problems performance; it may be the instructional strategies in use. Hence private schools with teacher training in problem-solving pedagogy, multiple representations, and language-Mathematics integration yield higher achievement, while those relying heavily on rote, lecture-driven methods see persistently poor word-problem scores. (Ogbu, 2025).

Mathematics word problems are integral to the curriculum of Nigerian secondary schools, serving as a bridge between abstract mathematical concepts and real-life applications. These problems require students to comprehend a narrative, extract relevant information, translate it into mathematical expressions, and apply appropriate operations to find a solution. This process not only tests students' computational skills but also their ability to reason and think critically. Students often encounter significant challenges when solving word problems. Research indicates that many students struggle with translating the language of the problem into mathematical symbols, a skill known as translation competence. This difficulty is compounded by language barriers, as English language is the medium of instruction especially in Nigeria, where many students' first language is not English. This linguistic gap impedes comprehension of the problem's context and the mathematical operations required. (Ojetokun & Omale, 2024)

The complexity of word problems often leads to cognitive overload which requires students to engage in multiple cognitive processes simultaneously such as reading comprehension, translation of words into mathematical symbols, and application of appropriate mathematical operations. This multi-step process can overwhelm students, especially when they lack a strong foundational understanding of the underlying mathematical concepts (ResearchGate,

2024). In response to these challenges, various instructional strategies have been proposed. The effectiveness of teaching strategies plays a pivotal role in students' ability to solve word problems. Traditional teacher-centered approaches, which focus on rote memorization and passive learning, have been shown to be less effective in fostering deep understanding and problem-solving skills. In contrast, student-centered strategies that promote active engagement and collaborative learning strategy have demonstrated significant improvements in students' performance (ResearchGate, 2024).

Collaborative learning strategy is an educational approach that emphasizes the active participation of students working together to achieve shared learning goals. This approach involves students collaborating to solve problems, discuss mathematical concepts, and support each other's learning. The foundation of collaborative learning lies in the belief that learning is a social process, where knowledge is constructed through interaction and dialogue among peers. Collaborative learning offers numerous benefits in Mathematics education and working in groups allows students to approach problems from multiple perspectives, leading to more effective and creative solutions. Collaborative learning strategy encourages students to discuss various strategies, evaluate different approaches, and collectively arrive at solutions, thereby enhancing their problem-solving abilities (Esuong, Owan, Edoho & Eni, 2023).

Collaborative learning strategy requires students to articulate their ideas clearly and listen to others, fostering better communication abilities. Through discussions and group activities, students learn to express their thoughts, ask questions, and provide constructive feedback, which are essential skills in both academic and real-world contexts. The social nature of collaborative learning can make tasks more engaging, motivating students to participate actively. When students work together, they often find the subject matter more interesting and are more likely to stay engaged and invested in their learning. This provides an environment for opportunities for students to develop teamwork, leadership, and conflict-resolution skills (Esuong, Owan, Edoho & Eni, 2023). These skills are invaluable, not only in academic settings but also in everyday life and future careers.

Studies have indicated that students involved in collaborative learning often perform better academically compared to those who learn individually. The shared responsibility and mutual support in collaborative learning contributes to improved academic outcomes. Effective implementation of collaborative learning in Mathematics classrooms requires careful planning and consideration. Groups should be diverse in terms of abilities, backgrounds, and perspectives to maximize the benefits of collaboration. Heterogeneous groups allow students to learn from each other and approach problems from different angles. Setting specific, measurable goals ensures that all group members understand the purpose and expectations of the collaborative task. Clear objectives guide students' efforts and help maintain focus on the learning outcomes (Esuong, Owan, Edoho & Eni, 2023).

Collaborative learning strategy has been identified as an effective pedagogical approach that enhances students' academic performance. In Nigerian secondary schools, where students often face challenges in understanding and solving word problems, collaborative learning offers a platform for peer interaction, discussion, and collective problem-solving. Studies have shown that when students work together in groups, they can share diverse strategies, clarify misconceptions, and support each other's learning, leading to improved problem-solving skills and higher academic achievement (Oribhabor, 2020). Furthermore, collaborative learning strategy fosters a positive attitude towards Mathematics. Students engaged in collaborative activities often experience reduced anxiety and increased confidence in their mathematical abilities. This shift in attitude is crucial, as a positive disposition towards Mathematics is closely linked to better performance in the subject (Oribhabor, 2020).

Private secondary schools in Nigeria are those educational institutions owned and operated by individuals, organizations or corporations instead of the government. The autonomy of private schools permits them to design their own curriculum, teaching methods and assessment criteria. Private schools are typically known for smaller class sizes that allow for more personalized attention and instruction. They have modern facilities such as well-equipped classrooms, libraries, science laboratories and sports facilities. Private secondary schools in Nigeria often have the advantage of smaller class sizes, better resources, and more flexible curricula, making them conducive environments for implementing both collaborative and individual learning strategies (Popoola, Adebayo-Shittabey & Adewale, 2025).

Suffice to discuss in this study is the concept of gender which has been identified as a significant factor influencing students' academic achievement in Mathematics particularly in solving word problems (Niyonsaba, Nkurunziza & Hakizimana, 2022). Research indicates that male students often outperform their female counterparts in mathematics assessments, including word problems. A study revealed that male students had higher mean scores in mathematics problem-solving tests compared to female students in Oyo State, Nigeria (Ogunsaju & Sam-Kayode, 2024). Similarly, male students exhibited more positive attitudes and higher achievement in science subjects, including Mathematics, than female students (Dawal, 2021). These findings suggest that gender disparities persist in mathematics education, potentially affecting students' problem-solving abilities.

The moderating role of gender in the effectiveness of teaching strategies, such as collaborative and individual learning approaches, has also been explored. A study investigated the impact of jigsaw, buzz group, and conventional learning strategies on students' achievement in Basic Science in Atiba Local Government Area, Oyo State. The study found that while the treatment had a significant main effect on students' achievement, there was no significant main effect of gender on students' achievement, and the interaction effect of treatment and gender on students' achievement was not significant. This suggests that gender may not significantly

influence the outcomes of certain teaching strategies (Obunge, 2021). However, other studies have reported mixed results regarding the interaction between gender and teaching strategies (Popoola, Adebayo-Shittabey & Adewale, 2025).

tudents were more motivated and had a positive attitude towards the subject than female students. Despite these differences, the study concluded that gender did not significantly predict performance (Niyonsaba, Nkurunziza & Hakizimana, 2022). This highlights the complexity of the relationship between gender and academic achievement, suggesting that other factors may also play a role (Olabiya, 2021). Given these varied findings, it is crucial to consider gender as a moderating variable in studies examining the impact of teaching strategies on students' academic achievement in mathematics word problems. The persistent challenges faced by students in solving Algebraic word problems in Mathematics necessitate the exploration of effective teaching strategies, such as collaborative learning strategy which has been shown to improve academic achievement, its impact on solving Algebraic word problems specifically in the Nigerian context requires further investigation.

Statement of the Problem

The persistent challenges faced by Nigerian secondary school students in solving Mathematics word problems remain a significant concern for educators, parents, and policymakers. This challenge affects the academic achievement of many students in the subject area, as evidenced by poor performance in key national examinations like the West African Senior School Certificate Examinations (WASSCE) and Junior Secondary School Certificate Examinations (JSSCE). One of the factors identified as contributing to this poor performance is teaching strategies currently employed by Mathematics teachers in most schools. Traditional methods which is teacher-centered still dominate many classrooms, where students are mostly passive recipients of knowledge. This method fails to foster critical thinking, active engagement, and the problem-solving skills necessary for tackling word problems. Although collaborative learning strategy has been identified as an effective pedagogical tool its implementation remains limited in many Nigerian secondary schools especially at Kosofe Local Government Area of Lagos state. Collaborative learning is underutilized due to overcrowded classrooms and insufficient teacher training. Moreover, many private secondary schools, despite having smaller class sizes and better resources, have not fully explored the potential of collaborative learning strategy in addressing this issue with sufficient literature known to the researcher. In light of these concerns, this study seeks to investigate the effect of collaborative learning strategy on students' academic achievement in Algebraic Word problems in private secondary schools in Kosofe, Lagos State.

Aim and Objectives of the Study

This study investigated the Effect of Collaborative Learning Strategy on students' Academic Achievements in Algebraic Word Problems in Mathematics in Kosofe, Lagos State.

Specifically, the objectives are to:

- examine the main effect of treatments (collaborative learning strategy, traditional teaching strategy) on students' academic achievement in Mathematics word problems in private secondary schools in Kosofe Local Government Area, Lagos State;
- examine the main effect of gender on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State; and
- determine the interaction effect of treatments (collaborative learning strategy, traditional teaching strategy) and gender on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

Hypotheses

The following hypotheses were tested at 0.05 level of significance.

H₀₁: There will be no significant main effect of treatments (collaborative learning strategy, traditional teaching strategy) on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

H₀₂: There will be no significant main effect of gender on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

H₀₃: There will be no significant interaction effect of treatments (collaborative learning strategy, traditional teaching strategy) and gender on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

Methodology

A quasi-experimental design with a 2 x 2 Factorial matrix using pre-test and post-test approach was adopted for this study which involved one experimental group and one control group: the experimental groups were treated with Collaborative Learning strategy in Group A while the control group, Group B was treated with traditional teaching strategy. Further information regarding the research design can be found in Table 1.

Table 1: 2 x 2 Factorial Design for the Study

Group	Treatment		2 Post-test
	1 (Pre-test)		
E ₁	Q ₁	X ₁	Q ₂
E ₂	Q ₃	X ₂	Q ₄

Source: Researcher's Fieldwork, 2026

Where E₁= Experimental Group 1 (for collaborative learning strategy)

E₂ = Control Group (for traditional teaching strategy)

- Q_1 = Pre-test for E_1
 Q_2 = Post-test for E_1
 Q_3 = Pre-test for E_2
 Q_4 = Post-test for E_2
 X_1 = Treatment for E_1 (collaborative learning strategy)
 X_2 = Traditional teaching strategy for E_2

The population for this study consisted 477 senior secondary school students from 25 registered Private Secondary Schools in Kosofe Local Government Area, Lagos State (Kosofe Local Government Education Authority, 2026). Distributed across two Political wards: Anthony-Maryland (264 students) and Oworonsoki (213 students). Multistage and Simple random sampling techniques was used to select one school from each ward, with one school assigned to each of the two interventions: Collaborative Learning, and Traditional Teaching strategies. Two intact SS2 classes were randomly selected from the two schools for the study, ensuring a fair representation of each intervention, with one assigned to Collaborative Learning strategy; and the other school assigned to Traditional Teaching strategy. A researcher designed and validated Mathematics Word Problem Achievement Test (MWPAT) was used for data collection, which consisted 24 multiple-choice questions (optioned A to D) that cover a variety of mathematical topics related to word problems, focusing on linear equations with one variable, real-life word problems leading to linear equations, the formulation of equations from word problems, and the solving of linear equations. Participating students were required to read and interpret word problems, form the corresponding linear equations, and then solve the unknowns. The multiple-choice format of the test allowed for efficient evaluation of their understanding, while the various cognitive levels ensure that the assessment covers both basic and advanced problem-solving skills. The guide for instruction in teaching and learning of word problems was also provided for the study designed to facilitate an interactive and engaging learning environment.

This strategy emphasizes peer-to-peer learning, where students work in small groups to discuss and solve word problems. The guide provides a structured framework for teachers to implement collaborative learning effectively in the classroom. The guide includes a comprehensive lesson overview that specifies the topic, target group, duration of the lesson, and required materials. It also outlined clear learning objectives, ensuring that students can collaboratively work through problems and articulate their thought processes. The study was conducted over an eight-week period, with data collection at both the pretest and posttest stages. During the lesson, each teacher who had been trained as research assistants at the start of the study presented the problem and

then facilitated the group work, where students engaged with one another, share ideas, and collaborate to find solutions. The teacher guided during the group discussions by providing support where necessary. After completing the group work, students came together for a class discussion where they reflect on the strategies used and the solutions found.

Results

Table 2: Pretest and Posttest Scores of the Student

Treatment	Pre-Achievement		Post-Achievement		Mean Difference
	$\bar{X}$	S.D ev	$\bar{X}$	S.D ev	
CLS	12.50	3.12	28.40	4.21	15.90
TTS	12.30	3.20	15.80	3.85	3.50

Note: $\bar{X}$ = Mean, S. Dev = Standard Deviation Source: Researcher's Fieldwork, 2026.

Table 2 presents the descriptive statistics showing the pre- and post-achievement test scores of students exposed to two different instructional treatments; Collaborative Learning Strategy (CLS), and the Traditional Teaching Strategy (TTS). The data indicate an improvement in students' performance across all groups after the treatment, with varying degrees of effectiveness. Students in the CLS group had a pre-achievement mean score of 12.50 with a standard deviation of 3.12, which increased to a post-achievement mean of 28.40 and a standard deviation of 4.21, resulting in a mean gain of 15.90. The traditional teaching strategy group showed the lower increase from a mean of 12.30 to 15.80, with a mean gain of 3.50.

These results suggest that Collaborative Learning was more effective than the traditional teaching strategy. However, despite observed mean differences, it is essential to test the hypotheses using ANCOVA to determine whether the differences in post-achievement scores are statistically significant after controlling pre-achievement scores.

Hypotheses Testing

H₀₁: There will be no significant main effect of treatments (collaborative learning strategy, traditional teaching strategy) on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

Table 3: Analysis of Covariance on Effect of Treatment and Gender on Students' Achievements in Word Problems

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6850.450 ^a	6	1141.742	65.420	<0.001	0.725
Intercept	2105.120	1	2105.120	120.550	<0.001	0.445

Pre-score	1850.230	1	1850.230	105.950	<0.001	0.412
Treatment	2100.540	2	1050.270	60.150	<0.001	0.448
Gender	120.500	1	120.500	6.901	0.009	0.044
Treatment * Gender	850.420	2	425.210	24.352	<0.001	0.245
Error	2619.550	150	17.464			
Total	105240.000	157				
Corrected Total	9470.000	156				

R Squared = 0.725, Adjusted R Squared = 0.714, Dependent Variable: Post-Test Score

Source: Researcher's Fieldwork, 2025.

The results presented in Table 3 revealed a statistically significant main effect of treatment on students' post-test achievement scores, $F_{(2; 150)} = 60.150$, $p < 0.001$, with a large effect size (partial $\eta^2 = 0.448$). This indicates that the

treatment had a significant effect on students' academic achievement, even after adjusting for prior achievement. To determine the specific direction of the effects, a post hoc analysis using Bonferroni adjustment was conducted and presented in Table 4.

Table 4: Bonferroni Post Hoc Pairwise Comparisons of Instructional Methods on Students' Achievement in Word Problems

Instructional Method Comparison	Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval
CLS vs. TTS	12.600*	1.050	< 0.001	[10.050, 15.150]

Note. Bonferroni adjustment applied to control for Type I error. *The mean difference is significant at the 0.05 level. (Dependent Variable: Post-Test Score, Covariate: Pre-Test Score)

Source: Researcher's Fieldwork, 2025.

The pairwise comparisons showed that students taught using Collaborative Learning Strategy (CLS) performed significantly better than those taught with the Traditional Teaching Strategy (TTS).

H₀₂: There will be no significant main effect of gender on students' academic achievement in Algebraic word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

As shown in Table 4, the analysis tested the interaction effect of treatment and gender on students' achievement. The interaction term (Treatment * Gender) was statistically significant, $F_{(2; 150)} = 24.352$, $p < 0.001$, with a substantial

effect size (partial $\eta^2 = 0.245$). This indicates that the effect of the instructional strategy on student achievement depends significantly on the gender of the student. Consequently, the null hypotheses H₀₂ was rejected.

H₀₃: There will be no significant interaction effect of treatments (collaborative learning strategy, traditional teaching strategy) and gender on students' academic achievement in Mathematics word problems in private secondary schools in Kosofe Local Government Area, Lagos State.

Table 4 also presents the estimated marginal means to illustrate the nature of this significant interaction.

Table 5: Post hoc comparison for the interaction of gender on each instructional method

Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
CLS	Male	32.500 ^a	1.020	30.480	34.520
	Female	24.300 ^a	0.980	22.360	26.240
TTS	Male	15.500 ^a	0.920	13.680	17.320
	Female	16.100 ^a	0.890	14.340	17.860

a. Covariates appearing in the model are evaluated at the following values: PRESCORE = 12.30. Source:

Source: Researcher's Fieldwork, 2026.

The estimated marginal means reveal a clear interaction pattern. In the Collaborative Learning Strategy (CLS) group,

male students ($M = 32.50$) significantly outperformed female students ($M = 24.30$). Conversely, in the Traditional Learning Strategy (ILS), female students ($M = 16.100$) significantly

outperformed male students ($M = 15.500$). This "crossing" effect explains the significant interaction: males benefited most from collaborative Learning strategy, while females benefited more from the traditional teaching strategy, leading to the rejection of the interaction hypotheses.

Discussion of Findings

The study revealed a significant main effect of collaborative learning on student academic achievement in word problems in private secondary schools in Kosofe Local Government Area, Lagos State. This finding indicates that students exposed to collaborative learning approaches demonstrated substantially higher achievement levels compared to those in conventional learning environments. A study supported this finding by establishing that collaborative learning strategies significantly enhanced students' academic achievement and interest in technical subjects. The strategy fostered active engagement and peer collaboration, enabling students to develop deeper comprehension of complex concepts through active participation in collaborative groups (Meremikwu, Ekwueme & Opoh, 2023). Another study also aligned with this finding by demonstrating that cooperative learning strategies such as Jigsaw and Think-Pair-Share substantially improved Secondary School II students' performance in algebra, with students taught using these strategies achieving mean gains considerably higher than those in conventional settings. The evidence indicates that structured cooperative approaches enable students to achieve significantly better outcomes in Mathematics (Oribhabor, 2020; Popoola, Adebayo-Shittabey & Adewale, 2025).

Further support for this finding was revealed by a study showing that peer collaborative learning technique was effective in reducing anxiety and enhancing academic performance across both male and female secondary school students indicates its broad applicability. The collaborative approach created psychological safety that enabled students to engage more actively in problem-solving tasks (Esuong, Owan, Edoho & Eni, 2023). Additionally, a study demonstrated that students taught using cooperative learning strategy achieved significantly higher post-test mean scores in compared to those taught through conventional lecture methods. The effectiveness of these varied collaborative structures suggests that multiple collaborative approaches can facilitate higher achievement in Mathematics (Oribhabor, 2020).

The study revealed a main interaction effect of collaborative learning and gender on students' academic achievement in word problems. This finding indicates that the effectiveness of collaborative learning varies based on gender, suggesting differential benefits for male and female students. A study supported this finding by examining the effect of peer collaborative learning technique and finding differential gender effects on the achievement outcomes (Niyonsaba, Nkurunziza & Hakizimana, 2022). The interaction between collaborative learning and gender highlighted the importance of considering how different groups respond to collaborative approaches.

Another study also aligned with this finding by demonstrating that reciprocal peer tutoring strategy showed differential effects by gender, with male students achieving higher mean gains than female students when exposed to this collaborative approach (Olabiya, 2021). This evidence suggests that certain collaborative structures may inadvertently advantage one gender over another. Further support for this finding was provided by a study showing that student-centered method improved achievement and retention with differential patterns across gender groups (Ogunsaju & Sam-Kayode, 2024). The variation in how male and female students responded to this structured collaborative strategy indicates that gender moderates the effectiveness of specific collaborative approaches. Additionally, a study revealed that reciprocal peer tutoring strategy enhanced students' achievement in Physics, though the post-test mean achievement scores varied by gender, with some gender-based differences in the magnitude of learning gains (Obunge, 2021). The consistent finding of gender-based variation across different content areas suggests that gender is an important moderator of collaborative learning effectiveness.

Conclusion

The study concludes that while active learning strategies are generally superior to traditional teaching, their impact is not uniform across genders. Collaborative learning is effective for male students, potentially due to the social dynamics that favor male interaction styles in this specific demographic. This implies that gender is a critical variable that modulates the effectiveness of instructional interventions in Mathematics.

Recommendations

Based on the findings from the study, the following recommendations emerged:

- i. when using Collaborative Learning strategy, teachers should monitor group dynamics closely to ensure that no group of students is marginalized and to consider using single-gender groups to see if that will bridge the gap;
- ii. teachers should be trained to recognize that boys and girls may respond differently to the same active learning strategy; and
- iii. both gender should be equipped to adapt to varying methods accordingly to cater for gender disparities.

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