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ENHANCING MATHEMATICS ACHIEVEMENT AMONG PRIMARY SCHOOL LEARNERS: A COMPARATIVE ANALYSIS OF PEER TUTORING AND COOPERATIVE LEARNING STRATEGIES

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Abstract

The study compared the impacts of two teaching strategies: peer tutoring and cooperative learning on pupils' Mathematics academic achievement in Enugu-North Senatorial Zone, Enugu State, Nigeria. For the proper structuring of the inquiry, three research questions and hypotheses were developed. The research adopted a quasi-experimental approach using a non-equivalent pretest-posttest group arrangement, and a total of 137 pupils selected through a multistage sampling process for participation in the study. For the execution of the intervention, four pre-existing classrooms were used. Two groups were exposed to peer tutoring, while the remaining two experienced cooperative learning. For the purpose of data collection, the study adopted a Mathematics Achievement Test (MAT), which was administered to the participants before and after the intervention, and the data collected were analyzed using descriptive statistics (mean and standard deviation) to address the research questions, and analysis of covariance (ANCOVA) to test the hypotheses at the 0.05 level of significance. The results revealed a significant difference in achievement between the groups, in favour of the learners exposed to the cooperative learning approach. Performance variation was also evident across gender, with female pupils demonstrating higher mean achievement scores than their male counterparts. Furthermore, an interaction between instructional strategy and gender further influenced achievement outcomes. Based on these findings, it is suggested that primary school teachers should priorities the use of cooperative learning strategies to enhance learners' academic achievement in mathematics.

Keywords: Mathematics Achievement, Peer-Assisted Tutoring, Cooperative Instructional Strategy, Primary School.

Introduction

In Basic and secondary education, mathematics is a core subject and so occupies a pivotal position because of its foundational role in developing the learners' reasoning and problem-solving skills (UNESCO, 2023; Siller & Ahmad, 2024). Furthermore, scholars have widely described mathematics as the language of science and a universal tool for fostering critical and analytical thinking (Okenyi,2023). Similarly, Chand et al. (2021), stressed the central role of mathematics in driving the global scientific and technological advancement. The Federal Republic of Nigeria (FRN, 2014), considered mathematics so important to academic advancement that it became a must-pass at the credit level for one to qualify for university education. The implication here is that for one to gain admission into the university in Nigeria, the person's achievement in mathematics must be above average.

Universally, academic achievement is commonly perceived as the measurable learning outcomes acquired by the learners after being instructed in a school setting (Yadav, 2024), often assessed through tests, examinations, or other standardized evaluation procedures (Aduke, 2025; Omonuyi & Fawehinmi, 2025). Mathematics achievement, therefore, refers to the measurable knowledge of mathematics concepts and principle demonstrated by a learner after instruction in the subject in an educational setting.

At the basic level of education, particularly among primary school pupils, Mathematics serves as a

critical tool for developing numeracy skills and fostering analytical thinking. According to the *Organisation for Economic Co-operation and Development* (OECD) (2023), numeracy skills and analytical thinking are necessary for lifelong learning and participation in science and technology-related fields. Similarly, Abed et al. (2025) pointed out that mathematics enables learners to interpret quantitative information, solve real-life problems, and develop higher-order thinking skills essential for advanced learning.

The importance of mathematics notwithstanding, learners' achievement in the subject at the primary school level in Nigeria remains consistently low and uninspiring (Basic Education Certificate Examination (BECE) Chief Examiners' Reports, 2023-2025). Evidence from the BECE Chief Examiners' Reports (2023; 2024; 2025) indicates consistent underperformance among learners, accompanied by poor conceptual understanding and negative attitudes toward the subject (Agbata et al., 2024; Ugiagbe, 2025). This persistent trend has raised concerns among educators and stakeholders in the education industry (Chief Examiner's Report, 2025). Existing empirical studies have attributed the persistence of learners' underachievement in mathematics to several factors, including but not limited to the dominance of teacher-centred instructional approaches, inadequate learning resources, and limited opportunities for active learner engagement (Roka & Khatri, 2024; Siller& Ahmad, 2024).

The continued reliance on traditional teacher-centred strategies, where the teacher dominates classroom interaction, and learners assume passive roles, has been identified as a major impediment to effective mathematics learning (Ezema& Okenyi, 2022; OECD, 2023; Ugiagbe, 2025). According to Abed et al. (2025), such approaches often deny the learners the opportunity to engage in active participation, critical thinking, and meaningful engagement with instructional materials. Obviously, this limits the learner's ability to develop a deep conceptual understanding of mathematics concepts. Consequently, contemporary educational research has increasingly emphasised the need for learner-centred instructional strategies that promote active engagement, collaboration, and active knowledge construction among learners (Ugwuanyi & Okeke, 2020; UNESCO, 2023; Nene et al., 2025).

Among learner-centred approaches that have gained increasing attention are peer tutoring and cooperative learning strategies (Hidayat et al., 2025; Møgelvang & Nyléhn, 2023). Peer tutoring is an instructional strategy in which learners work together in pairs or small groups, with one learner providing academic support to another to enhance understanding of specific concepts (Alexander et al., 2022; Topping et al., 2022; Ugiagbe, 2025). In the study, peer tutoring is a learning strategy in which a more knowledgeable learner supports a peer in enhancing understanding of specific mathematical concepts through guided interaction. According to Topping et al. (2022), Peer tutoring encourages individualized learning, immediate feedback, and reinforcement of knowledge that are essential for improving academic achievement among learners.

In contrast, the cooperative learning approach is a structured group activity with shared learning goals with each member being individually accountable for his/her contributions (Yang, 2023; Zhou & Colomer, 2024; Siller & Ahmad, 2024). Cooperative learning strategy is a structured instructional approach that involves small heterogeneous groups working toward shared academic goals, characterised by positive interdependence, individual accountability, and promotive interaction. According to Yang (2023) and Nene et al. (2025), this approach emphasises positive interdependence, face-to-face interaction, and the development of social and cognitive skills necessary for effective learning. Empirical evidence has demonstrated that cooperative learning is particularly effective in enhancing pupils' achievement in Mathematics. Studies have shown that learners exposed to cooperative learning strategies tend to exhibit higher levels of engagement, improved problem-solving skills, and better academic performance compared to those taught using conventional methods (Omasete et al., 2024; Roka & Khatri, 2024; Siller& Ahmad, 2024; Ngoc Tuong Nguyen et al., 2025; Okenyi, 2025; Abed et al., 2025; Efuribe et al., 2025). Similarly, peer tutoring has been found to demonstrate comparable effectiveness in fostering conceptual understanding and academic achievement in mathematics by providing

individualized support and reinforcing learning through interaction in diverse learning contexts (Toulia et al., 2023; Yahyaei et al., 2024; Parmar et al., 2025). However, Topping et al. (2022) and Ugiagbe (2025) point its effectiveness may vary depending on the competence of the tutor and the quality of interaction between learners. Despite these promising findings, evidence comparing the relative effectiveness of these two approaches, particularly at the primary school level, remains limited.

Beyond instructional strategies, the learners' characteristics, such as gender, remain an important variable and play a crucial role in understanding pupils' academic achievement in Mathematics. According to UNESCO (2023), gender refers to socially constructed roles, behaviours, and expectations associated with males and females, which may influence learning experiences and academic outcomes. Research findings on gender differences in Mathematics achievement have been inconsistent (OECD, 2023; Siller& Ahmad, 2024). While some studies report that male learners outperform female pupils in Mathematics due to differences in spatial abilities and confidence levels (Obi et al., 2021; OSILA, 2022; Amani et al.,2025), others have found that female learners perform equally well or even better, particularly in supportive and collaborative learning environments (Muhawenimana & Mutarutinya, 2023; Luo & Chen, 2024). Furthermore, some studies like that of Odo (2023) found that gender had no significant interaction effect on learners' achievement in mathematics. These mixed findings suggest that gender differences in achievement may be influenced by contextual factors, including the type of instructional strategy employed (Nene et al., 2025; Ugiagbe, 2025).

The theoretical foundation of this study is the social learning theory of Bandura (1977), which posits that learning occurs through interaction, observation, and collaboration with others. In the context of Mathematics education, both peer tutoring and cooperative learning provide opportunities for learners to engage in meaningful social interactions, exchange ideas, and co-construct knowledge (Johnson et al., 2022; Siller& Ahmad, 2024). According to Nene et al.(2025), these interactive processes are particularly important for young learners, as they enhance understanding, retention, and application of mathematical concepts.

Despite the extensive research on learner-centred instructional strategies, there is limited empirical evidence directly comparing the relative effectiveness of peer tutoring and cooperative learning strategies within the same experimental framework, particularly at the primary school level in the Nigerian context. Furthermore, the moderating role of gender within such a comparative design remains underexplored. There are no known studies in Nigeria that have directly compared the two instructional studies, especially at this level of education.

Based on the above discussion, the study examined the comparative effects of peer tutoring and cooperative learning strategies on primary school learners' academic achievement in Mathematics in Enugu-North Senatorial Zone. Additionally, the study investigated the moderating role of gender in these instructional effects. The findings provide empirical evidence to guide teachers, curriculum planners, and policymakers in adopting effective instructional strategies for improving Mathematics learning outcomes at the primary school level.

Research Questions

1. What differences occur in the mean mathematics academic achievement scores of primary school learners taught mathematics using peer tutoring and those taught using cooperative learning strategies?
2. To what extent does gender influence primary school learners' academic accomplishment in mathematics?
3. How does the interaction between instructional strategy and gender affect learners' achievement in mathematics?

Hypotheses

Ho_1: Exposure to peer tutoring and cooperative learning strategies does not produce a statistically significant difference in the mean mathematics achievement scores of primary school learners.

Ho_2: Gender does not significantly influence the mean mathematics achievement scores of primary school learners.

Ho_3: The interaction between instructional

strategy and gender does not have a statistically significant effect on learners' mean achievement scores in mathematics

Methods

Apre-test, post-test non-equivalent group research design was utilised in the investigation because a random assignment of individual learners was not feasible within intact classroom settings. The target population of the study comprised 2,341primary5 pupils in the Enugu North Senatorial Zone, Enugu State, Nigeria, of whom 137 participated in the study. A multi-stage sampling procedure was employed. First, two Local Government Areas (LGAs) were selected from the seven in the senatorial zone using simple random sampling (balloting with replacement). Subsequently, one primary school was selected from each LGA. Finally, two intact classes were purposively selected from each selected school (resulting in four intact classes) for participation in the study. The classes were designated to treatment conditions, thus: Experimental Group A Peer Tutoring), two classes and Experimental Group B (Cooperative Learning), two classes. Data were collected using a 30-item multiple-choice Mathematics Achievement Test (MAT), with four response options (A-D).The participants were assigned to two treatment groups: one group received instruction through peer tutoring, while the other group was taught using a cooperative learning approach. Three experts (One each from Mathematics Education, Educational Measurement and Evaluation, and Childhood Education) scrutinized the Mathematics Achievement Test to ensure both face and content validity. Its reliability index was established using the KR - 20 and yielded a coefficient of 0.88.Data analysis involved the use of mean and standard deviation to address the questions, while Analysis of Covariance (ANCOVA) was applied to in the testing of the hypotheses at a significance level of 0.05.

Results

Table1: Pretest and posttest mean achievement scores of pupils taught using peer tutoring and cooperative learning strategies

		Pretest		Posttest		
Instructional Strategies	n	Mean	Std. D	Mean	Std. D	MeanGain
Peer Tutoring	64	16.67	4.03	35.82	4.04	18.12
Cooperative Learning	73	16.91	2.64	43.48	6.22	25.58

Table 1 presents the pretest/posttest academic achievement of pupils exposed to peer tutoring and the cooperative learning strategies. While both groups showed improvement, pupils in the cooperative learning group recorded a higher mean gain compared to those in the peer tutoring group. However, greater variability was observed in the cooperative learning group.

Table 2: ANCOVA comparing the effects of instructional strategies on pupils' mathematics achievement.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3738.491	5	747.698	48.29	.000	.670
Intercept	2689.168	1	2998.168	304.731	.000	.599
Pretest	17.642	1	17.642	1.297	.259	.111
Gender	1460.940	1	1460.940	170.924	.000	.496
Instructional Strategies	801.831	1	801.831	51.78	.000	.251
Gender*instructional Strategies	199.113	1	199.113	20.153	.000	.048
Error	1565.500	114	15.483			

Total	210569.000	137				
Corrected Total	5903.992	136				

Table 2reveals a statistically significant difference in academic achievement between the two instructional strategies, F (1, 115) = 51.78, p < .05, favouring the cooperative learning approach. The effect size (η^2 = .251) suggests that a substantial proportion of the variance in pupils' academic achievement is attributed to the instructional strategy.

Table3 : Pretest and posttest mean achievement scores of male and female pupils

Gender	N	Pretest		Posttest		MainGain
		Mean	Std.D	Mean	Std.D	
Male	62	16.24	2.97	34.88	3.54	15.72
Female	75	15.41	1.77	45.70	5.75	27.37

As shown in Table 3, both male and female pupils improved from pretest to posttest. However, the female pupils demonstrated a higher mean gain in achievement. The variability in scores was also greater among female pupils.

Ho2: Gender does not significantly influence the mean mathematics achievement scores of primary school learners.

In Table 2 further analysis revealed that a statistically significant difference in achievement scores based on gender, with female pupils outperforming male pupils, F (1, 115) = 169.924, p < .05. This outcome indicates that gender had a significant influence on pupils' mathematics achievement.

Table4: interactive effects of instructional strategies and gender on pupils' mathematics achievement.

Gender	Instructional Strategies	N	Pretest		Posttest		Mean gain
			Mean	Std. D	Mean	Std.D	
Male	Peer Tutoring	34	18.62	3.68	33.93	3.26	15.31
	Cooperative Learning	29	17.73	1.47	36.42	3.71	18.68
Female	Peer Tutoring	28	15.38	1.12	39.47	4.49	24.00
	Cooperative Learning	46	17.00	1.87	48.12	3.82	31.13

Table 4 illustrates the interaction between instructional strategies and gender. Across both strategies, female pupils outperformed their male counterparts, with the highest achievement recorded among female pupils in the cooperative learning group

Ho3: There is no significant interaction effect of instructional strategies and gender on pupils' mean achievement scores in Mathematics.

Table 2 reveals that there is a significant interaction effect of instructional strategies and gender on pupils' mean achievement scores in Mathematics, *F (1, 115)* = 19.963, *p* = .001. Hence, the null hypothesis was rejected (*p*< .05). The implication of this is that the effect of instructional strategies on pupils' achievement in mathematics varies across gender.

Discussion

The result revealed that learners who were taught mathematics using cooperative learning had higher post-test achievement scores over their counterparts exposed to peer tutoring strategies. Again, it was revealed that there existed a significant difference in the mean mathematics academic achievement scores of pupils taught using peer tutoring and those taught using cooperative learning in favour of those taught with cooperative learning. The superior performance of the cooperative learning group may be attributed to increased interaction, shared responsibility, and active engagement in problem-solving tasks. By fostering teamwork among the pupils, cooperative learning promotes critical thinking and a culture of shared responsibility, and peer support, which ultimately enhances the learners'

engagement, leading to a better achievement. Contrary to this, peer tutoring encourages one-on-one direct interface that reinforces learning, where a peer teaches others in small groups in some cases. In this case, its effectiveness may be dependent on the varying levels of competency between the tutors and the tutees, potentially affecting the overall learning experience. The observed superior effectiveness of the cooperative learning strategy can be explained within the context of the Nigerian classroom setting. The Nigerian classrooms are often characterised by overcrowding and limited instructional resources. In such an environment, cooperative learning provides an opportunity for shared responsibilities, allowing the learners to support one another while becoming less reliant on the teacher. This finding corroborated the social learning theory, which posits that learning occurs through social interactions and collaboration.

This outcome is in line with previous studies, such as those by Omasete et al. (2024), Roka and Khatri (2024), Ngoc Tuong Nguyen et al. (2025), and Abed et al. (2025), who established that cooperative learning significantly enhances learners' academic achievement in Mathematics, and every other school subject through active participation and structured group interactions. Similarly, Topping et al. (2022), Ugiagbe (2025), and Efuribe et al. (2025), found that while peer tutoring improves learning outcomes, it is not as effective as cooperative learning in fostering long-term achievement in complex scientific subjects. Other studies, carried out by Siller and Ahmad, (2024), and Okenyi (2025),pointed to cooperative learning strategiesas being more effective in subject are as where collaborative problem-solving and critical thinking are indispensable like Mathematics. Thus, the overall findings validate the claim that cooperative learning strategy makes a difference in pupils' achievement in mathematics more than peer tutoring.

The finding indicated that female pupils outperformed the males. This outcome maybe because of the learning behaviors and characteristics of females, who often display stronger organizational skills, teamwork, attentiveness, and engagement in commonly in life including learning activities. Female pupils may also benefit from increased motivation and a higher tendency to seek collaborative support in learning, which enhances their academic achievement. Contrary to this, the males who are characterised by individualistic and independent way of life may exhibit these traits in learning environments, thereby relying on independent learning and problem-solving approaches. Though, this may be beneficial, it may not always translate into higher achievement scores in a structured academic environment.

This outcome is in line with the findings some previous studies, which demonstrated that female pupils tend to outperform male pupils in standardised academic assessments, including Mathematics particularly in supportive and collaborative learning environment (Obi et al., 2021;Osila, 2022; Muhawenimana, & Mutarutinya, 2023; Luo & Chen, 2024; Amani et al., 2025). However, Siller and Ahmad (2024) reported that male pupils achieved significantly better than female pupils in science subjects that require more logical reasoning, such as Physics and Mathematics, while other studies, such as thoseby Odo (2023) suggest that there is no significant difference in Mathematics achievement based on gender, highlighting the variability of findings across different contexts.

Conclusion

From the results obtained from the study it was found that pupils taught mathematics using cooperative learning strategy achieved better than their peers who were taught using peer tutoring instructional strategy. To this effect there for, the study concludes that, although, both peer tutoring and cooperative learning strategies enhance pupils' engagement and achievement in mathematics, the cooperative learning strategy produces superior outcomes in mathematics achievement among peoples.

Educational Implications

The findings of the study highlight the need to adopt more learner-centered approaches while teaching mathematics in primary schools. Particularly, cooperative learning provides practical framework for the improvement of primary school learners' engagement and academic achievement through structured interaction. For the teachers, this underscores the necessity of organizing classroom activities that promote cooperation, shared responsibility and peer interaction.

At the curriculum level, the results of the study indicate the need to embed cooperative learning tasks

within mathematics content at the primary school level to support active learning. Additionally, primary school teacher training programmes should be designed to place greater emphasis equipping teachers with the skills required to effectively implement cooperative learning strategies in diverse classroom settings.

Recommendations

In line with the findings of the study, the researchers recommend as follows:

1. Primary school teachers should be trained through structured professional development programmes on how to implement cooperative learning strategies effectively in mathematics classrooms.
2. There is the need for primary school teachers to be trained in the use of the cooperative learning strategy for them to be applying such in the teaching of Mathematics in the classrooms.

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