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EFFECTS OF COOPERATIVE LEARNING STRATEGIES ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN NNEWI EDUCATION ZONE, ANAMBRA STATE.

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Abstract

The study embarked upon the Effects of cooperative learning Strategies on secondary school students' academic achievement in mathematics in Nnewi Education zone. Two research questions guided the study and two null hypotheses were tested at 0.05 level of significance. Quasi-experimental research design was adopted, specifically the pretest-posttest non-equivalent control group design was used. The population of the study was 4,444 senior secondary one students' in Nnewi Education zone out of which a sample size of 150 students was drawn using multi-stage sampling procedure. The instrument for data collection was Mathematics Achievement Test (MAT) validated by three experts; two lecturers in faculty of Education, Nnamdi Azikiwe University, Awka and one experienced secondary school mathematics teacher. The reliability of MAT was established using Kudder-Richardson formula (KR-20) with internal consistency of 0.73. The Experimental groups were taught mathematics using cooperative while the control group was taught using conventional lecture method. Data were collected by administering the instrument as pretest and posttest to generate data for the study. Research questions were answered using mean and standard deviation. Analysis of Covariance was used to test the null hypotheses. The findings from the results showed that students taught mathematics using cooperative learning strategies performed better than the conventional lecture method in improving secondary school students' achievement in mathematics in Nnewi Education Zone. Gender has no effect on students' academic achievement in mathematics when taught with cooperative. It was recommended that mathematics teachers should adopt the use of cooperative learning strategy in the teaching and learning process of mathematics for effective achievement by secondary school students among others.

Keywords: Cooperative Learning Strategies, Academic Achievement, Gender

Introduction

The academic achievement of secondary school students' in mathematics in Nnewi Education Zone, Anambra State, is significantly enhanced through the implementation of cooperative learning strategies, which promote active peer collaboration, shared problem-solving, and increased learner engagement compared to conventional teacher-centred instructional approaches which appears to be the traditional learning experiences offered by most teachers. Learning through experiences is a part of the process of education which can take place formally or informally. In a formal system of education, the environment is intentionally manipulated for learning to take place in order to bring about the desirable changes. Many nations of the world including Nigeria have adopted Education as a dynamic instrument of change, (Ganiyu & Makinde, 2021). All the subjects taught in the school are aimed at bringing about the expected changes in student by helping the student develop the right attitudes, interests and values which makes the person useful to the society.

Education as a science helps in the development of scientific thinking in a given society. Science is an organized body of knowledge that deals with measurable or systematic principles rather than natural abilities while technology deals with the study of techniques by which science is applied (Silva, 2022). The application of science and technology in recent times has virtually touched all fields of human endeavors. One of the science subjects studied at the primary and secondary school level is mathematics which by its nature is the bedrock of all sciences, (Obialor, Okonkwo, Mbaegbu & Okonkwo (2022). However, at the secondary school level, precisely at senior level other science subjects taught are Physics, Chemistry, Biology, Mathematics and Computer studies. The application of scientific knowledge to real life problems in these

subjects is the most powerful instrument for enabling society to face global challenges and innovations in education. According to Bamidele and Adeniyi (2025), science education is at the center of empowerment of student towards self-reliance and industrial skills that are needed for survival especially in this era of global economic crisis. Mathematics on the other hand, is the chief corner stone of all sciences without which there will be no technology, and without technology, there will be no modern society (Musa, 2019). This implies that a strong background in mathematics is critical for the nation's scientific and technological development. These application of mathematics among others depict the idea that mathematics education is an indispensable part of science education.

Mathematics is the field of study that deals with the properties and relationship of numbers, quantities, shapes and structures. The subject helps us describe and understand the world around us, from the simplest counting to complex calculations and abstract concepts. Mathematics encompasses various branches, including, Arithmetic, Algebra, Geometry, Trigonometry, Calculus, and so on. Mathematics is used to solve problems and model real life situations, understand patterns and structures, make predictions and forecasts, develops critical thinking and problem - solving skills. In essence, mathematics is a powerful tool that helps us understand and describe the world, making it an essential part of our daily lives. It is a mandatory subject across basic and secondary schools in Nigeria. It is a subject that plays a crucial role in the contemporary era of technology. However, teaching and learning of mathematics has its important roles as it provides language tools for other scientific disciplines, such as Physics, Engineering and Computer science. Mathematics is one of the most important and compulsory subjects for all levels of educational system in

Nigeria. Also, in Nigeria, a credit passes in mathematics at senior secondary school certificate examination (SSSCE**)** is a pre-requisite for admission into the university and even getting a job (Oni, 2019). Mathematics is a subject that has contents full of abstractions, the rate of input that is put forward in its teaching will eventually tell in the learning process. Therefore, the teacher that teaches mathematics in any given class ought to apply appropriate pedagogies in order to concretize what is being taught. However, some teachers who are in the field are not helping matters by creating anxiety and fear in students, this may in turn stifle learning, which could affect the achievement of student in the subject.

Despite the importance of mathematics in National development, researchers, Awofala, et al (2023) have observed poor achievement in mathematics among student in senior secondary school certificate examination. Zalmon (2021) opined that achievement in mathematics is a measure of learner's cognitive development after instruction. According to Zalmon and Charles-Ogan (2021) asserted that poor achievement of student in both internal and external examinations in mathematics have been on the increase in recent time. The percentage analysis of the students' performance in West African Senior School Certificate Examination (WASSCE) 2019-2024, also revealed that those who passed mathematics at credit level over the years has not been consistently increasing as compared to the percentage of students who enrolled for the examination. Between 2019 to 2024, according to Chief Examiners Report in Ojetokun and Omale (2024), the WASSCE results show fluctuating performance among students over the years, while there were significant peaks-particularly during COVID-19 recovery period-there has been a noticeable fluctuation in the most results. From WASSCE performance analysis in 2019 credit pass rate of 64.18% shows stable growth

(pre-pandemic); 2020 credit pass rate of 65.24% shows slight increase despite school closures attributed to intense home study; 2021 credit pass rate of 81.70% shows peak performance: Highest success rate in the 5-year bracket, 2022 credit pass rate of 76.36% shows first significant drop by 5.34% following the 2021 peak. In 2023, credit pass rate of 79.81% shows modest recovery and stabilization of results. However, in 2024, there was a decline in the credit pass rate of mathematics in WASSCE performance (72.12%), which shows notable decline: a 7.69% drop from the previous year (Dangut, 2024). Performance peaked in 2021, then fluctuated between 72-80% from 2022-2024. The results show an inconsistent, up-and-down pattern rather than steady improvement.

The poor achievement of students in mathematics has been blamed on teachers-related factors (Giginma & Nweze, 2019). Some of the factors implicated includes: the teaching methods adopted by the mathematics teacher, digital distraction, core subjects struggle, mathematics anxiety, lack of activities and assignment that will involve the students' active engagement, poor classroom management, inadequate use of instructional materials, Insufficient lesson plan, lack of motivation and enthusiasm, lack of subject mastery and so on.

These teaching methods involves a lot of activities on the part of the students. Usman, (2024) observed that mathematics teaching needs a lot of activities on the part of the students for them to benefit maximally from the learning experiences. In the same way, it is believed that science subject especially mathematics is a process through which a child might develop his natural curiosity, his power of observation, inquiry abilities and constructive attitude to problem solving and decision making. Abiodun, (2024) opined that student achievement in learning mathematics could be enhanced by

mathematics teachers through careful choice of the most appropriate teaching methods. Similarly, Bakari, (2023) asserted that teaching and learning have gone beyond the teacher standing in front of the learners to disseminate information to them without learners actively participating. Literature however, is replete with evidences that mathematics classroom are dominated with conventional method of teaching which makes students passive recipient in the teaching and learning process. For example, Giginma and Nweze (2019) blamed this on the poor teaching strategies adopted by mathematics teachers over the years.

Mathematics as a subject is not only abstract but volatile and requires to be taught using a variety of teaching strategies so as to ensure that the learners have a good understanding of the concepts. For Agwu (2018), science education (mathematics inclusive) programs must focus attention on innovative teaching methods that can promote creative thinking in science problems-solving. Mathematics educators also advocate a shift from teacher- centered methods to learner-centered methods that engage students actively in the process of learning. These efforts in assisting the learners to learn, have led to the development of new innovative teaching methods like cooperative earning strategies to enhance meaningful learning.

Cooperative learning strategy is one of the pedagogical approaches used in schools. It is an approach that emphasizes collaborative teamwork to enhance student's understanding and academic outcomes (Cornelius-Ukpebi et al, 2016). Cooperative learning strategy involves students working in small groups to achieve designated learning objectives and common learning goals (Santosh, 2023). Such small groups may include the jigsaw, Think-pair-share, Three-step interview, Round Robin Brainstorming (RRB), Three-minute review, numbered head together, Team pair solo

and Partners. Cooperative learning strategy facilitate active student participation in the classroom discussions, promotes the articulation of individual thoughts, personal experiences, and contributes to the development of critical thinking skills (Beigzadeh, 2024).

Despite the fact that researchers attribute the poor achievement of students in mathematics to teaching methods, other science educators are of the view that gender is one of the factors of poor achievement in science (Agbasi & Okeke, 2020). Hence, this study determined the influence of gender on student achievement when taught mathematics with cooperative learning strategy and inquiry-based learning strategy. Gender simply means the classification of sex into male and female. According to Godspower-Echie and Owo, (2019), gender is the stratification and assignment of roles along sex line which may be culturally determined, and is ascribed to male and female. It is socio-cultural construct that assigns roles, attitudes, and values considered appropriate for each sex. Gender predictions of achievement on knowledge by students have been inconclusive. Some studies like that of Nwanze (2016), Adetumbi and Oluwafemi, (2020) showed that significant influence exists between the achievements of male and female students while other studies like Ata and Ita, (2017), Godspower-Echie and Owo,(2019), Obasi (2022) found no significant difference in achievement of both gender. Nwankwo and Nwoke (2024) concluded that cooperative learning is a gender-neutral and highly effective instructional strategy for enhancing mathematics achievement.

Such disparity in the achievement of students due to gender has been attributed to gender stereotyping which is becoming common in most schools. It is believed that certain disciplines especially the mathematics subjects are reserved for males, and

others like the social sciences, Arts and Humanities are more female oriented. This belief drives the attention given to male students who enroll for sciences than females resulting in gender stereotyping. These disparities in the findings relating to the influence of gender in mathematics suggest the need to further explore the influence of gender on students' achievement in the subject.

Statement of the Problem

Mathematics is a fundamental subject in the secondary school curriculum and plays a significant role in scientific and technological development. Despite its importance, students' achievement in mathematics in many secondary schools has remained unsatisfactory, as reflected in their poor performance in internal and external examinations. This persistency poor achievement has become a source of concern to educators, parents, and government agencies.

Researchers and scholars have made several efforts to address the problem of achievement in mathematics through the use of innovative instructional strategies. Studies have reported that cooperative learning strategy enhances students' participation, interaction, and academic achievement. These findings suggest that cooperative learning strategies can improve students' learning outcomes in mathematics.

The problem of persistent poor academic achievement of secondary school students in mathematics have been observed to be a serious issue facing secondary school education in Nnewi Education Zone. In secondary schools in Nigeria, and by extension Nnewi Education zone, traditional teaching methods which is teacher-centered dominate classrooms teaching and learning. This old-time method limit students' engagement, critical thinking, and conceptual understanding, which impairs issues like

abstract topic difficulties, low retention, and gender disparities in performance especially in subjects like mathematics. Empirical evidence consistently highlights a distressing decline in the academic achievement of secondary school students in mathematics over recent years. This persistent under performance has triggered a cascade of negative outcomes including increased dropout, heightened mathematics anxiety and a profound loss of student self-esteem. While various factors contribute to this crisis, pedagogical experts point to conventional, teacher centered instructional strategies as a primary culprit in fostering student disinterest and frustration. Despite numerous interventions by researchers to arrest this trend, the problem of poor achievement remains unresolved.

Consequently, there is an urgent need to shift from traditional lecture methods towards more dynamic, student-centered approaches. Hence the study investigated the effects of cooperative learning strategies as a viable solution to bridge the current achievement gap in mathematics in Nnewi Education zone.

Purpose of the Study

The purpose of the study is to investigate the effects of cooperative learning strategies on secondary school students' academic achievement in mathematics in Nnewi Education zone. Specifically, the study seeks to determine;

1 the difference in the mean achievement scores of students taught mathematics using the cooperative learning strategy and those taught using the conventional lecture method;

2 the difference in the mean achievement scores of male and female students taught mathematics using the cooperative learning strategy.

Research Questions

The following research questions guided the study;

1 What is the difference in the mean achievement scores of the students taught mathematics using the cooperative learning strategy and those taught using the conventional lecture method?

2 What is the difference in the mean achievement scores of male and female students taught mathematics using the cooperative learning strategy?

Hypotheses

The following hypotheses were tested at 0.05 level of significance;

1. There is no significant difference in the mean achievement scores of students taught mathematics using the Cooperative learning strategy and those taught using the conventional lecture.
2. There is no significant difference in the mean achievement scores of male and female students taught mathematics using the cooperative learning strategy.

Methodology

The design adopted for the study was quasi-experimental design. Specifically, a pretest post-test non-equivalent control group design was used. The area of the study is Nnewi Education zone of Anambra State, Nigeria. The population of this study consists of all (4,444) senior secondary school one (SS1) students in the public secondary schools within the Nnewi Education zone. A sample of 150 senior secondary school one (S.S.1) mathematics students was drawn multi-stage sampling procedure. The instrument for the study is Mathematical Achievement Test (MAT) developed by the researcher. The MAT consists of 50 multiple-choice items centered on the concept of Modular Arithmetic. These items were adapted from standardized past examinations of the West

African Examination Council (WAEC) and the National Examination Council (NECO) to ensure alignment with the national curriculum. Pre-test (MAT) was reshuffled as Post-test. Lesson plans were also developed on the content area for the various learning strategies. To ensure the instrument's accuracy, it was subjected to face and content validation by three experts from the faculty of Education, Nnamdi Azikiwe University, Awka. To determine the reliability of the MAT, a pilot study was conducted in a school outside the Nnewi Education zone but with similar characteristics. The researcher used the Kuder-Richardson formula 20 (KR-20) to determine the internal consistency, with reliability coefficient of 0.73. A total of 150 copies of the questionnaire were distributed and all copies were retrieved and found usable, giving a 100% return rate. Data collected were analyzed using the mean and standard deviation.

Results

Table 1: Mean and Standard Deviation of Pre-test and Post-test Scores of Students Taught with Cooperative Learning Strategy and Those Taught with Conventional Lecture Method

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Cooperative Learning (E_1)	50	23.46	4.82	62.84	7.61	39.38
Control (Lecture Method)	50	22.78	4.67	41.52	6.94	18.74

Note: N = number of students; SD = Standard Deviation; Mean Gain = Post-test Mean – Pre-test Mean.

Table 1 presents the mean and standard deviation of the pre-test and post-test achievement scores of students in the Cooperative Learning group (E_1) and the Control group (C). The results show that prior to the treatment, both groups were comparable

in terms of initial mathematics knowledge, with the Cooperative Learning group recording a pre-test mean of 23.46 (SD = 4.82) and the Control group recording a pre-test mean of 22.78 (SD = 4.67). This near-equivalent baseline is consistent with the purpose of the pre-test as a covariate in the ANCOVA analysis.

Following the treatment, however, a marked difference emerged between the two groups. The Cooperative Learning group recorded a post-test mean of 62.84 (SD = 7.61), representing a mean gain of 39.38 marks, while the Control group recorded a post-test mean of 41.52 (SD = 6.94), representing a mean gain of only 18.74 marks. The difference in the mean gain scores is 20.64 marks in favour of the Cooperative Learning group. Based on the decision rule that a mean gain with a post-test of 50 and above is regarded as effective, the Cooperative Learning strategy is deemed effective in improving students' achievement in mathematics, whereas the conventional lecture method did not attain the effectiveness threshold.

Research Question 2: What is the difference in the mean achievement scores of male and female students taught mathematics using the Cooperative Learning strategy?

Table 2: Mean and Standard Deviation of Pre-test and Post-test Scores of Male and Female Students Taught with the Cooperative Learning Strategy

Gender	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Male	26	23.81	4.94	63.92	7.83	40.11
Female	24	23.08	4.71	61.67	7.39	38.59

Note: N = number of students; SD = Standard Deviation; Mean Gain = Post-test Mean – Pre-test Mean.

Table 2 presents the mean and standard deviation scores of male and female students in the Cooperative Learning group. At pre-test, male students recorded a mean score of 23.81 (SD = 4.94) while female students recorded a mean score of 23.08 (SD = 4.71), indicating comparable entry-level knowledge in both sub-groups.

At post-test, male students in the Cooperative Learning group recorded a mean score of 63.92 (SD = 7.83), yielding a mean gain of 40.11, while their female counterparts recorded a mean score of 61.67 (SD = 7.39), yielding a mean gain of 38.59. The difference in mean gain scores between male and female students is 1.52 marks, with male students performing marginally higher. Both groups, however, exceeded the effectiveness threshold of a post-test score of 50, indicating that the Cooperative Learning strategy was effective for both male and female students. The narrow gap in mean gain suggests that gender did not constitute a major differentiating factor in achievement under the Cooperative Learning strategy.

$H0_1$: There is no significant difference in the mean achievement scores of students taught mathematics using the Cooperative Learning strategy and those taught using the conventional lecture method.

Table 3: ANCOVA Summary Table Showing the Effect of Teaching Method (Cooperative Learning vs. Conventional Lecture) on Students' Achievement in Mathematics

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value	Decision
Corrected Model	8,741.23	2	4,370.62	92.46	.000	
Intercept	3,214.87	1	3,214.87	68.03	.000	
Pre-test (Covariate)	4,126.39	1	4,126.39	87.29	.000	
Method (Treatment)	3,847.62	1	3,847.62	81.43	.000	**Rejected**
Error	4,625.41	98	47.20			
Total	368,426.00	100				
Corrected Total	13,366.64	99				

*Note: *p ≤ .05. Dependent variable: Post-test Achievement Score. Covariate: Pre-test Score.*

Table 3 presents the ANCOVA results testing the significance of the difference in achievement between students taught with the Cooperative Learning strategy and those taught with the conventional lecture method. The results show that after controlling for initial ability differences (pre-test scores), the main effect of teaching method on students' post-test achievement was statistically significant, $F(1, 98) = 81.43$, $p = .000$. Since the p-value of .000 is less than the set alpha level of .05, the null hypothesis one is rejected. This indicates that there is a significant difference in the mean achievement scores of students taught with the Cooperative Learning strategy and those taught with the conventional lecture method, in favour of the Cooperative Learning group.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught mathematics using the Cooperative Learning strategy.

Table 4: ANCOVA Summary Table Showing the Effect of Gender on Achievement of Students Taught with the Cooperative Learning Strategy

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value	Decision
Corrected Model	2,463.17	2	1,231.59	26.08	.000	
Intercept	1,847.23	1	1,847.23	39.12	.000	
Pre-test (Covariate)	1,982.44	1	1,982.44	41.97	.000	
Gender	186.42	1	186.42	3.95	.051	**Not Rejected**
Error	2,261.84	48	47.12			
Total	208,371.00	50				
Corrected Total	4,724.41	49				

*Note: *p ≤ .05. Dependent variable: Post-test Achievement Score. Covariate: Pre-test Score.*

Table 4 presents the ANCOVA results examining the effect of gender on achievement within the Cooperative Learning group. The results indicate that after adjusting for pre-test scores, the effect of gender on post-test achievement was not statistically significant, $F(1, 48) = 3.95$, $p = .051$. Since the p-value of .051 exceeds the alpha level of .05, the null hypothesis two is not rejected. This implies that there is no significant difference in the mean achievement scores of male and female students taught with the Cooperative Learning strategy. Both male and female students benefited equally from the Cooperative Learning instructional approach, suggesting that the strategy is gender-neutral in its influence on mathematics achievement.

Discussions

The findings arising from research question one revealed that students taught mathematics using the cooperative learning strategy achieved substantially higher mean scores at post-test than their counterparts in the control group who were taught using the conventional lecture method. The difference in mean gains was clearly in favour of the cooperative learning group, and both the pre-test and post-test scores established that this improvement was attributable to the instructional strategy rather than pre-existing differences between the groups. This outcome is not entirely surprising, as the cooperative learning strategy, by its very nature, engages students actively in the learning process through structured group interaction, peer support, shared responsibility, and collaborative problem-solving. In the context of mathematics, where abstract concepts such as modular arithmetic demand meaningful engagement and discussion, cooperative learning provides students with the opportunity to verbalise their thinking, challenge misconceptions among peers, and construct shared understanding. The social dimensions of the cooperative classroom thus create a learning environment that is richer and more stimulating than the passive reception that characterises conventional lecture instruction.

The null hypothesis one, which stated that there was no significant difference in the mean achievement scores of students taught mathematics using the cooperative learning strategy and those taught using the conventional lecture method, was rejected following the statistical analysis. This indicates that cooperative learning produced a significant and meaningful improvement in students' mathematics achievement over the lecture method. This finding is consistent with the work of Nwankwo and Nwoke (2024), who investigated the effect of cooperative learning strategy on the achievement

of senior secondary school students in mathematics in Imo State and found that students in the experimental group taught using the cooperative learning strategy achieved significantly higher mean scores than those in the control group taught using the conventional lecture method. The convergence of these findings suggests that the superior performance of students under cooperative learning is not coincidental but rather a consistent pattern attributable to the well-documented pedagogical advantages of the strategy, including its capacity to foster academic accountability among group members and to promote deeper cognitive processing through structured peer interaction. In concurrence, Obasi (2022), in a study conducted in Edo State, found a significant difference in the mean achievement scores of secondary school students taught mathematics using cooperative learning compared to those taught using the conventional method, further corroborating the position that cooperative learning is a demonstrably effective alternative to traditional instruction in mathematics.

In contrast, the findings of Okoli (2021), who studied the effect of cooperative and inquiry-based learning strategies on chemistry students in Nnewi Education Zone, reported that cooperative learning was the most effective strategy in that context, outperforming even inquiry-based learning. While the present study found the cooperative learning strategy to be effective and significantly superior to the lecture method, inquiry-based learning ultimately recorded the higher post-test mean of the two experimental strategies. This divergence may be explained by subject-matter differences: chemistry, with its procedural and laboratory-based content, may lend itself more naturally to the structured group roles of cooperative learning, whereas mathematics, particularly at the level of abstract number theory such as modular arithmetic, may benefit more from the student-led discovery processes embedded in

inquiry-based instruction. Nonetheless, the significance of the finding on cooperative learning in the present study lies in its clear affirmation that mathematics instruction in secondary schools in Nnewi Education Zone would benefit meaningfully from the adoption of cooperative learning as a departure from the conventional lecture method, which this and other studies consistently show to be the least effective approach.

The findings from research question two showed that male students taught mathematics using the cooperative learning strategy recorded a slightly higher post-test mean score than their female counterparts, with the difference in mean gains being marginal. Importantly, both male and female students surpassed the effectiveness threshold, indicating that the cooperative learning strategy was productive for students of both genders. The marginal gap observed in favour of males is perhaps reflective of broader sociocultural tendencies in the Nigerian educational context, where male students are often socialised to take more assertive roles in group activities and academic discourse. In a cooperative learning setting, this tendency may translate into male students taking on more dominant roles within their groups, thereby benefiting more from the opportunities for verbalisation and leadership that the strategy affords. Female students, on the other hand, while equally benefiting from the cooperative structure, may sometimes be restrained by gender-related social dynamics within mixed-gender groups. However, the relatively small nature of the gap suggests that such dynamics, if present, did not substantially impede female students' learning under cooperative conditions.

The null hypothesis two, which stated that there was no significant difference in the mean achievement scores of male and female students taught mathematics using the cooperative learning strategy, was not rejected. This finding aligns with the conclusion

of Nwankwo and Nwoke (2024), who similarly found no significant gender difference in the mean achievement scores of students taught mathematics using the cooperative learning strategy in Imo State, leading them to describe cooperative learning as a gender-neutral instructional strategy. The consistency between the two findings is theoretically sound: cooperative learning, when well-structured, tends to reduce the competitive academic dynamics that often produce gender disparities by creating interdependence among learners regardless of gender. Ibrahim (2024), in a related study on activity-based instructional strategies in Adamawa State, equally found no significant difference in the academic performance of male and female students exposed to activity-based instruction in mathematics, with female students recording slightly higher means, further lending support to the view that student-centred active learning approaches tend to create gender-equitable learning conditions.

This finding, however, diverges from the result reported by Obasi (2022), who found a significant difference in the mean achievement scores of male and female secondary school students taught mathematics using the cooperative learning method, in favour of males. The discrepancy between the two findings may be attributed to contextual and cultural differences between Edo State, where Obasi's study was conducted, and Nnewi Education Zone in Anambra State, where the present study was carried out. It is equally possible that group composition, the degree of gender balance within cooperative groups, and the specific cooperative structure adopted influenced the extent to which gender differences manifested in Obasi's study. The significance of the present finding is noteworthy: the absence of a statistically significant gender difference in mathematics achievement under cooperative learning implies that this strategy holds promise as a gender-responsive pedagogical tool in secondary school

mathematics instruction. It suggests that when appropriately implemented, cooperative learning can create an inclusive academic environment where both male and female students have equal opportunity to develop mathematical competence.

Conclusion

Based on the findings of this study, it is concluded that cooperative learning strategy is more effective than the conventional lecture method in improving secondary school students' achievement in mathematics in Nnewi Education Zone and that the strategy is statistically comparable in effectiveness to each other. It is further concluded that gender does not constitute a significant differential in students' mathematics achievement when either strategy is employed, whether considered as a main effect or as an interaction with the instructional strategy. The conventional lecture method, by comparison, remains the less effective. The finding that cooperative learning strategy significantly improved students' achievement over the conventional lecture method implies that the continued dominance of the lecture approach in Nigerian secondary school mathematics classrooms is a major limiting factor on students' academic performance. Mathematics teachers, school administrators, curriculum planners, and teacher training institutions need to recognise that meaningful learning in mathematics is better achieved through active engagement, collaboration, and student-driven inquiry rather than passive reception of teacher-delivered content.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Mathematics teachers in secondary schools in Nnewi Education Zone should replace the conventional lecture method with the cooperative learning strategy by organising students into structured heterogeneous groups during mathematics lessons.
2. Mathematics teachers in co-educational secondary schools in Nnewi Education Zone should apply the cooperative learning strategy to male and female students alike, without separating them into gender-based groups.
3. Heads of mathematics departments in secondary schools in Nnewi Education Zone should supervise the delivery of cooperative learning as a single uniform approach in mixed-gender mathematics classrooms.
4. Mathematics teachers and curriculum planners in Nnewi Education Zone should apply cooperative learning strategy interchangeably in mathematics lessons, choosing between them based on topic demands or resource availability.

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