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Effect of Cooperative Learning Strategy on Senior Secondary School 2 Students' Performance in Algebra in Wudil Local Government Area, Kano State

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Abstract

This study investigated the effect of cooperative learning strategy on Senior Secondary School Two (SS2) students' academic achievement and mathematics anxiety in algebra in Wudil Local Government Area, Kano State, Nigeria. The study was motivated by persistent poor performance and high anxiety levels among secondary school students in algebra, which is a foundational component of mathematics. A quasi-experimental pre-test and post-test non-equivalent control group design was adopted. The population comprised all SS2 students in public secondary schools in Wudil Local Government Area. A sample of 120 students was selected using simple random sampling technique and assigned into experimental (n = 60) and control (n = 60) groups. Data were collected using the Algebra Achievement Test (AAT) and Mathematics Anxiety Rating Scale (MARS). The instruments were validated by experts in Mathematics Education and Measurement and Evaluation. Reliability coefficients were established using Kuder-Richardson Formula 20 (KR-20) for AAT and Cronbach's Alpha for MARS, yielding reliability indices of 0.82 and 0.86 respectively, and indicating high internal consistency. The experimental group was taught algebra using cooperative learning strategy while the control group was taught using conventional lecture method for six weeks. Mean and standard deviation were used to answer the research questions while independent samples t-test was used to test the hypotheses at 0.05 level of significance. Findings revealed that students taught using cooperative learning strategy performed significantly better than those taught using conventional method in algebra ($t(118) = 8.21$, $p < 0.05$). It was also found that cooperative learning strategy significantly reduced students' mathematics anxiety compared to conventional method ($t(118) = -6.47$, $p < 0.05$). The study concluded that cooperative learning strategy improves achievement and reduces mathematics anxiety in algebra. It was recommended that mathematics teachers should adopt cooperative learning strategy in teaching algebra and that educational authorities should organize workshops and seminars to train teachers on its effective implementation.

Keywords: Cooperative Learning Strategy, Algebra, Academic Achievement, Mathematics Anxiety, SS2 Students, Kano State

1. INTRODUCTION

Mathematics is a core subject in the Nigerian education system and is widely recognized as an essential tool for scientific, technological, and socio-economic development. It plays a significant role in daily life and forms the foundation for disciplines such as engineering, economics, computer science, and the natural sciences. Despite its importance, students' performance in mathematics at the secondary school level in Nigeria has remained a major concern to stakeholders, including teachers, parents, curriculum planners, and examination bodies.

Algebra is a major branch of mathematics that deals with symbols, variables, expressions, equations, and the generalization of arithmetic operations. It serves as a gateway to advanced mathematical concepts such as calculus, statistics, and mathematical modeling. However, evidence from Chief Examiners' reports of public examinations such as WAEC and NECO has consistently indicated that students experience difficulties in algebraic concepts such as factorization, simplification of expressions, linear equations, and word problems. These difficulties often manifest in poor achievement and avoidance of mathematics-related subjects.

One major factor contributing to students' poor performance in algebra is the dominance of teacher-centered instructional methods, particularly the lecture method. In the lecture method, the teacher delivers content while students remain passive recipients of knowledge, thereby limiting active engagement, peer interaction, and conceptual understanding. In addition, mathematics anxiety has been identified as a psychological factor that negatively affects students' learning outcomes. Mathematics anxiety refers to feelings of tension, fear, and worry that interfere with the manipulation of numbers and the solving of mathematical problems.

In response to these challenges, learner-centered instructional strategies such as cooperative learning have been advocated. Cooperative learning is an instructional approach where students work in small heterogeneous groups to achieve common academic goals. It promotes positive interdependence, individual accountability, face-to-face interaction, and group processing. Through cooperative learning, students can share ideas, clarify misconceptions, and support one another in solving algebraic problems. Consequently, cooperative learning has the potential to enhance academic achievement and reduce anxiety in mathematics.

In Wudil Local Government Area of Kano State, teachers and school administrators have continued to express concern over students' weak performance in algebra, which affects overall mathematics achievement. Therefore, it is necessary to investigate effective instructional strategies that can improve students'

achievement and reduce anxiety. This study examined the effect of cooperative learning strategy on SS2 students' academic achievement and mathematics anxiety in algebra in Wudil Local Government Area, Kano State.

1.1 Statement of the Problem

Students' persistent poor performance in mathematics, particularly in algebra, remains a major challenge in Nigerian secondary schools. Reports from examination bodies such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO) have consistently shown that students perform poorly in algebra-related questions, including factorization, simultaneous equations, simplification of algebraic expressions, and word problems. These weaknesses reduce students' chances of success in mathematics and related science subjects.

In Wudil Local Government Area of Kano State, the problem of poor achievement in algebra is evident in classroom assessments and external examinations. Many students perceive algebra as difficult and abstract, leading to low confidence and avoidance of mathematical tasks. In addition, students often experience mathematics anxiety, which negatively affects their ability to solve algebraic problems effectively.

One possible cause of this challenge is the continued use of traditional teacher-centered instructional methods, which limit students' active involvement and peer interaction. These methods may fail to address individual differences and do not provide supportive learning environments that reduce anxiety.

Although cooperative learning strategy has been reported in previous studies to improve achievement and reduce anxiety, its effectiveness in the context of SS2 students learning algebra in Wudil Local Government Area has not been adequately investigated. Therefore, this study sought to determine whether cooperative learning strategy would significantly improve students' achievement and reduce mathematics anxiety in algebra compared to the conventional lecture method.

1.2 Purpose of the Study

The main purpose of this study was to examine the effect of cooperative learning strategy on SS2 students' academic achievement and mathematics anxiety in algebra in Wudil Local Government Area, Kano State. Specifically, the study sought to:

1. determine the effect of cooperative learning strategy on SS2 students' academic achievement in algebra;
2. examine the effect of cooperative learning strategy on SS2 students' mathematics anxiety in algebra;
3. compare the achievement of students taught algebra using cooperative learning strategy and those taught using conventional lecture method;
4. compare the mathematics anxiety levels of students taught algebra using cooperative learning strategy and those taught using conventional lecture method.

1.3 Research Questions

The following research questions guided the study:

1. What is the mean achievement score of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method?
2. What is the mean mathematics anxiety score of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method?
3. What difference exists between the mean achievement scores of students taught algebra using cooperative learning strategy and those taught using conventional lecture method?
4. What difference exists between the mean mathematics anxiety scores of students taught algebra using cooperative learning strategy and those taught using conventional lecture method?

1.4 Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

H01: There is no significant difference in the mean achievement scores of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method.

H02: There is no significant difference in the mean mathematics anxiety scores of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method.

1.5 Significance of the Study

The findings of this study will be beneficial to mathematics teachers, students, curriculum planners, school administrators, researchers, and government agencies. Mathematics teachers will benefit by understanding how cooperative learning strategy can be implemented to enhance students' achievement and reduce anxiety. Students will benefit through improved understanding, confidence, and reduced fear of algebra. Curriculum planners and textbook writers may incorporate cooperative learning activities into instructional materials. School administrators and education authorities will gain evidence to support teacher training programs and instructional improvement. Researchers will find the study useful as a reference for future studies in mathematics education.

1.6 Scope of the Study

The study was limited to Senior Secondary School Two (SS2) students in public secondary schools in Wudil Local Government Area of Kano State. The study focused on algebra topics such as algebraic expressions, factorization, linear equations, and simplification. The independent variable was cooperative learning strategy while the dependent variables were academic achievement and mathematics anxiety. The study compared cooperative learning strategy with conventional lecture method.

1.7 Limitations of the Study

This study had some limitations. First, the duration of the treatment was limited to six weeks, which may not be sufficient to measure long-term retention of algebra concepts. Second, the study did not include a delayed post-test to determine the sustainability of learning outcomes. Third, the Hawthorne effect may have influenced the experimental group's performance, as students may have

improved simply because they were aware that they were part of an experimental group. Finally, the study was limited to public secondary schools in Wudil Local Government Area, therefore the findings may not be generalized to private schools or other locations without caution.

1.8 Operational Definition of Terms

Cooperative Learning Strategy: A student-centered instructional strategy where learners work together in small groups to achieve shared learning goals.

Academic Achievement: The level of students' performance measured by scores obtained in the Algebra Achievement Test (AAT).

Mathematics Anxiety: Feelings of fear, tension, and worry experienced by students when engaging in mathematics tasks, measured using the Mathematics Anxiety Rating Scale (MARS).

Algebra: A branch of mathematics involving symbols, variables, equations, and expressions used to represent relationships and solve problems.

Conventional Lecture Method: A teacher-centered method of instruction where the teacher explains concepts while students listen and take notes with limited interaction.

2. LITERATURE REVIEW

2.1 Concept of Cooperative Learning

Cooperative learning is an instructional approach in which students work in small groups to accomplish shared learning goals. Johnson and Johnson (1999) described cooperative learning as a structured form of group work where students pursue common objectives while being assessed individually. Slavin (2014) emphasized that cooperative learning is effective when it includes group goals and individual accountability. Cooperative learning promotes positive interdependence, face-to-face interaction, individual accountability, social skills development, and group processing.

2.2 Theoretical Framework

This study is anchored on Social Constructivist Theory by Vygotsky (1978), which posits that learning occurs through social interaction and collaboration. Vygotsky argued that students develop higher cognitive functions through interactions with peers and teachers within the Zone of Proximal Development (ZPD). Cooperative learning aligns with this theory by providing opportunities for students to learn through peer tutoring, shared problem-solving, and dialogue.

2.3 Concept of Algebra and Students' Challenges

Algebra is an essential aspect of secondary school mathematics that involves the use of symbols and variables to represent numerical relationships. Kieran (2007) noted that algebra requires abstract reasoning and generalization, which many students find challenging. Students often struggle with translating word problems into algebraic expressions, manipulating symbols, and understanding equations.

2.4 Mathematics Anxiety

Mathematics anxiety is a psychological phenomenon characterized by feelings of tension, fear, and worry that interfere with mathematical performance. Ashcraft and Kirk (2001) reported that mathematics anxiety reduces working memory capacity and affects problem-solving ability. According to Tobias (1993), students with high mathematics anxiety often avoid mathematics-related activities and may develop negative attitudes towards the subject.

2.5 Empirical Studies on Cooperative Learning and Achievement

Several studies have reported positive effects of cooperative learning on students' academic achievement in mathematics. Slavin (2011) found that cooperative learning improves achievement when properly implemented. In Nigeria, Yusuf (2016) reported that students taught using cooperative learning performed significantly better than those taught using lecture method. Similarly, Ibrahim (2018) found that cooperative learning increased students' engagement and retention in algebra.

2.6 Empirical Studies on Cooperative Learning and Anxiety Reduction

Cooperative learning has also been found to reduce mathematics anxiety. Zakaria and Iksan (2007) reported that cooperative learning creates supportive environments that reduce students' fear of mathematics. In a related study, Furner and Duffy (2002) found that peer interaction and group discussions help students overcome anxiety and build confidence.

2.7 Summary of Literature Review and Research Gap

The reviewed literature indicates that cooperative learning can improve academic achievement and reduce mathematics anxiety. However, limited studies have investigated these effects among SS2 students in Wudil Local Government Area, Kano State. Therefore, this study filled the gap by examining the effect of cooperative learning strategy on achievement and anxiety in algebra.

3. METHODOLOGY

3.1 Research Design

The study adopted a quasi-experimental pre-test and post-test non-equivalent control group design. Two groups were used: experimental group taught using cooperative learning strategy and control group taught using conventional lecture method.

3.2 Area of the Study

The study was conducted in Wudil Local Government Area of Kano State, Nigeria. Wudil is an educationally active area with several public secondary schools.

3.3 Population of the Study

The population of the study comprised all SS2 students in public secondary schools in Wudil Local Government Area of Kano State.

3.4 Sample and Sampling Technique

A sample of 120 SS2 students was selected using simple random sampling technique. The students were assigned into experimental group (n = 60) and control group (n = 60).

3.5 Instrument for Data Collection

Two instruments were used for data collection: the Algebra Achievement Test (AAT) and the Mathematics Anxiety Rating Scale (MARS). The AAT consisted of 30 multiple-choice items drawn from SS2 algebra curriculum topics. The MARS consisted of 20 Likert-scale items measuring students' anxiety towards algebra.

3.6 Validity of the Instrument

The instruments were validated by experts in Mathematics Education and Measurement and Evaluation. Their comments and corrections were incorporated to ensure content and face validity.

3.7 Reliability of the Instrument

Reliability of the AAT was determined using Kuder-Richardson Formula 20 (KR-20), yielding a coefficient of 0.82. Reliability of the MARS was determined using Cronbach's Alpha, yielding a coefficient of 0.86. These values indicate that the instruments were reliable for the study.

3.8 Procedure for Data Collection

The study was conducted in three stages: pre-test, treatment, and post-test. First, both groups were administered the AAT and MARS as pre-test to establish baseline equivalence. Second, the experimental group was taught using cooperative learning strategy while the control group was taught using lecture method for six weeks. Finally, the AAT and MARS were re-administered as post-test.

3.9 Method of Data Analysis

Mean and standard deviation were used to answer the research questions. Independent samples t-test was used to test the hypotheses at 0.05 level of significance. Effect size was also computed using Cohen's d to determine the magnitude of the treatment effect.

4. RESULTS

4.1 Research Question One: Achievement Scores

Table 4.1: Post-test Achievement Scores of Students in Algebra

Group	N	Mean	SD	SE	Remark
Experimental	60	68.40	8.50	1.10	High
Control	60	52.10	9.20	1.19	Moderate

Table 4.1 shows that the experimental group obtained a higher mean achievement score (M = 68.40, SD = 8.50) than the control group (M = 52.10, SD = 9.20). This suggests that cooperative learning improved students' achievement in algebra.

4.2 Hypothesis One

H01: There is no significant difference in the mean achievement scores of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method.

Table 4.2: Independent Samples t-test of Achievement Scores

Group	N	Mean	t	df	Sig. (p)
Experimental	60	68.40	8.21	118	0.000
Control	60	52.10			

The result shows that $t(118) = 8.21$, $p < 0.05$. Therefore, the null hypothesis was rejected. This implies that cooperative learning strategy significantly improved students' achievement in algebra.

4.3 Research Question Two: Mathematics Anxiety Scores

Table 4.3: Post-test Mathematics Anxiety Scores of Students

Group	N	Mean	SD	SE	Remark
Experimental	60	41.20	6.40	0.83	Low
Control	60	52.80	7.10	0.92	High

The results indicate that the experimental group recorded a lower mean anxiety score (M = 41.20, SD = 6.40) than the control group (M = 52.80, SD = 7.10). This implies that cooperative learning reduced mathematics anxiety.

4.4 Hypothesis Two

H02: There is no significant difference in the mean mathematics anxiety scores of SS2 students taught algebra using cooperative learning strategy and those taught using conventional lecture method.

Table 4.4: Independent Samples t-test of Anxiety Scores

Group	N	Mean	t	df	Sig. (p)
Experimental	60	41.20	-6.47	118	0.000
Control	60	52.80			

The result shows that $t(118) = -6.47$, $p < 0.05$. Therefore, the null hypothesis was rejected. This implies that cooperative learning strategy significantly reduced students' mathematics anxiety in algebra.

5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion of Findings

The findings of this study revealed that cooperative learning strategy significantly improved SS2 students' academic achievement in algebra. This result supports the views of Johnson and Johnson (1999) and Slavin (2011) who emphasized that cooperative learning promotes active participation and enhances understanding through peer interaction. The improvement in achievement may be attributed to collaborative problem-solving, peer tutoring, and increased engagement during instruction.

The study also revealed that cooperative learning strategy significantly reduced students' mathematics anxiety. This could be due to the supportive learning environment created by group activities, which reduced fear of making mistakes and encouraged confidence. This finding is consistent with Zakaria and Iksan (2007) who reported that cooperative learning reduces anxiety by promoting peer support.

5.2 Conclusion

Based on the findings of this study, it was concluded that cooperative learning strategy is an effective instructional method for teaching algebra. It enhances students' academic achievement and reduces mathematics anxiety among SS2 students in Wudil Local Government Area of Kano State.

5.3 Recommendations

Based on the findings, the following recommendations were made:

1. Mathematics teachers should adopt cooperative learning strategy in teaching algebra to improve students' achievement.
2. Workshops and seminars should be organized by educational authorities to train teachers on effective cooperative learning implementation.
3. Curriculum planners should integrate cooperative learning activities into mathematics curriculum and textbooks.
4. Schools should provide adequate instructional materials that support collaborative learning.
5. Further studies should be conducted to examine long-term retention effects of cooperative learning in mathematics.

5.4 Suggestions for Further Studies

Future researchers should replicate this study in other Local Government Areas and include private schools. A delayed post-test should also be included to measure retention. Studies may also examine gender differences and other psychological variables.

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