

## Effects of Reciprocal Peer- Tutoring Strategy, Mathematics Test Anxiety on Senior Secondary School Students' Performance in Geometry

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### Abstract

This study investigated effects of reciprocal peer-tutoring strategy on the performance of senior secondary school students in geometry and mathematics test-anxiety in Bosso Local Government Area, Niger State. The population consisted of 4,478 SS II students and sample size of 245 students. A quasi-experimental design was employed. Two research questions and two null hypotheses were tested at a significance level of  $P \leq 0.05$ . Two instruments developed: The Geometry Performance Test and Geometry Test Anxiety questionnaire, with reliability coefficients of  $r=0.65$  and  $r=0.74$ , respectively. The data were analyzed using t-tests. Two lesson models were developed for the experimental and control groups. Findings revealed that the experimental group performed better than the control group in terms of geometry performance, and they also displayed lower levels of test anxiety. It was recommended among others that mathematics teachers should be exposed to Reciprocal Peer-Tutoring through conferences, seminars, workshops, and in-service training.

**Keywords:** Reciprocal Peer-Tutoring, Conventional Teaching Strategy, Academic Performance, Mathematics Test-Anxiety, Geometry

### Introduction

Mathematics plays an essential role in the scientific and technological development of every nation. Its significance in society has been evident since prehistoric times and continues to be relevant today. In secondary schools, mathematics is an indispensable academic subject that cannot be overlooked due to its importance in all aspects of life. Recognizing this, the federal government of Nigeria has made it a compulsory subject, outlining specific objectives for teaching mathematics in secondary schools. These objectives include fostering an interest in mathematics, providing a solid foundation for everyday life, developing computational skills, cultivating accuracy in problem-solving, and establishing a necessary groundwork for further education. The secondary school mathematics curriculum in Nigeria encompasses seven major segments: Algebra, Mensuration, Number and Numeration, Geometry, Trigonometry, Statistics, and Probability (Ahmad & Auwal, 2021).

Geometry, a branch of mathematics, focuses on the study of two- or three-dimensional shapes. Two-dimensional shapes, also known as plane shapes, include triangles, rectangles, squares, rhombuses, circles, and trapeziums. Three-dimensional shapes, on the other hand, are solid shapes such as cubes, cuboids, cones, pyramids, cylinders, and spheres. Geometry serves as a fundamental pillar in mathematics, providing the foundations for engineering and technical graphics. However, reports indicate that students often struggle with conceptual understanding in this subject, as many of them are ill-

prepared for its complexities (Hassan, 2010). In addition, mathematics, including geometry, is generally perceived as challenging and unenjoyable, leading to stress and anxiety among learners (Khadija, 2018). Consequently, students' performance in mathematics, particularly in geometry, tends to be unsatisfactory in both internal and external examinations (Ahmad & Auwal, 2021). According to the WAEC Chief Examiner (2016), the conventional instructional methods fall short of meeting the needs of the majority of learners, and their persistent use contributes to poor performance and increased anxiety, particularly when it comes to geometry concepts. In light of these concerns, the present study aims to investigate whether teaching geometry concepts in mathematics through Reciprocal Peer Tutoring (RPT) can enhance students' academic performance and alleviate test anxiety.

Reciprocal Peer Tutoring (RPT) is a collaborative instructional technique in which students of the same age and class take turns assuming the roles of tutees and tutors. As stated by Ginga, Mohammed, and Usman (2019), RPT provides each student with the opportunity to teach a review lesson, monitor their peers' progress, and evaluate their work through observations or work samples. This approach not only improves academic performance and reduces disruptive behavior but also promotes social competence, awareness of social skills, and peer acceptance.

Reciprocal Peer Tutoring (RPT) holds significant potential in reducing mathematics test anxiety by providing support when tackling difficult concepts through group learning. Working in groups often creates a more relaxed and supportive learning environment, where humor can be used to foster positive learning experiences. This strategy is particularly beneficial in inclusive classrooms, as groups can cater to a wide range of learning needs and disabilities. Cooperative and active learning, inherent in RPT, have been shown to decrease students' mathematics anxiety and positively impact their performance in the subject.

The present study aims to examine the effects of reciprocal peer tutoring on test anxiety and performance in geometry concepts among senior secondary school students. By implementing RPT, teachers gain additional time to work on upcoming lesson plans, while students benefit from receiving more personalized instruction and engaging in active learning. Moreover, RPT allows students to track their own progress, promoting a sense of accountability for their tasks.

The RPT lesson model involves four steps: predicting, clarifying, solving, and summarizing. This model, modified by Ginga, Mohammed, and Usman (2019) and adopted in this study, follows a group of four students who each assume a unique role: predictor, clarifier, solver, and summarizer. The predictor anticipates the type of mathematics questions and the required mathematical operations. The clarifier's role is to explain unfamiliar words and present all mathematical facts relevant to a given problem. The summarizer justifies the solutions and evaluates how they would refine the process when faced with a similar problem. Each group member rotates through the roles, ensuring everyone participates in all four strategies.

The teacher's role is to guide the students and ensure that each student effectively employs the strategies based on their abilities.

### Statement of the Problem

The teaching of mathematics, particularly geometry, in secondary schools in Nigeria has been a matter of concern due to the high incidence of mass failure among students, as reported by the Chief Examiner (2016, 2018 & 2019). Several prominent issues have been identified as contributing factors to the consistent poor performance of students in the Senior School Certificate Examination (SSCE). These issues include the presence of unqualified mathematics teachers, negative parental comments about mathematics, inadequate preparation for class instruction by mathematics teachers, adherence to

conventional teaching methods despite the availability of more effective alternatives, and students' negative attitudes towards mathematics (Ahmad & Baba, 2021).

The consequences of mathematics anxiety are well-documented in the literature, including the inability to comprehend mathematical concepts, decreased mathematics achievement, avoidance of mathematics courses, limitations in selecting college majors and future careers, and negative emotional experiences. Therefore, it is imperative to explore teaching methods that can enhance students' performance and reduce mathematics test anxiety. In light of this, the present study aims to investigate the effects of reciprocal peer tutoring on mathematics test anxiety and academic performance in geometry among senior secondary school students in Bosso Local Government Area.

### Objectives of the Study

This study has the following objectives:

1. To determine whether the mean achievement scores of mathematics students taught geometry using Reciprocal Peer Tutoring are higher compared to those taught using Conventional Teaching Strategy.
2. To examine whether the mean anxiety scores of mathematics students taught geometry using Reciprocal Peer Tutoring show a reduction in test anxiety compared to those taught using Conventional Teaching Strategy.

### Research Questions

1. What is the impact of Reciprocal Peer Tutoring and Conventional Teaching Strategy on the academic performance of students taught geometry concepts in senior secondary schools?
2. How does Reciprocal Peer Tutoring compare to Conventional Teaching Strategy in terms of reducing mathematics test anxiety among senior secondary students?

### Hypotheses

The following null hypotheses are formulated and to be tested at a significance level of  $P \leq 0.05$ :

1. There is no significant difference between the mean performance scores of students taught geometry concepts using Reciprocal Peer Tutoring and Conventional Teaching Strategy.
2. There is no significant difference in the level of mathematics test anxiety among students taught geometry using Reciprocal Peer

## Tutoring and Conventional Teaching Strategy.

### Methods

The research design employed in this study was a quasi-experimental design with two groups: a control group and an experimental group. The control group received instruction using a conventional teaching strategy, while the experimental group was taught using reciprocal peer tutoring. Intact classes were used to avoid disrupting the school program. The target population consisted of 4,478 students (2,430 males, 2,048 females) in SS Two class in public schools under the Niger State Ministry of Education in the Bosso local area of Niger State (M.O.E., 2021). Public schools were chosen due to their similar socio-economic status, admission policy, and staffing.

Multi-stage random sampling was employed. In the first stage, schools were grouped and selected based on location using cluster sampling techniques. In the second stage, two schools were selected from each cluster, with one school assigned as the control group and the other as the experimental group using simple random sampling. In the third stage, one intact class was selected from each of the selected schools. The sample size for the study comprised 125 students in the control group and 120 students in the experimental group.

Two instruments were used for data collection: The Geometry Performance Test (GPT) and the Geometry Test-Anxiety (GTA) questionnaire. The GPT consisted of twenty objective questions derived from the Senior Secondary School Certificate Examination (SSCE) and the National Examination Council (NECO), with options A-E. The GPT served as the

post-test to measure students' performance in geometry after the treatment. The initial GPT was initially comprised of thirty objective questions but was reduced to twenty items through face validation by two experts from IBB University Lapai and item analysis to determine the difficulty and discrimination power of each item. The test-retest method was employed to establish the reliability coefficient, yielding a PPMC value of  $r = 0.65$ .

The Geometry Test-Anxiety (GTA) questionnaire was developed by the researchers and utilized a five-point scale. The questionnaire comprised ten statements, and respondents were asked to rate their personal feelings after each statement using numbers 1 to 5. The ratings ranged from 1 (not at all or never true) to 5 (extremely highly or always true). The GTA questionnaire demonstrated a reliability coefficient of 0.74.

Two lesson models were designed for the treatment of the groups: the Reciprocal Peer-Tutoring Lesson Model (RPTLM) for the experimental group and the Conventional Teaching Strategy Lesson Model (CTSLM) for the control group. Subsequently, the experimental group received instruction using the RPTLM, while the control group received instruction using the CTSLM. The treatment period lasted five weeks. After the treatment, data was collected and analyzed using t-test statistics.

### Results

To examine the significance difference in the mean scores of the groups, a t-test analysis was conducted. The results of the analysis are presented in Table 1.

**Table 1: t-test Analysis of Control and Experimental Group in Post-test**

Variables	n	Mean	SD	Df	T- Cal	P-value	Remark
Exp. Gp	125	63.42	15.75	243	15.56	.00	Sig
Control Gp	120	32.26	16.55				

To assess the effectiveness of the instructions, a post-test was administered to both groups upon completion of the treatment. The data presented in Table 1 indicates that the significance level ( $\alpha$ ) of 0.05 is greater than the obtained p-value (0.000) at a degrees of freedom (DF) value of 243. Therefore, the null

hypothesis is rejected, and it can be concluded that there is a significant difference in the performance scores of the two groups in geometry concepts.

To assess the significance of the difference in test anxiety levels between the two groups, a t-test was employed. The results are presented in Table 2.

**Table 2: t-test Analysis of Experimental Group and Control Group in Geometry Test-anxiety scores**

Variables	N	Mean	SD	Df	T- Cal	P-value	Remark
Control	125	46.70	16.65	243	- 8.28	.00	Sig
Experiment	120	63.74	16.51				

Table 2 demonstrates that the significance level ( $\alpha$ ) of 0.05, which was set for this study, is greater than the obtained p-value of 0.00. This finding indicates that

there is a significant difference in the level of test anxiety between the two groups. As a result, the null hypothesis is rejected.

## Discussions

The findings of this study regarding the research questions and null hypotheses revealed that the experimental group, which was exposed to Reciprocal Peer Tutoring (RPT), outperformed the group exposed to Conventional Teaching Strategy (CTS). This finding supports the assertions made by Ginga, Mohammed, and Usman (2019) that RPT improves academic performance by providing opportunities for students to teach, monitor, and evaluate each other's work through observations and collaborative studies. It is also consistent with the findings of Fransco et al. (2018) and John (2016), who highlighted the positive impact of RPT on student cognition and its ability to reduce mathematics test anxiety through social interaction within the strategy. The experimental group, engaged in RPT, spent more time in the learning process, experienced direct interaction, and felt comfortable, which fostered active learning. Ultimately, RPT proved beneficial for both cognitive and social gains. The results further revealed that the experimental group, exposed to Reciprocal Peer Tutoring, exhibited lower levels of test anxiety compared to the control group. This finding aligns with the findings of Jerry, Desmond, and Rose (2019), who emphasized the significant relationship between mathematics test anxiety and performance. They noted that while mild nervousness can enhance performance, excessive anxiety can interfere with exam outcomes. Students involved in RPT may feel more at ease when interacting with their peers as tutors, leading to improved studying habits, increased concentration on learning tasks, reduced anxiety, and better comprehension of concepts (Ahmad & Baba, 2021).

## Conclusion

Based on the obtained results, it can be concluded that students exposed to Reciprocal Peer Tutoring demonstrate better performance than those exposed to Conventional Teaching Strategy. Additionally, the experimental group experienced lower levels of test anxiety compared to the control group. Thus, Reciprocal Peer Tutoring proves to be an effective approach for teaching and learning mathematics, particularly in geometry concepts, while also reducing mathematics test anxiety among students.

## Recommendations

Based on the findings of the current study, which highlight the effectiveness of Reciprocal Peer Tutoring in improving academic performance and reducing mathematics anxiety in geometry at the secondary school level, the following recommendations are strongly suggested:

1. Mathematics teachers should receive exposure to Reciprocal Peer Tutoring through conferences, seminars, workshops, and in-service training. This will provide them with the necessary knowledge and skills to effectively implement Reciprocal Peer Tutoring in their classrooms. Professional development opportunities should be provided to enhance their understanding of the strategy and its benefits.
2. Students should be encouraged to actively engage in group work. Collaborative learning environments can greatly assist in understanding the subject matter, reducing anxiety, building trust among peers, and creating a sense of ease in the classroom. Group work allows for peer support and promotes meaningful discussions and interactions, enhancing the learning experience for all students.
3. Emphasis should be placed on regular attendance in class. Encouraging students to attend lessons regularly fosters familiarity with their peers, promotes a sense of belonging within the mathematics classroom, and allows for a more enjoyable and productive learning experience. Regular attendance ensures that students do not miss out on important content and opportunities for collaborative learning.

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