

## EFFECTS OF RECIPROCAL PEER-TUTORING AND TEAM ASSISTED INDIVIDUALIZED STRATEGIES ON LEARNING OUTCOME IN MATHEMATICS AMONG UPPER-BASIC STUDENTS IN NIGER STATE

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**Abstract:** Quasi experimental design was used for the study. The population for the study was 64,724 as at 2020/2021 session. Six (6) local governments out of the 25 local government areas of Niger state were used for the study. A total of Eighteen (18) different schools were used as the base schools for the study. Intact classes were equally used. Simple random sampling technique was employed in allocating schools to Experiment groups and Control groups respectively. Sample size of one thousand, eight hundred and twenty-five (1,825) upper-basic II students which comprised of one thousand and fifty-four (1,054) male and seven hundred and seventy-one (771) female was used. The Instruments used for data collection were Mathematics Achievement Test (MAT). The Instruments were subjected to content and face validation by experts, from Mathematics Department from College of Education Minna. To ascertain the reliability of the Instrument, a trial testing was conducted by administering the Instrument on Upper-basic students outside the sampled schools using test and retest reliability technique. A reliability coefficient of 0.82 was obtained. Mean and Standard Deviation was used to answer the research questions while Analysis of Variance (ANOVA) to test the hypotheses set for the study at 0.05 level of significance. Findings of the study revealed that Reciprocal Peer Tutoring (RPT) strategy ( $\bar{X} = 72.92$ ,  $SD = 11.32$ ) and Team Assisted Individualized (TAI) Instructional Strategy (and  $\bar{X} = 72.82$ ,  $SD = 10.51$ ) were more effective in improving students' academic achievement and stimulating students' interest in Mathematics than the conventional traditional method ( $\bar{X} = 57.56$ ,  $SD = 10.65$ ). RPT and TAI were found to be gender friendly.

**Keywords:** Reciprocal peer-tutoring, team assisted industrialized, learning outcome, mathematics

### Introduction

Nigeria as a developing country has continued to witness various reforms in the social, economic and educational sectors. In the educational sector, policies have been formulated with the aim of meeting the challenges of primary and secondary education. In actualizing these policies and achieving critical targets of the goals of Education for All (EFA), the Nigeria Educational Research and Development Council (NERDC) developed a 9 – year Basic Education and new Senior Secondary (SS) Curricula based on different curricula structures. At the basic education level, the curriculum is divided into three components namely, lower basic education curriculum for primary one to three, middle basic education curriculum for primary four to six and upper basic education curriculum for Junior Secondary year one to three (Awofala, 2019).

At the basic education level, mathematics is made one of the compulsory and core subjects. Awofala & Lawani (2020), defined mathematics as the language of precision and whetstone of creativity, thinking and problem solving needed essentially to bring harmony, exactness compactness and accuracy into the knowledge of science, technology and engineering and their products. So, it is not surprising that mathematics is accorded significant important in Nigeria that gaining admission into Post-secondary Institution in the country has one of its requirements to be a credit pass in Mathematics. Recruitments and other job opportunities exercises are always assessed mathematically and the success of a candidate is always determined by a good performance in mathematics. Therefore, the relevance of Mathematics cannot be underestimated.

While numerous studies have investigated the effects of carefully planned instructional strategies (Awofala, Fatade & Olaluwa, 2012) on students' achievement in mathematics in Nigeria, based on

Knowledge of the researcher, few studies were carried out on the effect of Team Assisted Individualized (TAI) strategy and Reciprocal Peer Tutoring (RPT) strategy particularly in Niger

Peer Tutoring Strategy is an instructional strategy in which students work in pair forms to learn academic tasks in the class (Awofala & Lawani, 2020). It is an instructional strategy in which the class is organized in pair of two students may be of different abilities to act as tutor and tutee in a learning process in order to get maximum benefits from each other. There are different kinds of peer tutoring strategies which include Reciprocal Peer Tutoring (RPT) strategy.

Reciprocal Peer Tutoring (RPT) is a collaborative technique of instruction where students of the same class and age bracket alternate between the role of student (tutees) and teachers (tutors) and will follow a structural format to help team members make academic progress. Students alternate roles while in their groups or pairs. RPT enables each member in a group to participate in the group as a tutor and tutee. In RPT, students gain from the preparation and instruction in which the tutees engage in, and also from the instructions that the tutees receive. RPT has a structured format where students teach, monitor, evaluate and encourage each other. Students are part of the educational process and are able to prepare instructional materials and receive feedback from peers. The alternating structure is designed to increase students' choice and participation in the management of their own group interdependent teaching. RPT provides a non-judgment acceptance, care and support, opportunities to give and receive from others and creates a non-competitive, empowering environment. It introduces the much needed balance between cooperation and competition in the socialization process of students. The socialization experiences that occur during reciprocal peer tutoring can benefit both the tutor and tutee by motivating students to learn and increase their social standing among peers. There are other teaching strategies which could be employed by mathematics teachers in their quest to improve learning. Among them is the Team Assisted Individualization Strategy (TAI).

TAI (Team Assisted Individualization) strategy, initiated by Robert E. Slavin, is a combination of cooperative learning and individualized instruction. According to Slaving (2009), learning is designed to help overcome the learning difficulties faced by individuals, and then brought into the group. Within the group, the individual can learn and solve problems or questions that have been given by the teacher with co-learners in their group. In TAI, students work in cooperative learning teams to help each other in solving the problems and encourage each other to go forward. TAI method uses four – six member team formed from the class members with mixed learning ability. Rewards or certificates are awarded to high-performing teams. At the end, motivational incentives are given through the use of 'team recognition' of achievement, in which students of the group receive weekly awards based on the average performance of their teams. Ultimately, the strategy is aimed at attainment of academic achievement for the learners.

Academic achievement literally means a measure of the ability of students to gain or reach a set of goals through efforts and skills. Atsumbe (2012) stated that achievement is the outcome of education which involves the determination of the degree of attachment of the learner in a task, course or program to which the learner is sufficiently exposed. Awofala (2019) stated that achievement in education specifically refers to students' success in learning specified curriculum content. Academic achievement is the main focus of any instructional strategy. High academic achievement which is above the average measure is always the main goal of a teacher that is employing a particular instructional strategy. When such goal is achieved, then the strategy employed is effective. Therefore, Mathematics achievement requires an effective Instructional strategy.

An effective Instructional technique is expected to be narrative through which Mathematics learning should take place. This will involve inculcation of skills of problem solving, inquiry, reasoning and skill of communication in learning Mathematics. By applying these skills, learners are expected to develop a positive attitude towards Mathematics. Adoption of learner-centered activity-based and mind-on approaches that cater for individuals need can lead to achieving

and positive attitude towards Mathematics (Awofala, 2019). This study is aimed at the effects of Reciprocal Peer Tutoring (RPT) and Team Assisted Individualized (TAI) instructional strategies on achievement and Interest among Upper basic student in Niger state.

### Statement of the Problem

Problem to be addressed through this study is the learning methodology of Mathematics in the basic of the Nigerian education system. The basic education system is designed in such a way that learners move in phases. That is, from Pre-basic, Basic, to Post-basic with the knowledge of Mathematics as one of the dictating subjects for the progression. Ideally, a student is supposed to have adequate knowledge of Mathematics and also passed appropriate examinations in Mathematics during the course of the transition from one level of the Basic education to the other. Mathematics teachers are basically one of the driving forces in the progress of their students and the methods of teaching they employed would help the students in achieving their ultimate goal of acquiring Mathematics knowledge. But unfortunately the desired goal is not yet attained satisfactorily. This is evident in the statistics of performance displayed by the Nigerian external examination bodies like WAEC and NECO, where the trend shows relative dwindling performances.

In addition to individual learners who failed to have acquired the requisite Mathematics knowledge at a particular stage of his progression, the community may not be able to fill their gap in the higher institution of learning as a result of the premium attached to the Mathematics subject. Candidates have to pass Mathematics in order to secure a place in higher institutions of learning. Therefore, the persistence of the presented situation does not stop at the student alone, it also affect the community as well. This translates to the need to proffer solution to the existing problems.

Several studies have been carried out by various researchers to test some teaching methodologies that could enhance achievement in various subject areas and fields of studies including Mathematics. Most especially those methodologies that are learner-centered were studied. But researchers have not exhausted the application of collaborative methods such as Reciprocal Peer Tutoring (RPT) and Team Assisted Individualized (TAI) Instructional strategies in Mathematics. In this present study would seek to investigate their effects on learning of Mathematics. According to a research by UNESCO (2012), quality of teaching and students' performance has a strong relation. The National Policy on Education also corroborated the statement in the UNESCO research when it is stated that, no education system can rise above the quality of the teachers in the country (FRN, 2014). The quality in this case is the application of latest innovative methods of teaching. Therefore this research work seeks to find out the effects of two instructional strategies; Reciprocal Peer Tutoring and Team Assisted Individualized Instructional Strategies on achievement and Interest in Mathematics among Upper-basic Students in Niger State.

### Research Questions

What is the difference in the Mean Achievement scores of Upper-basic students taught Mathematics using Reciprocal Peer Tutoring, Team Assisted Individualized Instructional Strategies and Conventional lecture method

What is the difference in the Mean achievement scores of Upper-basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using the Conventional teaching method

What is the difference between the mean achievement scores of Upper-basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method?

Following null Hypotheses tested at 0.05 level of significance.

There is no significant difference between the Mean achievement scores of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using the Conventional method.

There is no significant difference between the Mean achievement scores of Upper Basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method.

There is no significant difference between the mean achievement scores of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using Team Assisted Individualized instructional strategy

Research adopted quasi-experimental design of pre-test, post-test, non-randomized, non-control group design. The population of the research were all the Upper-basic two (JSS) in Niger State which comprises of three hundred and eighty three (383) upper basic (JS) across the 25 local Government Areas in the State. The sample size comprised of one thousand eight hundred and twenty-five (1825) Upper-basic II students from eighteen (18) secondary schools in Niger state. Mathematics Achievement Test (MAT) was used as the instrument for data collection. MAT was validated by three experts from Mathematics Department college of education Minna. The test instrument was pilot tested using Government Girls Science Secondary School, Bosso road Minna, Niger State. The internal consistency of the MAT was established using Kuder-Richardson 21 (KR - 21) which gives a reliability coefficient of 0.91. The teachers collected the data before and after the experiment, after which the data was collected and organized accordingly for data analysis. The data collected were analyzed using Mean and Standard deviation was used to answer research questions while Analysis of Variance (ANOVA) was used to test hypotheses at 0.05 level of significance.

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Experimental Group I, II and Control Group

Group	N	Pretest		Posttest		Mean Gain
		X	SD	X	SD	
Group I Strategy	581	25.64	8.77	72.92	11.32	47.28
Group II Strategy	627	24.81	7.65	72.82	10.51	48.01
Control Strategy	617	25.83	7.80	57.56	10.65	31.73

Table 1 shows the mean and standard deviation of the mean achievement scores of experimental group one, two and control group in pretest and posttest. The result revealed that mean and standard deviation scores of the pretest and posttest experimental group one are  $\bar{X} = 25.64$ ,  $SD = 8.77$  and  $\bar{X} = 72.92$ ,  $SD = 11.32$  respectively. This gives a mean gain of 47.28 in favour of the Reciprocal Peer Tutoring. Mean and standard deviation scores of the pretest and posttest experimental group two are  $\bar{X} = 24.81$ ,  $SD = 7.65$  and  $\bar{X} = 72.82$ ,  $SD = 10.51$  respectively. This gives a mean gain of 48.01 in favour of the posttest Team Assisted Individualized Instructional Strategy. On the other hand, the mean and standard deviation of the pretest and posttest of the control group are  $\bar{X} = 25.83$ ,  $SD = 7.80$  and  $\bar{X} = 57.56$ ,  $SD = 10.65$  respectively and gives a mean gain of 31.73 in favour of the posttest. The result also revealed that experimental group one, two and control group had mean gain of 47.28, 48.01 and 31.73 respectively, and with the experimental group one having the highest mean gain of 48.01

**Table 2: Mean and Standard Deviation of Pretest and Posttest Scores of Reciprocal Peer Tutoring Strategy and Control Group**

Group	N	Pretest		Posttest		Mean Gain
		X	SD	X	SD	
Reciprocal Peer Tutoring Strategy (RPT)	581	25.64	8.77	72.92	11.32	47.28
Conventional Teaching Strategy (CT)	617	25.83	7.80	57.56	10.65	31.73

Table 2 shows the mean and standard deviation of the mean achievement scores of experimental group and control group in pretest and posttest. The result revealed that mean and standard deviation scores of the pretest and posttest experimental group are  $\bar{X} = 25.64$ ,  $SD = 8.77$  and  $\bar{X} = 72.92$ ,  $SD = 11.32$  respectively, this gives a mean gain of 47.28 in favour of the posttest. On the other hand, the mean and standard deviation of the pretest and posttest of the control group are  $\bar{X} = 25.83$ ,  $SD = 7.80$  and  $\bar{X} = 57.56$ ,  $SD = 10.65$  respectively and gives a mean score of 31.73 in favour of the posttest. The result also revealed that experimental group and control group had mean gain of 47.28 and 31.73 respectively, and with the experimental group having the highest mean gain of 47.28.

**Table 3: Mean and Standard Deviation of Pretest and Posttest Scores of Reciprocal Peer Tutoring Strategy and Control Group**

Group	N	Pretest		Posttest		Mean Gain
		X	SD	X	SD	
Team Assisted Individualized instructional strategy (TAI)	627	25.64	8.7750	72.82	10.51	47.18
Conventional teaching strategy (CT)	617	25.83	7.8038	57.56	10.65	31.73

Table 3 shows the mean and standard deviation of the mean achievement scores of experimental group and control group in pretest and posttest. The result revealed that mean and standard deviation scores of the pretest and posttest experimental group are  $\bar{X} = 25.64$ ,  $SD = 8.77$  and  $\bar{X} = 72.82$ ,  $SD = 10.51$  respectively. This gives a mean gain of 47.18 in favour of the posttest. On the other hand, the mean and standard deviation of the pretest and posttest of the control group are  $\bar{X} = 25.83$ ,  $SD = 7.80$  and  $\bar{X} = 57.56$ ,  $SD = 10.65$  respectively and gives a mean score of 31.73 in favour of the posttest. The result also revealed that experimental group and control group had mean gain of 47.18 and 31.73 respectively, and with the experimental group having the highest mean gain of 47.18.

**Table 4: ANCOVA results of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using the Conventional method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	70695.278 <sup>a</sup>	2	35347.639	292.776	.000
Intercept	462781.815	1	462781.815	3833.113	.000
PreTest	141.492	1	141.492	1.172	.279
Group	70617.189	1	70617.189	584.906	.000*
Error	144275.481	1195	120.733		
Total	5278731.000	1198			
Corrected Total	214970.759	1197			

\*: Significant at 0.05 (p<0.05)

Table 4 shows ANCOVA results of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using the Conventional method. From the table, there is significant difference in the performance scores of Upper Basic students taught Mathematics using reciprocal Peer Tutoring strategy and those taught using the Conventional method at 0.05 level of significance,  $F_{(1,1198)} = 584.96$ ,  $p < 0.05$ . Hence, hypothesis one is rejected; this indicates that there is difference between the Mean achievement scores of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using the Conventional method

**Table 5:** ANCOVA results of Upper Basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	72522.340 <sup>a</sup>	2	36261.170	323.546	.000
Intercept	448361.361	1	448361.361	4000.572	.000
PreTest_A	39.979	1	39.979	.357	.550
Group_A	71828.927	1	71828.927	640.904	.000*
Error	139084.229	1241	112.074		
Total	5509972.000	1244			
Corrected Total	211606.569	1243			

\*: Significant at 0.05 ( $p < 0.05$ )

Table 5 presents ANCOVA results of mean achievement scores of Upper Basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method. From the table, there is significant difference in the achievement scores of Upper Basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method at 0.05 level of significance,  $F_{(1,1244)} = 640.904$ ,  $p < 0.05$ . Hence, hypothesis two is rejected; this indicates that there is difference between the Mean achievement scores of Upper Basic students taught Mathematics using Team Assisted Individualized instructional strategy and those taught using the Conventional method.

**Table 6:** ANCOVA results of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using Team Assisted Individualized instructional strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	526.381 <sup>a</sup>	2	263.190	2.215	.110
Intercept	568645.678	1	568645.678	4786.480	.000
PreTest	523.391	1	523.391	4.406	.036
Group	.156	1	.156	.001	.971 <sup>ns</sup>
Error	143156.973	1205	118.802		
Total	6558359.500	1208			
Corrected Total	143683.354	1207			

\*Not Significant at 0.05 ( $p > 0.05$ )

Table 6 ANCOVA presents results of Mean achievement scores of Upper Basic students taught Mathematics Reciprocal Peer Tutoring strategy and those taught using Team Assisted Individualized instructional strategy. From the table, there is no significant difference in the achievement scores of Upper Basic students taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using Team Assisted Individualized instructional strategy at 0.05 level of significance,  $F_{(1,1208)} = 0.001$ ,  $p > 0.05$ . Hence, hypothesis three is not rejected; this indicates that there is no significant difference between the Mean achievement scores of Upper Basic students

taught Mathematics using Reciprocal Peer Tutoring strategy and those taught using Team Assisted Individualized instructional strategy

### Discussion of Findings

There was no significant difference in the Pre-test score of the students in the Experimental groups I and II as well as the Control group, indicating that the three groups were comparable before the intervention. Therefore Analysis of Variance (ANOVA) was used to analyze the Post-test data. The result in Tables 1 and Table 2 indicate that the Upper-basic students taught Mathematics using reciprocal Peer Tutoring strategy (experimental group 1) and those taught Mathematics using Team Assisted Individualized (TAI) instructional strategy have higher mean achievement score than the Control group. This was further confirmed by the results in tables 4 and 5 which revealed that the difference is statistically significant. Therefore teaching Mathematics at Upper-basic level using RPT and TAI produced significant difference on their academic achievement. This finding is in line with the findings of Agbi (2016) that study habits have significant effect on students academic achievement (in chemistry). Similarly the study by Eze (2009) is also in line with this finding of this study. The study revealed that students taught French using Peer Assessment Technique (PAT) performed better than those taught using the conventional method. It was also found from the study that Upper-basic students in each of the experimental groups performed better than their counterpart in the Control group. But when the two experimental groups were compared, it was found that there was no significance difference in their academic achievements. This means that each of the treatment is capable of bringing out similar academic achievement when deployed for use.

### Conclusion

The need to find practicable instruction method to assist Upper-basic students in learning of Mathematics and stimulate their interest in Mathematics is paramount since interest is essential for achievement and retention of knowledge in Mathematics. The study therefore, is aimed at determining the effect of Reciprocal Peer Tutoring (RPT) and Team Assisted Individualized (TAI) instructional strategies on achievement and Interest in Mathematics among Upper-basic students in Niger State. This study found out that Reciprocal Peer Tutoring (RPT) as well as Team Assisted Individualized (TAI) instructional strategies have the ability to effectively to improve students' academic achievement and motivate interest Mathematics. The two techniques were also found to be gender friendly. It can be concluded that, as presented by the findings of this study, RPT and TAI strategies are formidable alternative to the Conventional strategy of teaching Mathematics in the Junior secondary schools.

### Recommendation

The following recommendations were made based on the findings of this study:

1. Mathematics teachers should live the old method of teaching and ensure that teaching in Mathematics becomes active oriented as exemplified by the use of RPT and TAI strategy.
2. Educational administrators should make provision for training workshops to be periodically organized for mathematics teachers to enhance their competence in the choice and use of the various instructional strategies such as RPT and TAI.
3. Students in Niger state secondary schools should embrace the use of RPT and TAI in learning Mathematics to enhance academic achievement as well as stimulate Interest.

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