

## Mathematics Anxiety and Students' Academic Achievement in a Reciprocal Learning Environment

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### **Abstract:**

*The study determined the mathematics anxiety and students' academic achievement in a reciprocal learning environment. It sought to determine the level of achievement of students when exposed to reciprocal learning environment (RLE) and to those exposed to non-reciprocal learning environment (non-RLE) in terms of their pretest, posttest and retention test scores; describe the level of anxiety in mathematics when exposed to RLE and those exposed to non-RLE; identify the difference between the achievement of the students when exposed to RLE and to those exposed to non-RLE in terms of their posttest and retention test scores; and lastly, compare the difference of the anxiety of students in mathematics when exposed to RLE and those exposed to non-RLE.*

*The study utilized a quasi-experimental research design which was conducted at Magpet National High School, Poblacion, Magpet, North Cotabato. Students in Grade 8 were the research respondents of the study.*

*The students who are exposed to RLE have "very low performance" in the pretest and have "moderate performance" in the posttest and retention test while those who were exposed to Non-RLE also have "very low performance" in the pretest and have "moderate performance" in the posttest and retention test. Moreover, for the level of students' anxiety towards mathematics, they have high anxiety before the treatment and becomes moderate after the intervention for both RLE and Non-RLE groups. The mathematics achievement of the students who were exposed to RLE is comparable to the achievement of those students who were exposed to non-RLE. Also, no significant difference in the mathematics anxiety of students was observed in both groups.*

**Key Words:** *reciprocal, non-reciprocal, pretest, posttest, retention test*

### **Introduction**

It is believed that individual knowledge is formed if learners are capable of drawing ideas from their experiences and connect to new situations and scenarios. Hence, cooperative and

collaborative learning put emphasis on active learning through active participation by working fellow learners in engaging shared task (Braza and Supapo, 2014).

The study of Braza and Supapo (2014) claimed the shortcomings that can affect students' achievements in Mathematics: lack of mastery of the basic concepts and skills, lack of problem solving and critical thinking skills, diverse behavior of students and inappropriate teaching skills and approaches of teachers in dealing the students in the class of mathematics. Evidently, the National Achievement test result of the students nationwide in Mathematics was only 48.90 where it is described as poor achievement and below the national standard passing rate. Additionally, mathematics subject ranked two among the subjects in terms of low MPS, NETRC (2012). Furthermore, in Magpet National High School, it gained the following MPS in National Achievement Test (NAT) which is administered nationwide yearly: in SY: 2012- 2013- 61.56, SY: 2013- 2014- 55.26, SY: 2014- 2015- 45.65. Moreover, the MPS for Mathematics in 2015 is only 50.55. As observed in the statistics, the MPS for the past years of the school were diminishing. The result is below the passing percentage which is 75% and this means that students had difficulty in dealing the subject which is alarming and a recurring situation. It is believed that majority of the students feel difficult and tiresome to handle the subject. Thus, it is a great challenge for the teachers to have a couple of solutions in coping with these problems in the classroom. One of these is, a teacher must incorporate cooperative learning in the class like reciprocal learning strategy.

Another factor which might hinder students in learning mathematics is due to their anxiety on the subject. Mathematics anxiety is connected to students' feeling tense or anxious in working with numbers or solving problems in mathematics. Students who suffer from mathematics anxiety do not necessarily experience anxiety in other subjects. It is affirmed that achievement in mathematics is conversely proportional to their anxiety. Hence the researcher aimed to use reciprocal learning strategy to remedy students' anxiety and improve their achievement.

Reciprocal learning is a strategy where both teacher and student share the responsibility for dealing the task or the material. This is a research-based strategy with a proliferation of studies cementing its foundation. Students using reciprocal learning improved their achievement and worked more independently and being self-reliant than the students not using this teaching strategy. Moreover, the reciprocal learning classes saw lesser nuisance behaviors because the students were more cognitively engaged and connected in the material and task.

Thus, the conduct of the study is geared to assess and evaluate the effectiveness of reciprocal learning strategy in improving the achievement of students in learning Mathematics

### **Academic Achievements in Mathematics**

Mathematics needs not to be stressing, even if it is not easy as perceived by majority, this can still be appreciated. Enjoyment of the subject relies on its meaningfulness and dynamics of concept illustrated. It is the essential role of the teachers to guide and direct the students on getting knowledge, thus right ground on methods, strategies and techniques must be considered in giving a comprehensive environment which causes to arouse the interest and challenge the students to the higher level of learning mathematical (Generalao, 2012).

According to Nambatac, (2011), among the 41 participant countries, Filipinos performed poorly in Mathematics. Moreover, it is reported that Filipino students have poor performance in Science and Mathematics subjects. In fact, the National Mean Percentage Score in Math on 2012 was only 48.90 which is described as below the national standard and the it is among the lowest in the five subjects in the National Achievement Test (NETRC, 2012). Furthermore, in Magpet National High School in North Cotabato, it gained the following MPS in National Achievement Test (NAT) which is administered nationwide yearly: in SY: 2012- 2013- 61.56, SY: 2013- 2014- 55.26, SY: 2014- 2015- 45.65. Hence, the MPS for Mathematics in 2015 is only 50.55. As observed in the statistics, the MPS for the past years of the school were diminishing. The result is below the passing percentage which is 75% and this means that students had difficulty in dealing the subject which is alarming and recurring situations. Moreover, the study of (Pagtulon- an and Tan, 2018) states that students perform poorly in mathematics as reflected in their scores. Additionally, its findings are expected due to insufficient basic foundation or they don't have a strong foundation of the concepts.

Hence, it is believed that majority of students feel tiresome to learn mathematics. Thus, it a big responsibility of the teachers to earn couple of solutions in coping these problems in the classroom. One of these, the teacher must incorporate cooperative learning in the class. Hence, it is important for teachers to be sensitive to students' understanding and misconceptions and determine their learning gaps in mathematics. Principles and Standards for School Mathematics of NCTM (2000) acknowledge that there are significant challenges in meeting the vision for enhancing mathematics education. The vision calls for involvement of teachers, school administrators, institutions of higher learning, professional organizations, parents, students and other stakeholders. The combined efforts of the groups might result to brighter hope in the fulfillment of the vision and developing shared commitment in terms of improvement of mathematics instruction in the Philippines.

Moreover, Horario, as cited by Andamon (2015), that mathematics is the second most difficult subject in both elementary and high school level. Thus, Senator Angara, chairman of the Senate Committee on Education, Arts and Culture stressed the insufficiency of competence and skills in mathematics, science and technology which are the major causes of the country's poverty and distress.

### **Mathematics Anxiety**

Majority of the people in the world hate the four-letter word, MATH, they don't like it and feel that they are not good at it", Yang (2014). He described it as "People who feel tension, apprehension and fear of situations involving math might have anxiety in the subject. Anxiety in Mathematics is easy to describe. This is manifested through the feelings of discomfort and nuisance that some individuals may encounter when having problems mathematics learning. "Feelings of tension, apprehension and fright that disturbed the usual manipulation of number and the solving of mathematical problems", Ashcraft & Faust, (2000). In many forms of anxiety, students have the feeling that their hearts beat fast, they may believe that they cannot complete mathematical problems or may avoid taking math courses, Sheffield & Hunt, (2006).

Anxiety of the students in response to mathematics is important concern for teachers and many stakeholders in perception that high anxiety may connected to fear in the subject, Anderson (2007). Mathematics is a significant course in school curriculum. Young age children must learn the basic foundations of the subject which is useful in functioning well in their everyday lives, Lebens, Graff & Mayer, (2011). Mathematics is taught so that students can understand the numerical data presented to them and able to solve simple mathematics computations in a day to day living. It is a belief among children that mathematics subject is a difficult to learn. In mathematics education, plenty of researchers endorse innovative ways of teaching, linking concept and real- life applications and motivating the students to have interest in mathematics, Hemmings, Grootenboer & Kay, (2011). Therefore, in order to meet students' needs and thirst for mathematics, effective teaching pedagogy must be applied in the classroom. However, in the study of Dagaylo-an & Tancinco (2016) concluded that the teaching approach used by the teachers in Mathematics has nothing to do with the Math anxiety of the students. Furthermore, they concluded that there is no significant relationship between the level of mathematics anxiety and the mathematics performance of the students.

### **Reciprocal Learning**

Reciprocal learning strategy is a teaching and learning strategy dated back from the Greek mythology. This strategy is a concept that a person concurrently learns and relearns in teaching another person for a skill or idea. Fields have gained scholarly attention include technology and language acquisition, Berano (2002). However, teaching with its steady influx of student- teachers and apprenticeship models is a more than suitable place to study the human phenomenon of reciprocal learning. Curriculum in a teacher education and development professionally practices have grown to include more reflective practices, Watson (2008). As a result, to have a teacher educator's feeling that mentor- teacher might have something to learn from as well as teach to, their student- teachers, LeCornu & Ewing (2008).

The reciprocal learning strategy is initiated to discuss with a partner, it should also be guided always by the learning goal associated with the particular question or idea. Also, this strategy gives the opportunity for teachers to hear a wide range of students by circulating during

the pairing stage and in class discussion. In addition, the increased wait time aspect of reciprocal learning strategy has been shown to increase the number of students participating in a class interaction, Rowe (nd), so these important aspects of effective informal assessment are built into the reciprocal learning strategy. Furthermore, this strategy is a combination of many beneficial classroom practices. It inherently allows for an increase in wait time. Therefore, by Rowe findings (nd), it is like the reciprocal learning strategy that will increase the number of students participating in class discussion and increase discussion based on evidence. Other cooperative learning techniques have been shown to increase students' self-esteem (Goodwin, 1999). Moreover, action research has shown that reciprocal learning strategy does increase students' participation in class, Renhart (2000).

### Conceptual Framework

In the Philippines system of education, one of the subjects which have placed as of great importance is Mathematics. Hence, it should be stressed out in the classroom and must be coupled with the meaningful and effective teaching pedagogies in order to meet the desired goals of teaching which is an effective transfer of learning from the teacher to the students. Wherever someone goes, whatever situations someone are in and the present and future times might offer, mathematics is always on the go. In the classical or the traditional classroom instruction in mathematics, teacher may have taught using the lecture or discussion method coupled with a paper and pen test as mode of assessment. Presently, times change the way students should be catered, sometimes traditional mode of teaching and assessment may not be effective already and need to exchange with such some meaningful strategies to meet their expectations and needs. So, educational researchers encourage school stakeholders especially the educators to look for innovative and engaging activities which may provide students the opportunity to transfer their knowledge in a meaningful and useful applications. One of the strategies is the Reciprocal Learning.

In using the Reciprocal Learning, students working in pairs allow many advantages over group works because they have the opportunity to state their own views, hear from others, polish their argumentative skills and so forth without the administrative cost of the group work such as time spent assigning people to groups, class time used just for getting in groups and so on. Moreover, pairs make it virtually impossible for the students to avoid participating thus making each person accountable.

Lev Vygotsky's scaffolding theory (1978) which describes the type of assistance and help offered by a teacher or peer to support and improve learning. The teacher offers help with only those skills beyond the student's capabilities and abilities. The teacher shall give instruction to his students to do the tasks meaningfully and effectively. In the RLE, the teachers will constantly monitor students' progresses as they are doing the activities given to them. Teachers also extend

assistance when they are in trouble and correct some misconceptions and ununderstood meaning of the concept so that they can have a worthwhile learning experience.

### **Methodology**

#### **Research Design**

The study employed the quasi- experimental control group design. The respondents were two intact sections where the second and the third sections were set as the control and experimental groups, respectively. Pretest, posttest and retention test were administered to the two groups.

The two groups took the standardized mathematics test that served as pretest of the study. The same test was used as the posttest at the end of the intervention in the RLE and in the Non-RLE. Retention test was administered two (2) weeks after the posttest. The pretest, posttest and retention test results served as the data in the evaluation of the study.

#### **Research Locale**

The study was conducted at Magpet National High School, Poblacion, Magpet, North Cotabato. The school is one of the most populated learning institutions in Cotabato Division in terms of number of students and teachers. In the recent academic calendar, Magpet National High School has a population which is close to 2000 students. It offers the complete academic curriculum such as science curriculum, basic education curriculum and special education for students who need special instruction and treatment.

#### **Respondents of the Study**

The representative samples of the target population of the study were the two sections of Grade 8 students of Magpet National High School, SY 2017-2018 who were taking Mathematics 8 subject, specifically, topics on statistics and probability. The RLE and Non- RLE class are Section C and Section B, Respectively.

Since the study employed quasi-experimental research design, two intact classes were used. The chosen sections were having 38 students in each.

#### **Data Gathering Procedure**

A designed lesson plan for Reciprocal Learning Environment and Non- Reciprocal Learning Environment classes were made to see the difference and significance of improvement on the performance of the students.

A pretest was given before the experimental period while the posttest was administered after the discussion of the topics. Retention test was administered two (2) weeks after the

conduct of the posttest. The students also answered a Mathematics Anxiety Rating Scale (MARS) to measure their level of anxiety on the given intervention before and after the experimental period. The performance of the students was measured based on their achievement on the standardized mathematics test.

The study assumed that the two groups are comparable in anxiety towards mathematics as evident in their pretest scores. The research respondents were exposed to similar conditions such as classrooms, class size and subject teachers in reducing experimenter effects, the same teacher was teaching the group using the strategy for the RLE and Non- RLE.

### **Reciprocal Learning Environment Group**

In the RLE, the reciprocal learning strategy was used as the intervention to the students. Reciprocal Learning, a cooperative structure that takes “working in pairs” up a notch.

It went a little something like this:

- Every pair consisted of a “Student A” and a “Student B.”
- Each student had his own set of problems or exercises to work on. Here’s the twist: Student A has the answers to Student B’s problems, and Student B has the answers to Student A’s problems.
- Students took turns coaching each other through the problems, not giving the answers, but helping their partner reach the correct answer on their own.

This arrangement, if done right, helped students become more self-directed, increased academic gains, and improved the quality of social interactions.

### **Non- Reciprocal Learning Environment Group**

In the Non- RLE, the traditional teaching approach was utilized in teaching desired concepts reflected in the table of the specification of the research instrument for measuring academic achievement of the students. The usual drills and practices on the exercises found in the textbook were done until the students fully understood the topic and sample problems were followed.

## **Research Instrument**

### **Academic Achievements**

The researcher prepared a 50-item standardized test which covered the topics in the Fourth Grading Period stipulated in the K to 12 Mathematics 8 Curriculum. It is a multiple-choice type of test which was content- validated and pilot- tested. It served as the pretest, posttest

and retention test. The topics included in the teacher- made test were statistics and probability. Its Reliability (KR21) is equal to 0.693. Items were scored 1 for every correct response, and 0 if otherwise. The results were interpreted using the scale below adapted from the standards set criteria of DepEd order no. 8 series of 2015 after the scores were transmuted:

Range Scale	Level of Proficiency	Interpretation
90%-100%	Exemplary	Very High Performance
85%-89%	Above Average	High Performance
80%-84%	Average	Moderate Performance
75%-79%	Below Average	Low Performance
74% & Below	Deficient	Very Low Performance

### Mathematics Anxiety

To determine the mathematics anxiety of the students, the researcher adapted the Mathematics Anxiety Rating Scales (MARS) developed by Ikegulu as cited by Rubio (2011). The scale is a Likert scales with items answered on a five-point scale- from strongly agree to strongly disagree. Cronbach's alpha coefficient obtained is 0.92. The scoring procedure was as follows:

Scale	Range	Qualitative Description	Interpretation
5	4.20-5.00	Strongly Agree	Highly Positive
4	3.40-4.19	Agree	Positive
3	2.60-3.39	Undecided	Moderate
2	1.80-2.59	Disagree	Negative
1	1.00-1.79	Strongly Disagree	Highly Negative

### Statistical Techniques

The researcher used descriptive statistics such as frequency, mean and standard deviation to describe the mathematics anxiety and academic achievement of the students.

An analysis of covariance (ANCOVA) was used to see the significant difference on the mathematics anxiety and academic achievement of the students who were exposed to Reciprocal Learning Environment (RLE) and those who were exposed to Non-Reciprocal Learning Environment (Non- RLE).

### Summary

This study was conducted to determine the difference of students' anxiety and academic achievements in Mathematics in Grade 8 at Magpet National High School. Two (2) sections were utilized based on the quasi- experimental research design wherein the experimental and control group are section C and B, respectively. There was a total of 38 students in each section being utilized in the study.

Specifically, it answered the questions on the level of students' anxiety towards Mathematics as exposed to RLE and those exposed to non- RLE prior and after the intervention, level of academic achievement of students when exposed to RLE and those exposed to non- RLE, difference on the achievement of students in Mathematics when exposed to RLE and those exposed to non- RLE and difference on students' anxiety towards Mathematics when exposed to RLE and those exposed to non- RLE.

The RLE group attained a mean score of 13.24 in their pretest which indicates that students' scores are below average signifying a very low performance while the Non- RLE group gained a mean score of 14.26 which also indicates that students' scores are below average signifying a very low performance in the pretest. During the posttest, the RLE group gained a mean score of 32.00 indicating a moderate performance while the Non- RLE group had a mean score of 30.39 indicating also a moderate performance level. The retention test results showed a moderate performance for both RLE and Non- RLE groups. RLE group attained a mean score of 32.66 while the Non- RLE group acquired a mean score of 31.79.

Moreover, on the anxiety of students towards Mathematics, the overall mean score prior to the intervention for the RLE group is 3.58 while for the Non- RLE group is 3.52. This implies that the students have high anxiety towards Mathematics as a subject. On the other hand, the mean score in anxiety towards Mathematics of the students after the intervention are 2.61 and 2.70 for RLE and Non- RLE groups, respectively. This implies that the two (2) groups have moderate anxiety towards Mathematics as a subject.

The F- value between groups is 3.980 with a probability of .050 ( $p \geq 0.05$ ) indicating that there is no significant difference, thus the null hypothesis which states that the students' achievement when exposed to RLE is comparable to those exposed to Non- RLE in terms of posttest failed to be rejected. Moreover, the F- value between groups is .685 with a probability of .410 ( $p > 0.05$ ) which indicates a no significant difference, thus the null hypothesis which states that the students' achievement in Mathematics when exposed to RLE is comparable to the achievement of those who were exposed to Non- RLE in terms of retention test failed to be rejected.

The students' anxiety in Mathematics when exposed to RLE gained a mean score of 2.61 with a standard deviation of .28 while the Non- RLE group attained a mean score of 2.70 and a

standard deviation of .31. Its results show an F- value 3.036 with a probability value of 0.086 ( $p>0.05$ ) indicating that there is no significant difference in the students' anxiety towards Mathematics in the RLE and Non- RLE groups. Thus, the null hypothesis stating that the anxiety towards Mathematics of the students exposed to RLE is comparable to those who were exposed to the mathematics anxiety of Non- RLE failed to be rejected.

### **Conclusions**

The student's achievement in Mathematics, in the RLE and Non- RLE groups are statistically comparable in the posttest and retention test. There is an improvement in the level of achievement of the students from deficient level to average level for both RLE and Non- RLE groups.

Students in both groups have a high anxiety towards Mathematics as a subject before the intervention. After the intervention, both the RLE and Non- RLE groups have a moderate anxiety in Mathematics as a subject.

The academic achievement of the students in Mathematics when exposed to RLE is comparable to the achievement of those exposed to Non- RLE. Thus, students in RLE has similar achievement with those in the Non- RLE group.

Lastly, the Mathematics anxiety of the students towards Mathematics as a subject when exposed to RLE is statistically equivalent to the mathematics anxiety of those who were exposed to Non- RLE in the study. Thus, both groups have moderate anxiety towards the subject.

### **Suggestions and Recommendations**

The academic achievements of the students are deemed important in determining their levels of learning and in assessing whether the teaching and learning process have taken place comprehensively. Therefore, the educators of mathematics are encouraged to monitor the progress of their students academically. Moreover, based from the findings of the study, the RLE may be utilized by the teachers of mathematics to cater students' needs and gap in learning the subject effectively. It may help students understand mathematics concepts in a collaborative, meaningful and quite enjoying way of learning. This may also be used by the mathematics teachers as an activity in teaching particular concept. Students will not only learn the topics but it may also build their confidence and enhance their skills in communication through this strategy because they must have to communicate with their pairs while dealing the task.

Teachers, parents and administrators must have to put in their minds that they must have actions in determining the anxiety level of the students in mathematics. If it becomes too low, a significant action must be taken immediately and ensure that the action must be implemented. Utilizing this strategy in learning in the classroom is encouraged because it can definitely help lower the anxiety level of the students. They may not be able to think that they are alone in learning Math because they are all involved while doing the activities. In this way their trust and confidence in their selves may be built and honed and this will also help enhance their communication skills.

The duration of the intervention must always be taken into consideration to help lessen students' anxiety of the subject, the longer it is implemented, the more students feel that they may enjoy having math lessons. Furthermore, studying other factors of attitudes is suggested other than this, which might also help improve student achievement in the subject and would also help teachers in handling the subject.

Teachers, administrators and curriculum managers are suggested to incorporate reciprocal learning strategy in the curriculum to improve achievement of students in the subject and their retention of the concepts being learned. It may also help them realize that mathematics is not that too scary subject to learn to and help them appreciate it and see the significance of the concepts taught to them. Additionally, in the quest of outcomes-based education, this strategy might be of great help in increasing involvement of the students and they may participate in the class activities.

Teachers, administrators and curriculum makers are encouraged to have an array of different teaching pedagogies and updated means of teaching mathematics in order to lower the level of anxiety of the students towards the subject. Hence, trainings, seminars and other activities for professional development and teaching enhancement are deemed necessary to give students meaningful learning experiences and achieve better results.

And, for the future educational researchers, a study of other types of teaching- learning strategy may be conducted. The duration of its implementation must be considered for the effectivity and reliability of the methods used.

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