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Reciprocal Peer Tutoring Strategy on Students' Anxiety, Self-Efficacy, and Mathematics Performance

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Abstract

The study aimed to investigate the effectiveness of Reciprocal Peer Tutoring (RPT) in reducing mathematics anxiety and improving self-efficacy to advance the mathematics performance of senior high school students in a General Mathematics course. The researchers employed the quasi-experimental design, specifically the Pretest 1, Pretest 2 – Posttest design. Two groups were randomly assigned: the conventional teaching strategy (CTS) group (control) and the reciprocal peer tutoring (RPT) group (experimental). The mathematics anxiety and self-efficacy were measured using an adapted instrument. Mathematics performance was measured using the General Mathematics Achievement Test (GMAT), a researcher-made test. The significant findings of the study reveal that the mathematics anxiety of the experimental group is significantly lower than that of the control group. Further, the prediction model indicated that mathematics anxiety significantly predicts mathematics performance. Unfortunately, it is found that RPT is not effective in improving self-efficacy. Several probable reasons were identified.

Keywords: General Mathematics, K to 12 Curriculum, Senior High School

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INTRODUCTION

Advancing the learners' performance level in mathematics remains a global challenge to all, especially among low-income countries worldwide, including the Philippines. The government, despite its efforts undertaken through the adoption of the K to 12 Education Program in 2012, has continually lagged its Asian comparators for several years now, as evidenced by the dismal performance in international assessments such as the Program for International Student Assessment (PISA) results (OECD, 2019; OECD, 2022). Students' persistently low mathematics performance remains a pressing issue. This observable decline in Mathematics performance (MP) is a serious issue for mathematics educators, especially since mathematics is seen as essential for technical and industrial development in the global landscape (Kiwanuka, 2015).

Several researchers conducted studies to investigate what impedes students from achieving high performance in the subject and search for potential solutions to the persistent problem in mathematics education. Some authors (e.g., Luneta & Sunzuma, 2022; Apostolidu & Johnston-Wilder, 2023) aver that addressing emotional aspects of learning, such as anxiety and self-efficacy, is crucial for creating a supportive learning environment, necessary for improving the student's overall learning outcomes. The students need to learn to manage emotions and establish positive relationships with others as they are seen as essential life competencies,

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crucial for academic success, which Edgar and Elias (2020) called socio-emotional learning skills.

Mutodi and Ngirande (2014) defined mathematics anxiety (MA) as the fear of not overcoming a mathematics task that often stems from a lack of confidence among the learners. Related studies confirmed that MA hinders students' learning experiences and mathematics performance (e.g., Hiller et al., 2021; Omar et al., 2022; Jamaludin, et al., 2023; Das et al., 2014). One tends to underperform in a task at hand when seeing a given circumstance as a threat (Beilock & Maloney, 2015).

Low self-efficacy is also seen as a hindrance to achieving high performance in mathematics. Self-efficacy is defined as the people's views of their ability to function correctly at a designated level of performance (Bandura, 1994). In recent studies, the results revealed that self-efficacy has a significant positive correlation to other constructs such as mathematics performance (e.g., Hiller et al., 2021; Özcan & Kültür, 2021) and academic achievement (Meera & Jumana, 2016).

Meanwhile, many scholars have invested in finding effective learning models to improve students' achievement. For example, a meta-analytic study conducted by Savelsbergh et al. (2016) on the impact of innovative teaching strategies on students' achievement claimed that teaching strategies significantly affect students' performance. They concluded that it is the quality of the content and the implementation of the innovative teaching strategies that matter. Cook and Cook (2011) further emphasized in their work the need for evidence-based instructional practices, meaning that teaching methods should submit to rigorous research through experimentation, to ensure that they are both effective and reliable in improving student outcomes.

One promising teaching strategy based on the results of recent studies is Reciprocal Peer Tutoring (RPT). RPT involves students alternating roles as tutor and learner, work together to support each other's academic achievement through scaffolding. The previous research showed evidence for RPT being an effective strategy in improving students' MP (e.g., Moliner & Alegre, 2022; Bailey et al., 2018; Alegre et al., 2020; Mkpanang, 2016), reducing MA (e.g., Moliner & Alegre, 2020) and increasing interest in learning and SE (e.g., Moliner & Alegre, 2022).

The use of cooperative learning approaches in teaching Mathematics is receiving increased attention as studies show that these strategies significantly improve constructs relative to students' achievement. However, as highlighted earlier the importance of evidence-based instructional practices to ascertain an effective teaching strategy (Cook & Cook, 2011). Therefore, an experimental study was conducted to confirm further recent claims on the effectiveness of RPT, or otherwise. While recent studies focus the investigation along with these constructs (i.e., MA, SE, and MP) separately, this paper ventured into another perspective, making MA and SE lurking variables between teaching strategy and mathematics performance. It is assumed that the reduction of MA and improvement in SE play a critical role in improving the student's performance in mathematics. The findings of this study might be a modest contribution to what has already been known about RPT for its successful implementation.

Hence, this study aimed to investigate RPT's effectiveness in reducing Mathematics anxiety and increasing the respondents' self-efficacy to improve their performance in the General Mathematics course. Specifically, this study sought to answer the questions: (1) What is the level of Mathematics anxiety, self-efficacy, and Mathematics performance among Senior High School students? (2) What is the effect of Reciprocal Peer Tutoring on the students' level of Mathematics anxiety and self-efficacy? (3) What is the effect of Mathematics anxiety and self-efficacy on the students' Mathematics Performance while learning using Reciprocal Peer Tutoring?

Conceptual Framework

To provide a clear direction to where the study was heading, a conceptual framework was developed (see Figure 1). What is on the left side of the figure is the RPT intervention. RPT is a teaching strategy designed to pairs of students who switch roles as tutors and tutees to provide each other academic support. On the other side, opposite RPT is the students' MP. MP is the measure of mathematics achievement of the students. It is the score the students obtained by answering a researcher-made test.

The line connecting the RPT to MA and SE of the students, then to MP, suggests that something should be done to the MA and SE of the students before an effect in MP is observed. Backed with the learning theories, the aspects of RPT being team-oriented, model-driven, and age cohort sensitive were used as bases for choosing the RPT strategy as the central topic in this study. Consistent with the Social Cognitive Theory of Bandura, as cited in Zhou & Brown (2015), activities like RPT could produce desirable outcomes to one's knowledge, skills, and behaviors – SE and MA. Moreover, one of the sources of SE is the vicarious experiences provided by social models (Bandura, 1994). It suggests the use of observational learning or modeling in the process of learning is one of the effective strategies to influence other students to perform or to behave similarly with the models, especially if the learner and the model share the same characteristics.

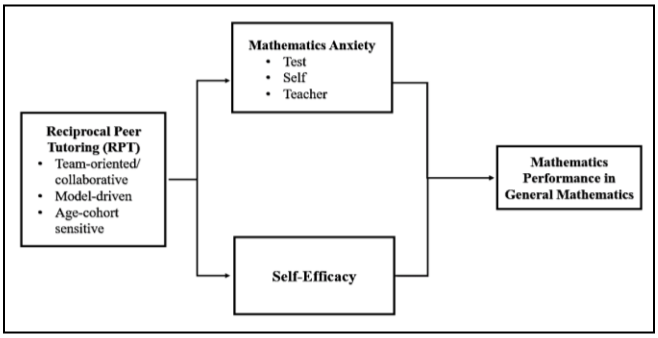

Figure 1. The conceptual framework for the investigation of the effect of RPT on MA, SE, and MP of the students.

In mathematics, learners encounter challenges that are hard to handle on their own. However, with Vygotsky's scaffolding, learners could succeed in a task by receiving the needed support from the more competent ones. Eventually, the observed behavior, attitude, practice, beliefs, and skills from the social models, with sustained efforts, can be translated into an observable learning outcome.

Research Design

The study employed a quasi-experimental design. The researchers chose the Pretest 1, Pretest 2-Posttest experimental design for experimentation (see Figure 2). The said design uses two groups randomly assigned as experimental and control groups. The study employed two pre-tests to increase the stability of MA and SE levels of the students and to establish the equivalency in terms of the MA, SE, and MP between the two groups before the implementation of the intervention (i.e., RPT strategy). The experimental period has two parts: the first half and the second half. In the first half of the experiment, both groups of students were taught using the conventional strategy (i.e., used solely lecture discussion as the strategy), whereas, in the second half, while RPT group was taught using RPT, the CTS group was taught using the same strategy as the first half (T_3).

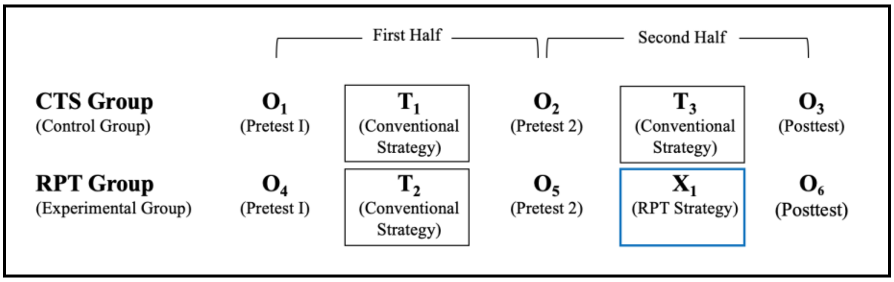

Figure 2. Pre1, Pre2 – Posttest experimental design

It follows four steps to complete the experiment. First was administering the Pretest 1 to both the groups (O_1 and O_4). After all the topics in the first half of the experiment were delivered using conventional strategy (T_1 and T_2), it was only then that the Pretest 2 (O_2 and O_5) was administered. It became the second step of the experiment. The third step was implementing the treatment or the intervention (i.e., used RPT strategy; X_1) to the experimental group. The CTS group, on the other hand, was expose to conventional strategy (T_3). The last step was the administration of the Posttest (O_3 and O_6) to both the CTS and RPT groups upon completion of the intervention. Thus, this study recorded six observations separately for MA and SE.

Research Locale and Participants

The study respondents were taken from the population of the two sections (having 29 students each) of Grade 11- STEM (Science, Technology, Engineering, and Mathematics) students in one of the secondary schools in Partido District of Camarines Sur, Philippines, who were taking General Mathematics subject. One student in each section was excluded because the pairing requires an even number. Using the fishbowl technique, one student for each section was randomly chosen and omitted from the list. One section plays the role of the control group (Conventional Teaching Strategy - CTS Group), whereas the other is the experimental group (RPT Group). The assignment of the role was done using a randomization technique.

Research Instruments

The study used a survey questionnaire, test, and learning plan. The Mathematical Self-efficacy and Anxiety Questionnaire (MSEAQ), adapted from May (2009), was used to gather the needed data about the MA and SE of the respondents. It is a 5-point Likert-type scale designed to measure the level of MA (Part I) and SE (Part II) of the respondents. To check on the validity of part I, the researchers requested three (3) experts in the field of education to evaluate its content.

Further, it was subjected to a reliability test by computing its Cronbach's alpha. The results revealed that the items in the subscales "test," "self," and "teacher" were regarded as "acceptable" with alpha values of 0.86, 0.85, and 0.71, respectively. Thus, four subscales with 20 overall items were reduced to 3 subscales with 15 items. The new sets of items to measure the respondents' MA had an alpha of 0.90, indicating "acceptable" items. For part II of the questionnaire, the reliability test result revealed that the initial set of SE items with an alpha of 0.89 was considered "acceptable." However, it revealed that the scale obtained a higher alpha value of 0.90 upon reviewing the alpha values when certain items were deleted. Thus, item 5 was removed (i.e., I believe I will be able to use mathematics in my future career when needed.).

The General Mathematics Achievement Test (GMAT), a researcher-made test, was used. The test had four (4) options, one being the correct answer and three incorrect answers. Two sets of test questions were designed for the first and second half of the experiment. The tests comprised 40 items to capture the first quarter competencies identified in the DepEd Curriculum Guide for Grade 11 General Mathematics. Kuder-Richardson Formula 20 (KR 20) was employed to test the reliability of GMAT. The result revealed that the Achievement Test for the first and second half was "acceptable," with a coefficient value of 0.74 and 0.80, respectively. Since the KR-20 reliability coefficient condition was satisfied, the instruments were utilized. The pretest and post-test data were obtained in the first and second half of the experiments using the same instrument.

A learning plan was used for the implementation of the RPT. In crafting the material, the researchers focused on the competencies present in the curriculum guide the Department of Education used in teaching General Mathematics. The first quarter competencies were divided into two units: one for the first half and one for the second half. For the first half, lesson plans were implemented in both groups. However, in the second half, the researchers developed two lesson plans, one for the RPT group and one for the CTS group. Further, to ensure its validity, three experts were consulted.

Intervention

Ability Classification and Pairing

Respondents under the experimental group were classified based on their Grade Point Average (GPA) in all of the Mathematics courses they had taken in their Junior High School years, plus their GMAT results at Posttest1 on the first half of the experiment. Secured with the respondents' consent, the researchers requested each student's grades from the school principal. The upper 50% of respondents were marked as high performers, whereas respondents in the lower 50% of the rank were labeled as low performers. High performers were then randomly paired with the low performers. This action was based on the finding of Gazula et al. (2017), who discovered that other students prefer to learn from the experts rather than from less experienced peers.

Materials used in the Intervention

Along with implementing the intervention, the researchers used problem drill sheets to facilitate the experiment's conduct. The problem drill sheet came in the form of a whole sheet of paper partitioned into four parts, where each section had a Mathematical problem printed in it. Each Mathematics problem was labeled with "Try 1", "Try 2", "Help," and "Try 4", respectively, starting from the upper left side to the lower right side of the paper. In each pairing, each one had a different set of problems. At the back were the answer keys matching computations to the problem set given to his or her partner. One had no hold of the key to correcting their own problem sets; only their partner could see it.

Detailed Procedure of the Intervention.

The implementation of the intervention was composed of three phases: Pre-teaching, tutorial, and Post-teaching. The steps included in the list are based on the findings of several related studies (e.g., Gazula et al., 2017). The pre-tutorial phase prepared the respondents for the actual tutorial sessions. Teachers had lecture discussions and demonstrations of the concepts or processes they needed to know before the tutorial sessions. Furthermore, in this phase, problem drill sheets were provided to the respondents to become familiar with the solutions to mathematical problems.

In the tutorial phase, the respondents performed the actual tutoring. While the tutorial session was on, the teacher facilitated the activity and monitored the class to identify who among the students needed assistance. They were given 15 minutes to answer the problem drills assigned to them and switched roles as tutors or tutees afterward. While the tutee was answering the problem in a session marked "try 1", the tutor observed his tutee's work while holding up the answer key. If the tutee answered it correctly, they would proceed to the problem in "try 2". Otherwise, the tutor gave some pointers to help the tutee answer the second problem. In case the tutee did not make it yet on the second attempt, they showed and explained to him or her the correct solution by answering the 'help' section of the problem drill sheet. Next, the tutee was asked to answer the mathematical problem in the "try 3" section. The switching of roles for each student was done after the 15-minute time allotment. The first set-up followed after the switching of roles.

Finally, under the post-tutorial phase, the respondents discussed with their partners the essential points or the misconceptions they had observed during the session and clarified them. At their level, the first peer tutor gave their comments and observations from the activity. The peer tutee had the chance to clarify vague concepts he or she had encountered during the tutorial. Then, abstraction was made involving the whole class, which the teacher had facilitated.

Data Analysis

In this study, both descriptive and inferential statistics were utilized. Weighted mean and standard deviation were employed to determine the respondents' MA, SE, and MP levels. However, for problems that required hypothesis testing, inferential statistics were used. Specifically, to test the research hypothesis that "there are significant differences between the mean scores according to group (RPT group and the CTS group)," the independent samples t-test was employed. Moreover, Pearson correlation and Regression Analysis were used to test the hypotheses that "there is a significant relationship between the MA and SE and MP of the respondents" and "MA and SE significantly affect the MP of the respondents," respectively. The prediction equation was obtained from the regression analysis. Statistical Package for Social Sciences (SPSS) version 21.0 facilitated computation.

RESULTS AND DISCUSSION

RPT on Mathematics Anxiety

The following are the results and findings on the MA of the respondents. In the test dimension of MA, indicators relative to anxiety in taking Math tests are included. The results in Pre1 under test dimension reveal that the mean score of the CTS group

(M = 3.98, SD = 0.67) is slightly higher than the mean score of the RPT group (M = 3.85, SD = 0.66) (see Table 1).

Table 1. MA of the respondents concerning test-dimension

Group		Pre1	Pre2	Post
CTS Group	Mean	3.98	3.61	3.56
	SD	0.67	0.72	0.64
RPT Group	Mean	3.85	3.59	3.11
	SD	0.66	0.86	0.69

However, the independent samples t-test analysis indicates that the mean difference between the two groups is insignificant, $t(54) = .712$, p = .479 (see Table 2). It means that their mean scores are comparable. The results in Pre2 show that the mean scores under the test dimension of CTS (M= 3.61, SD = 0.72) and RPT (M = 3.59, SD = 0.86) groups are nearly the same and that no significant difference is noted, $t(54)= .066$, p = .948. Similarly, Pre1 shows that their level of test anxiety is regarded as "high," indicating that no significant changes occurred in terms of their test anxiety when exposed to no treatment.

Table 2. t-test analysis on test dimension for respondents' MA

Pair	Group	Mean	Diff.	t value	df	p-value
Pair 1	CTS_Pre1	3.98	.13	.712	54	.479
	RPT_Pre1	3.85				
Pair 2	CTS_Pre2	3.61	.02	.066	54	.948
	RPT_Pre2	3.59				
Pair 3	CTS_Post	3.56	.45*	2.491	54	.016
	RPT_Post	3.11				

* $p < 0.05$

On the other hand, after the RPT group was exposed to the treatment condition, the post-test results revealed a remarkable difference in the mean scores between the two groups. The RPT group (M = 3.11, SD = 0.69) is 0.45 lower than the CTS group (M = 3.56, SD = 0.64). While the latter remains at the "high" level, the former group stepped down to the "moderate" level. The t-test result validates the claim that there is a significant difference in their mean scores, $t(54) = 2.491$, p = .016, with a medium effect size (r = 0.37). This means that the strategy used in the experiment accounted for 14% of the variance in the students' test anxiety scores.

The self-dimension of MA refers to anything that causes anxiety to the respondent, particularly relating to oneself. It includes their perceptions of how they see themselves performing in Mathematics as a whole. Table 3 indicates that the CTS group (M = 3.51, SD = 0.86) has a higher mean score than the RPT group (M = 3.34, SD = 0.73), which were regarded as "high" and "moderate" levels, respectively.

Table 3. MA on the self-dimension of the respondents

Group		Pre1	Pre2	Post
CTS Group	Mean	3.51	3.28	3.38
	SD	0.86	0.77	0.68
RPT Group	Mean	3.34	3.43	2.96
	SD	0.73	0.87	0.76

Table 4. t-test analysis on self-dimension for respondents' MA

Pair	Group	Mean	Diff.	t value	df	p-value
Pair 1	CTS_Pre1	3.51	.17	.789	54	.434
	RPT_Pre1	3.34				
Pair 2	CTS_Pre2	3.28	.15	.672	54	.505
	RPT_Pre2	3.43				
Pair 3	CTS_Post	3.38	.42*	2.142	54	.037
	RPT_Post	2.96				

* $p < 0.05$

However, the difference in their mean score is insignificant, $t(54) = .789$, p = .434 (see Table 4). It indicates that the test anxiety of the students from both groups is likely equal. Further, changes are noted in Pre2 as the mean score of the RPT group (M = 3.43, SD = 0.87) becomes slightly higher than the CTS group (M = 3.28, SD = 0.77). Hence, while the former's SE is "high," the latter is "moderate ."Nevertheless, like Pre1, the mean difference is insignificant, $t(54) = .672$, p = .505. Finally, in the post-test, the RPT group (M = 2.96, SD = 0.76) exhibits a sudden decrease in mean compared to that of the CTS group (M = 3.38, SD = 0.68). The former is .42 lower than the latter group. The t-test results reveal that the difference is significant, $t(54) = 2.142$, p = .037, with a small effect size (r = 0.28). It indicates that exposure to different strategies accounted for approximately 8% of the variance in the MA scores under self-dimension. This implies that the CTS group is more anxious than the RPT group.

The teacher dimension refers to the factors concerning teachers' attributes and teaching practices that might contribute to the respondent's anxiety. Table 5 presents the respondents' level of MA concerning teacher dimension. Based on the result in Pre1, respondents in both groups generally have a "low" level of anxiety. The mean scores of the CTS group (M = 2.21, SD = 0.52) are nearly equal to the mean score of the RPT group (M = 2.24, SD = 0.63), and that no significant difference is recorded, $t(54) = .136$, p = .892 (see Table 6).

Table 5. MA on teacher dimension of the respondents

Group		Pre1	Pre2	Post
CTS Group	Mean	2.21	2.16	2.07
	SD	0.52	0.61	0.48
RPT Group	Mean	2.24	2.33	1.76
	SD	0.63	0.72	0.65

Table 6. t-test analysis for the respondents' MA concerning teacher dimension

	Group	Mean	Diff.	t value	df	p-value
Pair 1	CTS_Pre1	2.21	.03	.136	54	.892
	RPT_Pre1	2.24				
Pair 2	CTS_Pre2	2.16	.17	.944	54	.349
	RPT_Pre2	2.33				
Pair 3	CTS_Post	2.07	.31*	2.016	54	.049
	RPT_Post	1.76				

* $p < 0.05$

In Pre2, however, the same results are found with Pre1, where the CTS group (M = 2.16, SD = 0.61) and RPT group (M = 2.33, SD = 0.72) are both regarded as "low." The t-test result indicates no significant difference between their mean scores, $t(54)$ = .944, p=.349 (see Table 6). Meanwhile, in the posttest, though both groups showed a decrease in mean, the RPT group (M = 1.76, SD = 0.65) was 0.31 lower than the CTS group (M = 2.07, SD = 0.48). The former group's anxiety level even drops down to a "very low" while the latter group remains at "low." The t-test result shows that the difference in their mean scores is significant, $t(54)$ = 2.016, p= .049, with a small effect size (r = 0.26). The finding means that the strategy used accounts for approximately only 7% of the variance in the students' anxiety scores under the teacher dimension. It indicates a steady finding that the intervention has significantly lowered the RPT group's anxiety level in the subject compared to their counterparts in the CTS group.

Notably, the respondents are highly anxious when taking a Mathematics test. This finding confirms the result of the study of García-Santillán et al. (2017), who claim that MA is associated with the test. Also, Driscoll (2004, cited in Ahmed et al., 2017) purports that, based on the American Test Anxieties Association, 20% of learners are bothered with severe test anxiety. Furthermore, the results suggest that only when the intervention has been implemented in the RPT group is a significant difference in their mean scores noted. The RPT intervention is effective because it substantially changed the RPT group's MA level.

The reason for the latter finding might be that the CTS group was not given much time to discuss the lesson with a partner, unlike the respondents from the RPT group, who were given ample time to clarify matters with their partners. It is evident in the statement of Student 10, "*I feel excited and more dedicated because most of the previous lessons lack interaction and discussion if the student is not active, especially in recitation*."

Seemingly, the concept's retention does not last for long, making students forget easily and might not fully understand the topic. Thus, during exams, students become fearful of not doing well on the test and doubt their capacity to perform well in the subject. This fear leads to stress that hinders them from performing well during exams. Regarding this finding, Ashcraft and Moore (2009) hypothesized that students' anxiety is conceivably aroused when asked to answer a problem and during a test. Thus, test results as a measure of students' Mathematics proficiency do not accurately describe their actual performance (Ashcraft & Moore, 2009).

However, the possibility that a student in a traditional classroom can adapt to his or her test anxiety is not disregarded. The result shows that the Pre2 result of the CTS group is lower than their Pre1 result, and the difference is significant. It implies that other factors, besides the strategy used, might have reduced the participants' test anxiety, which is not accounted for in this study. The probable reason for this is the differences in the test-taking strategies and the coping mechanisms each of them has. Students in the CTS group may have developed their mechanisms to manage their test anxiety. Aside from this, familiarity with the type or kind of test their teacher gives could have helped them adjust quickly to the setting.

Further, results indicate that the respondents' MA under self-dimension ranges from moderate to high and that anxiety relative to one's perception of his or her performance is prevalent among the respondents. This finding adheres to the claim of Justicia-Galiano et al. (2017), who stated that anxiety towards the subject stems from their negative beliefs about their capacity to solve Mathematical problems. The finding in this study implies that predisposition towards one's ability and learning significantly influences anxiety build-up.

These findings suggest that the RPT group respondents were less worried about themselves learning the subject, perhaps because they saw themselves learning the lessons quickly while working with others. As a result, the respondents developed self-assurance towards their capacity to perform in the subject, causing a change in their level of MA. It is evident in Student 15's statement when she said, "*I had realized that when I worked with others, I became more active and paid attention to the topic. Because of working with others or with my partner, I had to learn about myself. I become more responsible*".

Hence, this implies that having various mechanisms to address the students' anxiety is important, especially since the learner's tolerance and coping ability vary from student to student. The diversity in students' anxiety tolerance levels and coping ability is a major challenge to every teacher in managing this psychological problem that they are experiencing.

Regarding the respondents' MA for teacher dimension, results show that the respondents in both groups demonstrate a relatively low level of MA in almost all the different survey periods. It means that how mathematics teachers handle classes, even when using conventional teaching strategy conditions, is relatively beneficial to the students. Another reason might be due to familiarity with their teacher. However, some students still prefer the RPT, for they can freely express their ideas, inquiries, and opinions with their peers. It is apparent in Student 13's statement, "*If I am working with peers, I am not shy when asking questions if I do not get it right, unlike with a professor or a teacher.*" The results show that the RPT effectively reduces MA relative to the teacher dimension.

The result affirms Vakili and Pourrazavy's (2017) work, claiming that the teacher is one of the contributory factors to a high level of MA among the students. It is probably because, in some cases, teachers are the primary cause of the learners' negative experiences in the subject. The anxiety build-up, however, depends on how teachers' qualities and learners' expectations go along. Hence, students vary in terms of experiences in mathematics classes from school to school. The finding implies that teachers' attributes play an essential role in reducing the MA of the students. Hence, teachers should be more kind, accommodating, and approachable to minimize student anxieties.

Though the two groups have the same MA level, the RPT group shows a considerable decrease compared to the CTS group's mean scores. It means that RPT has contributed to reducing MA among the respondents in the RPT group. This finding supports Guita and Tan's (2018) work, saying that students exposed to a reciprocal learning environment significantly decrease MA after the intervention. The environment created by the strategy caters to individual differences, which is necessary so every student can help each other learn (Mkpanang, 2016). Additionally, the collaborative nature of RPT offers a fun and exciting environment, which, according to Gazula et al. (2017), is an avenue to an anxiety-free classroom environment for the students.

The finding infers that the teaching strategies affect the students' MA level. Some researchers even claim that MA is shaped inside the classroom (Harari et al., 2013). Thus, teachers need to re-examine the teaching strategies they employ in the classroom. Meera and Jumana (2016) posited that strategies requiring students' interaction and involvement promote an enjoyable and engaging environment to develop positive attitudes toward the subject (Mutodi & Ngirande, 2014)

This phenomenon is strengthened by Albert Bandura's Social Cognitive Theory, which claims that learning is the product of observation from the model's behavior and competence exhibited by, for example, a teacher or classmate (Zhou & Brown, 2015). In this study, by seeing how their partner behaved before and during the test to cope with their anxiety, the beliefs in their capacity to learn might have influenced them to do the same. Hence, peer collaboration reduces MA.

RPT on Self-efficacy (SE)

Table 7 shows the weighted means and standard deviations of the respondents' responses to the MSEAQ survey for information on their SE level across the three survey periods. The mean of the CTS group (M = 2.83, SD = 0.54) is 0.05, greater than the mean of the RPT group (M = 2.78, SD = 0.74), and the former is more homogenous regarding SE scores than the latter group. Nevertheless, their mean difference is not significant when the two groups are compared using the independent samples t-test, $t(54) = .298$, $p = .767$ (see Table 8). It indicates that the respondents' SE is relatively equivalent.

Consequently, in Pre2, the data show that the CTS group (M = 2.88, SD = 0.60) exhibits a little higher compared to the mean of the RPT group (M = 2.61, SD = 0.80). Their level of SE remained at "average." However, the mean scores' difference is again not significant, $t(54) = 1.412$, $p = .164$.

Table 7. Level of respondents' SE

Group		Pre1	Pre2	Post
CTS Group	Mean	2.83	2.88	2.82
	SD	0.54	0.60	0.68
RPT Group	Mean	2.78	2.61	2.88
	SD	0.74	0.80	0.73

Table 8. t-test analysis for the respondents' SE

Pairs	Group	Mean	Mean Diff.	t value	p-value
Pair 1	CTS_Pre1	2.830	.053	.298	.767
	RPT_Pre1	2.777			
Pair 2	CTS_Pre2	2.879	.266	1.412	.164
	RPT_Pre2	2.613			
Pair 3	CTS_Post	2.816	-.069	-.363	.718
	RPT_Post	2.885			

* $p < 0.05$

Finally, a little difference of about 0.06 is noted in the post-test between the CTS group (M = 2.82, SD = 0.68) and the RPT group (M = 2.88, SD = 0.73). But then, as with the findings in Pre1 and Pre2, the difference in their mean scores is not significant, $t(54) = -.363$, $p = .718$. The study results suggest that the respondents' self-concept of their ability to perform well in Mathematics is average throughout the experiment. Furthermore, it can be noticed that although the mean score of the RPT group is slightly higher than the CTS group in the post-test, no significant difference has been noted. Hence, the finding suggests that regardless of whether one is exposed to conventional teaching strategies or the RPT strategy, his or her SE is not largely affected.

The study's results suggest that the respondents' self-concept of their ability to perform well in Mathematics is average throughout the experiment. Furthermore, although the mean score of the RPT group is slightly higher than the CTS group in the post-test, no significant difference has been noted. Hence, the finding suggests that regardless of whether one is exposed to conventional teaching strategies or the RPT strategy, his or her SE is minimally affected.

This happened may be because some tutees feel intimidated for lack of mathematical skills and when paired with those who are mathematically endowed. For instance, Student 24 said, "*I learn more from other students' explanations on lessons, but it can be very intimidating, especially when the tutor is excellent in the subject*." Similarly, Student 13 said, "*I dislike the pressure when I don't get or understand the lesson well while others easily understand it.*"

According to the statement of Student 3, "*If you are paired with someone you don't like, that will make it uncomfortable*." This reflects that MA and SE can happen if there is an interaction between learners. This finding also indicates a constraint in the methodological choices regarding ability pairing such that there is only one type of pairing (i.e., low performer and high performer). The variations in pairings of low, average, and high groups of learners may result in optimum effect.

Negative experiences with their peers might have caused a decrease in their self-perception. Student 5 shared that his tutors sometimes shout at him when asking questions: "*My tutor shouted at me when I asked some questions, but at the same time, I learned some techniques in solving with the help of my tutor*." According to Bandura (1994), as cited in Zimmerman (2000), SE may be attributed to "vicarious experiences" provided by social models. This vicarious experience occurs when one feels the same feeling as what he or she observed from the model. When one observes that other people behave differently towards him or her, it might induce an idea that they deserve the treatment. And he or she would think lowly of one's ability. Hence, this affects the level of SE of the respondents.

Likewise, the above reasons might be the same as why the CTS group believes they can learn more in Mathematics than the RPT groups. These findings, therefore, imply that the careful pairing of learners needs to be considered because rapport between students is a critical factor in the successful implementation of any form of intervention.

RPT on Mathematics Performance (MP)

MP in this study refers to the students' academic performance revealed by their scores in a standardized General Mathematics Achievement Test. Relative to this, Table 9 presents the means and standard deviations of scores regarding the respondents' MP level across the different test administration periods.

Table 9. Level of MP of the respondents

Period		CTS Group		RPT Group	
		Mean	SD	Mean	SD
First Half	Pre1	13.75	2.52	15.21	4.43
	Post1	28.57	4.38	27.86	4.99
Second Half	Pre2	15.50	3.62	16.54	4.88
	Post2	26.82	5.86	31.89	4.38

Table 9 shows the descriptive statistical analysis of the respondents in terms of their MP both in the first half (Pre1, Post1) and the second half (Pre2, Post2) of the experimental period. The table shows that in Pre1, the RPT group (M=15.21, SD =4.43) performed better than the CTS group (M=13.75, SD=2.52). To determine if the claim is true, the independent sample t-test was performed. As a result, it was found that there is no statistically significant difference in their mean scores, $t(42.781) = 1.52$, p=.134 (see Table 10). It means that the MP of the two groups is comparable; thus, they are the ideal groups to become respondents to the study.

In the Post1, however, the CTS group (M=28.57, SD=4.38) outperformed the RPT group (M=27.86, SD=4.99). The standard deviations indicate that the CTS group is more homogeneous in scores both at Pre1 and Post1, which is a good indication that the mean obtained is a true description of their performance. Results revealed no statistically significant difference between the two groups' mean scores, $t(54) = .570$, p = .571. It only shows that respondents' performance in both groups is the same when taught using a conventional teaching strategy.

Furthermore, in the second half of the experimental period, it was noted that the MP of the respondents from the RPT group (M=16.54, SD=4.88) and the CTS group (M=15.50, SD=3.62) was consistently poor. The standard deviations show that the scores of the CTS group are more homogenous than the RPT group. But then, the t-test result reveals that no significant difference is noted between their mean scores, $t(54) = .902$, p= .371.

In Post2, the mean score of the RPT group (M=31.89, SD=4.38) becomes considerably higher than that of the CTS group (M=26.82, SD=5.86). The t-test result shows that the mean difference of 5.07 between the two groups is statistically significant, $t(54)=3.536$, p=.001, showing a medium effect size on their mean difference (r=.43). It means that the difference in the strategy used in teaching the subject accounts for approximately 18% of the variance in the students' MP scores in the post-test.

Table 10. t-test analysis for respondents' MP

Period	Group	Mean	Mean Diff.	t value	df	p-value
First-half	CTS_Pre1	13.75	1.46	1.52	42.781	.134
	RPT_Pre1	15.21				
	CTS_Post1	28.57	.71	.570	54	.571
	RPT_Post1	27.86				
Second-half	CTS_Pre2	15.50	1.04	.902	54	.371
	RPT_Pre2	16.54				
	CTS_Post2	26.82	5.07*	3.536	54	.001
	RPT_Post2	31.89				

* $p < 0.05$

It can be concluded that the assumption regarding the respondents' low MP at the experiment's beginning is reasonably valid. The respondents' poor performance in the pretests is consistent with Launio's (2015) work. The result found that the students from one of the public high schools in Capiz, Philippines, performed poorly in Mathematics at the beginning of the experiment.

Moreover, the t-test analysis on the Post2 results suggests that the significant reduction in MA, through the RPT intervention, effectively improves the students' MP. This finding supports the work of Moliner and Alegre (2022), who found out that middle school students exposed to RPT garnered a considerable increase in their mathematics achievement. Other findings further suggest that the performances of the respondents depend on the strategies employed in the study and that MP can be improved by using creative and innovative teaching strategies responsive to varied learners' needs.

This means that RPT effectively increases the students' MP in General Mathematics class with a satisfactory performance in the GMAT test compared to the CTS group. However, as hypothesized, RPT is more effective in improving MP because of its attributes that help reduce the MA experienced by the respondents in the RPT group.

Effect of MA and SE on MP of the Respondents

This study theorized that either the reduction of MA or an increase in SE could significantly improve the MP of the learners in an RPT setting. MA and SE's effect on the respondents' MP was investigated to ascertain this claim. Thus, this section presents the correlation and regression analysis between MA, SE, and MP. The result reveals a significant moderate negative relationship between MA and MP, $r = -.432$, $p = .022$, $N = 54$, with 19% of the variance explained by the variables' linear relationship. A correlation test between SE and MP recorded a moderate positive relationship between the two constructs, which are insignificant, $r = .243$, $p = 0.212$. Furthermore, a regression analysis was performed to test whether MA is a significant predictor of MP. The F-test analysis found that MA explains a considerable proportion of MP of the respondents, $R^2 = 18.7$, $F (1,27) = 5.972$, $p < 0.05$. It means that the former is a significant predictor of the latter. This finding supports the work of Núñez-Peña et al. (2013), who claim that MA significantly predicts the MP.

Table 11. Model summary of MP predictor

	Mathematics Performance		
	B	p-value	95% confidence interval
Constant	41.494*	.000	[33.236, 49.753]
MA	-3.672	.022	[-6.761,-.583]
R^2	.187*		
R	.432		
ΔR^2	.156		
ΔF	5.972		

Note: N = 28, * significant at 0.05 level of significance

Table 11 shows the model summary of the MP, indicating that MP can be predicted using the model $Y' = -3.672 (MA) + 41.494$. This model would predict the MP of the students by plugging in their mean scores for MA. From the formula, the predictor variable MA's negative coefficient suggests an inverse relationship between

MA and MP. The findings of this study revealed that an increase in MA would mean a considerable decrease in one's MP. Additionally, the effect size indicates that 19% of the student's scores for MP can be accounted for in their MA. The probable reason for this is that Mathematics-anxious individuals cannot think soundly because of the disturbing feeling of tension and pressure while performing the task. The finding is consistent with the works of Hiller et al. (2021), Omar et al. (2022), Launio (2015) and Mutodi and Ngirande (2014), who claim that anxiety negatively affects students' performance in Mathematics.

In addition, since SE is not associated with the respondents' MP. This result contradicts the findings of Taylor (2014) and Meera and Jumana (2016), who reported that SE has a significant relationship with one's academic achievement. The only plausible reason for the contradiction is the limited number of study samples. However, While the small number of samples constrains the validity of the result, it nonetheless provides reasonable evidence that the RPT strategy effectively reduces the MA of the students, as supplemented by the narratives given by the respondents about the implementation of the intervention. Moreover, though the same factor constrains the finding's generalizability, it is still significant, especially to the respondents or their equivalent groups. However, to verify the study's findings, it is suggested that more extensive research be done with a more significant number of samples to draw more conclusive results.

Furthermore, the result also suggests that MA has a negative effect on students' MP. This study confirms the previous study, which found a negative association between the two constructs (Das et al., 2014). One reason is that a high-level MA hinders students from thinking soundly due to their negative emotions, such as fear, tension, worry, and the like. Hence, they cause frustrations while learning. Additionally, because of MA, they tend to under-perform they see a given circumstance as a threat (Beilock & Maloney, 2015). It could be that they fear getting unsatisfactory grades in the subject that students are most anxious about.

Furthermore, MA hinders their working memory (Perina, 2002, as cited in Motudi & Ngirande, 2014). It is one of the many reasons why most students perform below or on the basic level of Mathematics competencies. Therefore, teachers should take the matter seriously since it adversely affects students' MP.

CONCLUSION

Recent studies show that students’ MP is generally poor. With this steadily recurring problem, the search for possible reforms has become a growing interest among researchers in Mathematics education. This study focuses on investigating RPT’s effectiveness in reducing MA and increasing the students’ SE to improve their MP. While the claim about poor MP was apparent in the pretests, the post-test results showed a significant increase in mean scores in both groups. However, the RPT group exhibited a higher mean score than the CTS group. Given the significant decrease in the MA level among the respondents in the RPT group, it is concluded that the strategy is effective. Additionally, the result showed that MA is a significant predictor of MP and that MA negatively predicts MP. It means that when MA increases, MP decreases. RPT, however, did not significantly increase the students’ SE. Future studies may emphasize pairing students if using RPT to obtain a positive effect on self-efficacy.

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