

THE EFFECTIVENESS OF RECIPROCAL PEER TUTORING (RPT) ON THE ACADEMIC PERFORMANCE OF STUDENTS IN MATHEMATICS

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ABSTRACT

The importance of facilitating study and practice materials that are consistent with graded assessments and instructional objectives is well known, if not commonly used, in educational practice. This study focused on the effectiveness of Reciprocal Peer Tutoring (RPT) against the traditional approach in learning. A well-established procedure of RPT was developed for an effective peer tutoring process that can be implemented with a minimum of teacher participation was used in this study. Students engaging in RPT are paired at random and given instruction on how to prepare practice exercises and or multiple choice format tests within the scope of the topic as indicated in study guides provided to them. During an RPT activity, each student of a dyad is independently responsible for synthesizing course content, preparing math exercises and constructing multiple-choice format test questions, complete with answers and explanation. Each dyad then administers practice test to each other every RPT session and prior to formal class examinations. Group monitors are also appointed to give feedback on RPT activities and also served as on-line peer tutor via e-mail. This one-on-one email-based mentoring will enable students under RPT group and the researcher to thrive in the online learning environment. Access to lesson outlines and sample problems through @yahoogroups.com was established. Likewise, posting of assignments aligned to e-tutor lesson modules can be accessed through the same e-tutor bulletin board. This study aimed to determine the effectiveness of RPT on the academic performance of engineering students in College Algebra was conducted at New Era University, College of Engineering and Technology during the second semester of Academic Year 2008-2009 with a sample size of 35 first year engineering students for each sample group using cluster sampling method. It was found that RPT intervention was more effective in causing significant increase in student's performance and RPT was a more effective strategy than that of the traditional chalk and board to improve student's performance in College Algebra. Based on the findings and conclusions, the researcher recommended considering the use of RPT as an alternative instructional intervention to improve student's performance in College Algebra and in other courses. Furthermore, it was recommended to modify/strengthen the research to determine whether RPT procedures can be redesigned to make them more meaningful for the learning needs of college students.

INTRODUCTION

The article written by Thomas R. Guskey entitled "The Rest of the Story" from a journal "Educational Leadership", issue of January, 2008 inspired the researcher to focus her study on peer-mediated intervention. According to Guskey, "A well-designed formative assessment should provide students with essential feedback and inform teachers about the quality of their teaching by identifying concepts that students have and haven't mastered."

As the name implies, formative assessments are just there to inform. They pinpoint to both teachers and students what concepts and skills have been learned well and what learning problems still exist. It is evident then that formative assessments alone do little to improve student learning or teaching quality. What matters most is how students and teachers use the results.

In other words, what really counts is what happens after the assessments. Just as regular checking of your blood pressure or blood sugar or body weight does little to improve your health if you do nothing with the information gained.

In this regard, educators today should consider regular checks on learning progress to be an integral part of the instructional process.

Hence, the following academic issues that need to be addressed are:

1. Many educators today overlooked the vital aspect of formative assessment (Guskey, 2008).
2. Teachers often do not implement prescribed intervention with accuracy and integrity (Esteve, 2005).
3. Poor performance of students in college algebra suggests inadequacy of their conceptual understanding (Ancheta, 2008).

To address these issues, one possible solution is the use of peer-mediated interventions. Peer-mediated interventions enable a student to conduct the intervention, leaving the teacher to supervise rather than participate in the intervention. Peer tutoring, in its various forms, has been well documented as an effective and inexpensive intervention for all academic areas.

In peer tutoring, when a student being tutored makes a mistake, the tutor points out the error and immediately provides further explanation and clarification. Academically successful students typically initiate their own feedback and correctives. They follow up on the mistakes they make on quizzes and tests so that they do not repeat their learning errors. Most students, however, need a more structured classroom corrective process. In this regard, the purpose of this study is;

1. To incorporate a well-structured procedure of RPT to develop an effective peer tutoring process that can be implemented with a minimum of teacher involvement.
2. To determine the effectiveness of RPT as an academic intervention in enhancing performance and in retaining learned concepts in College Algebra.

What is RPT?

RPT is a collaborative approach in learning. Reciprocal Peer Tutoring (RPT) was developed by John Fantuzzo in 1984. In this procedure, students are assembled in groups of two or more and are trained to work together on a specific academic task. The students work together to prompt, monitor, and evaluate each other, while working toward group goals.

The typical procedure was to pair students throughout the semester. Students in each dyad were responsible for preparing and constructing multiple-choice format test, administering these tests to each other, and providing explanations for incorrect responses to their partners.

Thus, the procedure enabled students to provide facilitating processes for each other: instruction, evaluation, feedback and social support.

The researcher has been regularly using RPT in her classes since she started this study last year. It is an amazingly simple and effective teaching tool that requires little effort on the instructor's part. It is also cost effective. In addition, if presented correctly, students usually report positive learning experiences with RPT.

This study hopes to benefit all concerned.

- Students in need of remedial instruction can accurately and effectively tutor one another.
- Students with average and below average IQ alike may develop their self confidence as they are trained to support one another by acting as tutor and tutee.
- College Teachers may use this peer-mediated approach to train students' social skills, enhance their self-efficacy, and remedy skill deficiencies.
- School Administrators may gain deeper insights into their role as instructional leaders and supervisors of the teaching learning process by recommending the use of this strategy in other subjects.
- Curriculum planners may be guided in writing relevant modules in their respective subjects using this peer-mediated approach.
- Future Researchers may benefit from this endeavor in such a way that the result may be used as a guide in conducting similar study and develop methods to increase the use of RPT and other peer-mediated interventions within school settings

This study aimed to determine the effectiveness of Reciprocal Peer Tutoring (RPT) on the academic performance of engineering students in College Algebra during the Academic Year 2008-2009 aimed to answer the following:

1. How do the respondents assess the RPT in terms of:
 - 1.1 objectives,
 - 1.2 design,
 - 1.3 instructional materials, and
 - 1.4 techniques?
2. What is the performance of the respondents in College Algebra before and after the introduction of RPT?
3. Is there a significant difference in the performance of the students who attended the RPT program and those who did not?
4. What problems were encountered by the respondents in the use of RPT with regard to:
 - 4.1 objectives,
 - 4.2 design,
 - 4.3 techniques, and
 - 4.4 instructional materials?
5. How may the findings be utilized in preparing a guide on the use of RPT to improve student academic performance in College Algebra?

CONCEPTUAL FRAMEWORK

The studies conducted by Greenwood (1983), Fantuzzo (1986), and Mickelson (2003) provided a graduated and conceptually supported framework for the researcher to implement the RPT intervention. In 1983, Charles Greenwood developed Classwide Peer Tutoring (CWPT). In cooperative teams, three to five students get together to discuss their learning gaps and to help one another. The role of a group monitor is needed to the procedure. In cooperative teams, students get together to discuss their learning gaps and to help one another. The teams are heterogeneous, assigned by the teacher and usually stay intact for several learning units. Students work

together in their groups to achieve established goals or rewards that are contingent upon group performance.

During each session, students review the assessment on a per item basis. Any question or crucial element that one or more students have missed is explained by another team member who understands it. If all the members of the team are having difficulty, they can work collaboratively to find a solution or call on the teacher for assistance.

John Fantuzzo and his colleagues conducted successive studies on RPT and developed an intervention that combines the benefits of peer tutoring, interdependent group reward contingencies, and individual accountability procedures. Both members of a peer tutoring pair participate in the tutor role.

In this technique, students function reciprocally as both tutor and tutee. This dual role is beneficial because it enables students to gain from both the preparation and instruction in which tutors engage, and from the instruction that tutees receive.

Three basic principles underlying RPT and CWPT interventions are:

- (a) increasing academic engagement,
- (b) increasing the opportunity to respond, and
- (c) increasing timely feedback regarding students' responses.

According to the study conducted by Mickelson et al., "For RPT to be more effective, RPT intervention needs to be modified from the form originally proposed by Fantuzzo et al. (1989)". Hence, it is suggested that one modified RPT approach is making the item writing a weekly or day to day activities for very short period of time to give students additional experience in writing items. This will allow students to see the process of item-writing and peer collaboration as an ongoing and important aspect of their learning.

The study population consists of engineering students enrolled in College Algebra. One section (35 students) with RPT treatment and one section (36 students) without the RPT treatment were carried out during the second semester SY 2008-2009. Total sample size was 71.

INSTRUMENT/TECHNIQUE

Teacher-Constructed Test

The primary dependent variable for this study was teacher-constructed test. Each examination (pre and posttest) consisted of 50 multiple-choice questions with specific test items prepared by the instructor. The items comprising each examination were selected and were prepared ensuring content validity of the examinations relative to course objectives and content. Students for both RPT and non-RPT classes were taught the course using the same syllabus. The tests were secured and the same exam questions were provided to both the experimental and control group. The researcher of the study being also the instructor and class evaluator gives rise to the problem of research bias, however, this problem was minimized since multiple-choice questions of similar nature were used for the tests for both groups and the results of the tests were validated using optical scanners for grading electronically. Similarly, item analyses for both exams were obtained using the same instrument.

Construction and Validation

The pre-test (midterm exam) and the post-test (final term exam) were prepared following the criteria for its construction based on the books, references, and on the syllabus. Its development started with the preparation of a table of specifications. Using the table of specifications as a guide, a 50-item test (pre- and post-test) was developed and presented to fellow instructors for content validation.

Administration and Retrieval

A letter requesting permission for the researcher to conduct the study was given to the Dean of College of Engineering and Technology. After the permission was granted, diagnostic exam was conducted on the experimental group and controlled group as well. Retrieval for the said examination results was done by the researcher.

Student-Constructed Test

Additional data consists of the multiple-choice items constructed by each student as part of the RPT treatment intervention. The student-developed items were collected at the end of each review sessions and became the primary data for the content analysis on student involvement with the course content through item writing.

STATISTICAL TREATMENT

The researcher used experimental method; specifically the Non equivalent Control Group Design (NCGD). Other statistical treatments are the following:

1. Weighted mean was used to determine the assessment of the respondents on the effectiveness of RPT with regard to objectives, design, instructional materials, and technique.
2. Ranking was used to determine the most predominant practice.
3. Percentage was used to determine the problems that the respondents have encountered with the use of RPT with regard to objectives, design, instructional materials, and technique.
4. Correlated t-test was used to determine the significant difference in the assessment of the two groups of respondents- those who used RPT and those who did not use RPT.

METHODOLOGY

Two term examinations (midterm & final term) for the duration of the semester class were given. At the start of the experiment period, the same test (the midterm exam) was given to both groups. Here, the midterm exam score acted as a pre-test base line score for both experimental and control group. RPT intervention activities were not initiated prior to the midterm examination. The experimental RPT intervention occurred (for the experimental group) when class resumed after the midterm exam so that effect of RPT intervention was measured in the final term exam and the score from this examination was the post treatment observation. The results of the term exams and the respondents' assessment of the study were the dependent variables obtained during the pretest and posttest separately in terms of mean scores.

A brief lecture on peer tutoring was conducted to impress upon the minds of the students the relevance of cooperative learning. The class was also given handouts to guide them on how to construct multiple-choice items. Initially, the class was

grouped in four and a group mentor (who will also be the online peer tutor of the group) was appointed to give feedback on RPT activities. On-line peer tutoring was conducted by peer mentors one to two hours each week via e-mail. This one-on-one email-based mentoring will enable students under RPT group and the researcher to thrive in the online learning environment. Access to lesson outlines and sample problems through @yahoogroups.com was established. Likewise, posting of assignments aligned to e-tutor lesson modules can be accessed through the same e-tutor bulletin board.

During class time students were randomly paired and were given time to complete the RPT activity. The tutorial session took place after the concept has been discussed by the instructor and few examples and application of the principles were presented. The class met twice a week and one and a half-hour every meeting, hence, the researcher decided to allot 30 minutes as the length of time for each pair to interact and administer the pre-constructed multiple-choice items to each other alternately acting as tutor and tutee. During this activity, the prepared practice test, each item written in a 3 x 5 inches index card, covering the unit material was administered to his or her partner. The index card served as a flash card. The researcher gave students specific instructions about the format of the practice tests (a mix of problem solving and multiple-choice format test), the answers or solution for each item was written at the back of the index card. If the tutee arrived at the correct answer, then the next item was shown, however, if the tutee did not arrive at the correct answer, the tutor would explain the correct answer by showing the step by step solution at the back of the card. Then the next item would be shown following the same procedure. When the last item was shown and answered, the tutor would score his partner. This would be the opportunity to discuss questions that were answered incorrectly or that were questionably written. Then the pair would exchange role, the tutee would be the tutor and the tutor would be the tutee. After the session, students were allowed to ask questions to the instructor. A tutee who obtained a perfect score would select from the 'goodie box' an item as a reward.

During the initial RPT session, it was learned that justifications should be provided as to why this technique is being used, because students often initially think it is just "busy work." It was explained to the students that an ongoing research is being conducted on the effectiveness of RPT. Moreover, the students were told that it can be an "early warning system," letting them know if they don't understand certain material and, consequently, need to do more studying. It also served as an opportunity to teach the students about the properties of good tests. As they become better test-makers, they are less likely to label the examination as "unfair" or "arbitrary."

Finally, the students' RPT materials were collected and graded as completed or not completed, and treated like any other class assignment. As such, failure to complete any of the RPT assignments did have a negative consequence on students' grades. The RPT materials count 20 percent of their total grade. Comments were also written on their materials and some suggestions for improving the quality of the tests.

Before the end of every session, students were instructed (as reading assignment) to formulate a new set of 5-item multiple-choice test format and bring these questions, with answers and explanation, to class, to be used for the next tutorial session. In this approach, each student is compelled to read the next topic as provided in the study guide. Finally, prior to the final examination, two independent sets of pre-selected 30-item test from the items developed by the class were distributed to each student. These served as the review material in preparation for the exam and the material in the final RPT session.

The control group did not receive the RPT item writing assignment but had a typical comprehensive review session prior to the final examination. The review summarized the material recently covered and the instructor entertained students' questions. Homework assignments were augmented with additional problems so that the expected amount of time that students worked outside of class is equivalent.

RESULTS

The overall assessment of the respondents to RPT as to Objectives, design, instructional mat and techniques are very satisfactory. The controlled group got a pretest mean score of 63.92 and posttest mean score of 64.36 whereas the experimental group got a pretest mean score of 64.79 and posttest mean score of 71.03.

Using t-test, to determine if there is significant difference in the performance of the students who attended the RPT program and those who did not, the computed value of t was 53.76 while the tabular value of t was 1.896. The computed value of t was tested at $\alpha = 0.05$ level of significance.

The result of the survey indicated no prevalent problem with regard to RPT objectives. Nearly 92 percent perceived that RPT had positive effect on their academic performance in College Algebra. As to design, almost 70 percent of the respondents thought the 30 minute allotted time for the peer tutoring session was too short and that peer-to-mentor relationship need to be enhanced. As to instructional materials, about 90 percent judged that the topic outline covering the lecture made them better prepared and assisted them in developing the questions. However, despite the provision of the topic outline to be distributed by the group mentors, about 30 percent failed to secure a copy of the study guide. As to technique, approximately two-thirds of the respondents preferred taking their partner's test than tutoring him/her in RPT session. Nevertheless, about 80 percent perceived RPT technique as a good study technique.

Based on the findings, RPT as an academic intervention was able to generate ideas, foster interdependence and communication among students since the activity encouraged students to read in advance and be better prepared for classroom discussion, provided an effective way for the students to work collaboratively through continuous students' interaction in small groups and provided a technique that induced reinforcement and motivation to increase the interest of the students. The academic performance of College Algebra student before and after the introduction of RPT showed improvement of the students' performance but the experimental group in which RPT treatment was applied obtained a greater improvement against the controlled group where there was no intervention. Also, based on the findings, the following problems were encountered: First, the students found the 30-minute RPT session too short for them to interact with each other. Second, there is a need to enhance peer-to-mentor and peer-to-peer relationship. Third, a number of students lack the ability to express oneself in the language of the tutee. Fourth, despite the provision of topic outline to the group monitors, some members of the group failed to secure a copy of the guide. And finally, many of the respondents preferred taking their partner's test than tutoring him/her in RPT session.

Based on the findings the following recommendations are hereby listed: First, consider the use of RPT as an alternative instructional intervention to improve students' performance in College Algebra and in other courses. Second, make adjustments on the allotted time for each session, or on the number of items to be answered, depending on the difficulty of the topic. Third, organize training sessions emphasizing the qualities of a good tutor so that the students can carry out the peer tutoring procedures with high integrity. Fourth, establish a non-threatening and supportive setting through continuous interaction and bonding with peers even outside the classroom setting. Fifth, conduct a lecture on item analysis using Bloom's taxonomy or a similar type of taxonomy, and give detailed instruction on how to develop items to assess higher order of thinking and reasoning skills. And lastly, constantly remind the students the value of the peer-mediated intervention for them to develop an attitude of personal interest and caring towards their RPT partner.

Finally, based on the findings, a follow-up research will be conducted to determine whether the perceived benefits have effects on course learning that were not measured in the present study. It is suggested that some RPT procedures may be modified to strengthen the research and to determine whether RPT procedures can be redesigned to make them more meaningful for the learning needs of college students. Another interesting aspect of RPT procedure that should be considered more closely are the perceived benefits of on-line peer tutoring as an extension of RPT activity outside classroom setting.

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