

Use of Reciprocal Peer Tutoring Technique in an Environmental Control Systems Course at an Undergraduate Level

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The purpose of this study was to examine the effects of reciprocal peer tutoring (RPT) on student performance in one of the Environmental Control Systems courses offered by the Department of Construction Science, Texas A&M University. Reciprocal peer tutoring has been used extensively at school level for developing academic skills of the students. It has also been used at college level for different disciplines. In this technique, students occasionally function equally as both tutor and tutee in a classroom situation. It enables the students to gain both from the preparation and instruction in which the tutors engage, and from the instructions that the tutees receive. The study population consisted of the students who attended the course in Summer terms of 1998 and 2000, and Spring semester of 2000. Sample size of the study was 156 students. Relevant data was collected from the Student Information Management System database of the university. Chi-square tests were performed to ascertain the relationship between student performance and RPT. The findings generated from the analysis of the data indicated that RPT has a statistically significant effect on student performance in this particular Environmental Control Systems course.

Key words: Environmental Control Systems, Reciprocal Peer Tutoring, Undergraduate Education.

Statement of the Problem

Peer tutoring is a cooperative learning strategy that capitalizes on the benefits students receive from preparing to tutor one another. It has been found to be an effective technique for increasing students' academic achievement (Jenkins & Jenkins, 1985; Magolda & Rogers, 1987; Slavin, 1991). Literature indicates that both the tutors and tutees attain a better understanding of the materials by participating in the process (Annis, 1983; Sherman, 1991).

Advancing this strategy a step further, a few other researchers have developed a procedure that enables all the members in a group to participate in the role of the tutor. This is known as reciprocal peer tutoring (RPT). In this technique, students function equally as both tutor and tutee. It enables the students to gain both from the preparation and instruction in which the tutors engage, and from the instructions that the tutees receive (Griffin & Griffin, 1997).

Reciprocal peer tutoring has been used extensively at junior and high school levels for developing academic skills of the students. It has also been used at college level for different disciplines. Some studies indicate that this teaching procedure helps the students improve their academic skills (Gartner & Riessman, 1994; Kohler & Greenwood, 1990). There are yet other findings that do not provide a strong support for the effectiveness of the procedure (Griffin & Griffin, 1998).

The Department of Construction Science within the College of Architecture at Texas A&M University offers Environmental Control Systems courses at an undergraduate level. Apart from Construction Science students, Environmental Design students of the College of Architecture also take these courses. The author introduced reciprocal peer tutoring (RPT) to teach an Environmental Control Systems course in the summer of 2000. It appeared that the student performance in that class was significantly higher than the previous classes in which RPT was not adopted. The purpose of this study is to test the hypothesis that reciprocal peer tutoring has a positive effect on student performance in Environmental Control Systems courses.

Methodology

Study Population

The study population consists of the students who registered for and actually attended Environmental Control Systems I course offered by the Department of Construction Science, Texas A& M University, in the following semesters:

1. Summer I, 1998
2. Spring, 2000
3. Summer I, 2000.

Reciprocal peer tutoring technique was not introduced in Summer I, 1998 and Spring, 2000; the students from these semesters form the non-RPT classes in the study. The technique was adopted in Summer I, 2000; students in this semester form the RPT class in the study. Number of students in the non-RPT classes was 116 (25 females and 91 males) and that in the RPT class was 40 (11 females and 29 males). The total population size was 156. The entities under study are the students who attended these classes. The unit of analysis is the student.

Data Collection

The RPT class was divided into small groups ranging from three to five students. The groups met every alternate day during the class period, discussed the materials that were presented by the tutor on the previous day, developed a series of questions on the materials, and used the questions to quiz each other. The questions with correct answers were handed to the tutor at the end of the class. Students in this class formed the treatment group.

Students from the non-RPT classes formed the control group. This group did not have any exposure to the reciprocal peer tutoring technique. None of the activities mentioned above adopted under this technique were performed by the students in this group. The final letter grades of both the groups of students in the course were recorded as student performance.

Grading Criteria

Students for both RPT and non-RPT classes were taught the course using the same syllabus. Both the groups did four assignments and took three tests during the semester. The final grade was a weighted average of the assignments and tests. The assignments were worth 40 percent and the tests were worth 60 percent of the total.

The researcher of the study being also the instructor and class evaluator gives rise to the problem of researcher bias. The problem was recognized and attempts were made to minimize it as follows:

1. Multiple-choice questions of similar nature were used for the tests for both the groups of classes. The students recorded the answers on SCANTRON[®] computers forms that were fed into optical scanners for grading electronically.
2. The assignments were checked against standard checklists for both the groups.

Variables and their Operationalization

Student Performance (GRADE)

Student performance is the actual academic performance of the student in the class. It was measured by the letter grade (*A*, *B*, *C*, *D*, or *F*) obtained by the student in the course. For the purpose of providing a minimum number of observations in every cell in the statistical analysis, the observations for letter grades *D* and *F* were collapsed to form a category called *Other*. The relationship between a letter grade and numerical grade was as follows:

A = 90 per cent or above;

B = 80 percent and above, but lower than 90 per cent;

C = 70 percent and above, but lower than 80 percent;

Other = lower than 70 percent.

Reciprocal Peer Tutoring (RPT)

This variable was included to measure the effect of the particular teaching method on student performance. For the purpose of statistical analysis, a "yes" was assigned to the students who used reciprocal peer tutoring technique and a "no" was assigned to those did not use it. The total counts of "yes's" and "no's" were used for the statistical analysis.

Analysis and Interpretation

Results

A chi-square test was performed to determine the relationship between student performance and reciprocal peer tutoring. It is a non-parametric test of statistical significance for bivariate tabular analysis. A hypothesis tested with chi-square is whether or not two different samples are

different enough in some characteristic or aspect of their behavior that we can generalize from our samples that the populations from which our samples are drawn are also different in the behavior or characteristic (Ott, 1988). If the chi-square value is found to be larger than the critical value at a chosen probability of error threshold, then the data present a statistically significant relationship between variables used in the test.

The formula for calculating chi-square is:

$$\chi^2 = \sum \{(o-e)^2/e\} \quad (1)$$

Where, o = observed data and e = expected data.

The results of the test are shown in Table 1.

Table 1

Chi-square Analysis of RPT

GRADE	RPT		Chi-square	Degrees of Freedom	p-value	Critical Value of Chi-square
	Yes	No				
<i>A</i>	16 (0.40) ¹	17 (0.1466) ¹	16.238			
<i>B</i>	20 (0.50) ¹	57 (0.4914) ¹		3	0.001	7.815
<i>C</i>	4 (0.10) ¹	36 (0.3103) ¹				
<i>Other</i>	0 (0) ¹	6 (0.0517) ¹				
Total	40 (0.2564) ²	116 (0.7436) ²				

(1) Figures within parenthesis represent the proportion of students receiving grades in different categories.

(2) Figures within parenthesis represent the proportion of students in RPT and non-RPT classes.

Interpretations

The chi-square value was found to be quite high at a level of significance of 0.001. The results showed that the proportions of students in the RPT class (RPT “yes”) receiving grades of *A*, *B*, *C*, and *Other* were 0.40, 0.50, 0.10, and 0 respectively; and those of the in the non-RPT classes (RPT “no”) receiving grades of *A*, *B*, *C*, and *Other* were 0.1466, 0.4914, 0.3103, and 0.0517 respectively. The difference in proportions (except that for grade category *B*) was found to be significant. In other words, the results indicated that overall student performance in the class in which reciprocal peer tutoring technique was adopted differed significantly from that in the classes where the technique was not adopted. Students in the class that used RPT performed better than those in the classes that did not use the technique. A graphical representation of student performance is given in Figure 1.

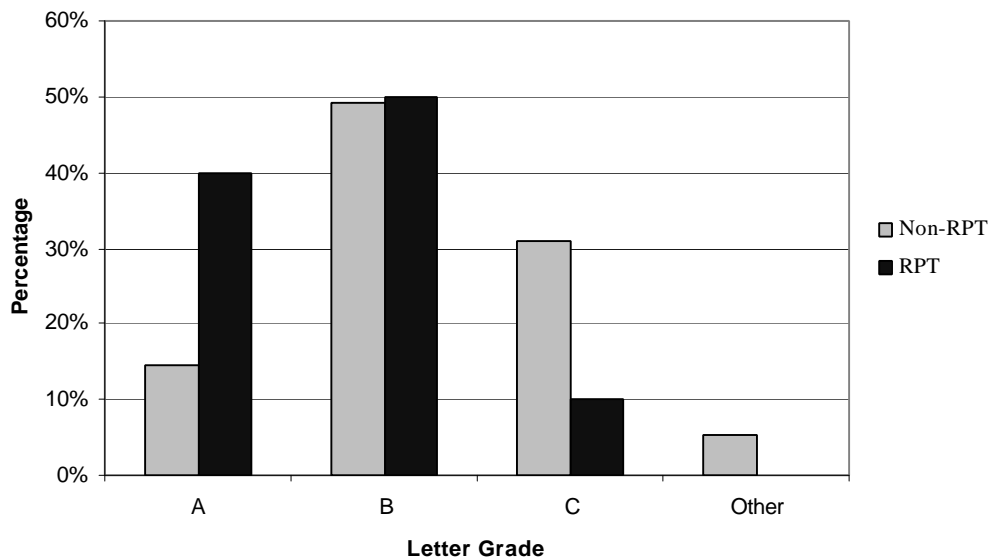


Figure 1. Student Performance

Conclusions

Reciprocal peer tutoring (*RPT*) was found to have a significant positive effect on student performance in environmental control systems courses at the 0.001 level. This is probably because of the reason that cooperative learning results in higher level of reasoning and more frequent generation of ideas and solutions than individualistic learning. Literature indicates that students tend to form multidimensional and realistic impressions of one another's competencies and give accurate feedback in a reciprocal peer tutoring process (Johnson & Johnson, 1994).

An informal discussion with the students using *RPT* revealed that their perceptions about the technique were positive. Nearly all of them agreed that the technique was useful because it forced them to apply the course content and provided additional review and practice. It made them better prepared for the tests and to complete the major class assignments. However, the results should be viewed with caution because the technique had been adopted for only one class in a summer semester. For future studies, it will be worthwhile to use data from regular semesters with *RPT* effect.

A chi-square test allows a researcher to make decisions about whether a relationship between two or more variables exists; it does not provide the strength of that relationship. It will be interesting to perform statistical analyses that allow one to determine whether *RPT* continues to remain statistically significant in the presence of other probable correlates of student performance such as overall academic ability, class size, and gender difference (Choudhury, 1999).

The study was conducted to observe the effect of RPT only on Environmental Control Systems courses. It may be useful to replicate the study to find whether RPT has similar positive effects on student performance in other courses in Construction Science.

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