An investigation of the effects of reciprocal peer tutoring

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A B S T R A C T

This study investigated the effects of reciprocal peer tutoring (RPT) on student achievement, motivation, and attitudes. Four sections of an educational technology course were randomly assigned to one RPT and one non-RPT group. Participants in the RPT group were then randomly assigned to groups to tutor and support each other while participants in the non-RPT group worked individually. The results suggested that the RPT and non-RPT groups did not differ on student achievement and motivation. Findings concerning student attitudes revealed that what students liked about RPT were helpful group members, opportunities to work in groups, feedback from groups, the comfort that RPT provided, and knowledge sharing. What students disliked about RPT were the unnecessary work and lack of interaction.

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1. Introduction

Research studies on cooperative learning have demonstrated that it can be an effective strategy to use in elementary and middle grades. It may bring important educational gains for high school and college students as well (Emerson & Mosteller, 2004a). The benefits of cooperative learning include a deeper understanding of knowledge, enhanced student achievement, improved inter-group relations, greater opportunities to work together, and increased acceptance of academically handicapped peers (Sanders, 2001; Slavin, 1995). Joyce, Weil, and Calhoun (2004) contended that the synergy in cooperative learning generates more motivation than individual, competitive settings. Cooperative learning also contributes to a higher level of reasoning and more frequent generation of ideas and solutions (Choudhury, 2002). It works well with homogeneous classes and is especially needed for classes with a wide range of student skills, for it can make diversity a resource rather than a problem (Slavin, 1995).

The concept of cooperative learning is based on a social learning theory that students are more likely to possess high self-efficacy to complete a task when they know they will have assistance from their peers (Ormrod, 1999). When working cooperatively with others, people acquire more effective learning strategies and solve problems more successfully (Gillies & Ashman, 2003; Ormrod, 1999). Other theories related to cooperative learning include Vygotsky’s (1978) concept of the zone of proximal development (ZPD) and social constructivism. The ZPD refers to “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). In essence, people are able to accomplish more difficult tasks when they have assistance from other individuals.

Peer tutoring is a type of cooperative learning in which students coach one another as they develop specific skills (Choudhury, 2002; Sanders, 2001). Forman and Cazden (1985) argued that peer tutoring requires a difference in knowledge between the tutor and tutee so the more knowledgeable individual can tutor the less knowledgeable. Falchikov (2001a) also described peer tutoring that can occur between students in the same class group with similar expertise and development levels. Peer tutoring provides an alternative teaching and learning approach where students take proactive roles in thinking, questioning, and sharing knowledge (Luca & Clarkson, 2002).

Whereas tutors and tutees increase achievement by participating in peer tutoring, students acting as tutors benefit most from the process (Benware & Deci, 1984). In light of the circumstance that student tutors make greater content-specific gains than student tutees, Pigott, Fantuzzo, and Clement (1986) developed an instructional strategy called reciprocal peer tutoring (RPT) to promote mutual tutoring. RPT is a type of cooperative learning that requires students to fulfill both tutor and tutee roles (Al-Hassan, 2003; Griffin & Griffin, 1995; Riggio, Fantuzzo, Connelly, & Dimeff, 1991). Students thus benefit through the rehearsal in which tutors engage as well as from the assistance tutees receive.

The effects of RPT have been researched in math, reading, and vocabulary at elementary as well as middle school levels. Studies on regular education students, underachieving students, students with learning disabilities and mild mental retardation, and aca-
demically at-risk students generated positive results (e.g., Fantuzzo, Davis, & Ginsburg, 1995; Fantuzzo, King, & Heller, 1992; Ginsburg-Block & Fantuzzo, 1997; Heller & Fantuzzo, 1993; Malone & McLaughlin, 1997; Mastropieri et al., 2001; Pigott et al., 1986). Students in the RPT group outperformed those who received more traditional instructional intervention.

Researchers have also examined academic achievement, self-efficacy, test anxiety, levels of distress, and student satisfaction regarding the effects of RPT on the college level (Choudhury, 2002; Griffin & Griffin, 1995, 1998; Mickelson, Yetter, Lemberger, Hovater, & Ayers, 2003; Riggio, Whatley, & Neale, 1994; Riggio et al., 1991; Rittschof & Griffin, 2001; Robinson, 1995). Although mixed results have been reported, the influence of RPT has only been studied in a limited number of disciplines, such as in abnormal psychology, industrial/organizational psychology, social psychology, human growth and development, educational psychology, human development, and introductory statistics. Additionally, the method used in RPT was to have students construct test items, take turns administering these items to their partners, and provide one another with explanations for questions answered incorrectly. This method may not be applicable to all disciplines. Researchers have suggested that cooperative learning methods could be effective in technological areas (Emerson & Mosteller, 2004b; Lou, Abrami, & d’Apollonia, 2001; Springer, Stanne, & Donovan, 1999). Nevertheless, the impact of RPT has not been explored in subject matter of this kind. The interdependence between educational technology and cooperative learning has been relatively unexplored (Johnson & Johnson, 2004).

The requirement for people to work cooperatively in using the tools of technology calls for children, adolescents, and young adults to develop and increase technological and teamwork literacy. However, teachers and schools have been slow in adopting innovative technologies, and the uses of such technologies in classrooms have been infrequent (Cuban, 2001). One of the barriers to adopting new technologies may be the failure of utilizing cooperative learning as an inherent part of educational technologies. Cooperation can promote a thorough mastery of the procedures in technology-supported lessons. Students learn how to use software programs more effectively when they engage in cooperative groups (Johnson & Johnson, 2004). In this study, the researchers investigated how reciprocal peer tutoring affected student achievement in the subject area of educational technology.

While student satisfaction is the only affective trait that has been investigated in previous RPT studies with college students (Riggio et al., 1991, 1994; Robinson, 1995), student total motivation as well as four motivational factors: attention, relevance, confidence, and satisfaction (ARCS) were relatively unexplored. The motivational benefits of cooperative learning have been justified in previous literature (Johnson & Johnson, 1989, 2003; Joyce et al., 2004). From a motivational perspective, cooperative learning creates a situation in which group success determines whether group members can attain their personal goals. Consequently, group members must help their group to be successful as well as encourage their peers to exert maximum effort in order to meet personal goals. In other words, when students work cooperatively, their efforts help their group members succeed. Students, therefore, encourage each other to learn and reinforce one another’s academic efforts (Slavin, 1995). In this study, the researchers also investigated how reciprocal peer tutoring affected student motivation and attitudes in the subject area of educational technology.

Cooperative learning is an indispensable element in schools that mirrors the authentic working environments where graduates will most likely work and communicate in teams. While it is common for university courses to teach isolated skills in the application of software (Oberlander & Talbert-Johnson, 2004), cooperative learning prepares students for the increasingly technological world by providing a context that helps to reinforce students’ technological skills through sharing and combining expertise. Therefore, it is crucial to investigate the importance of cooperative learning in combination with technology to prepare students to become lifelong learners of technology.

The purpose of this study was to determine whether reciprocal peer tutoring (RPT) improved student achievement and motivation as well as assess student attitudes toward RPT in four sections of an undergraduate educational technology course. The researchers utilized a mixed methods study in which both quantitative and qualitative research methods were employed. The following research questions were investigated in the study:

1. Does RPT have an effect on student achievement in an undergraduate educational technology course?
2. Is there a differential effect on the achievement of RPT and non-RPT students on different software programs in an undergraduate educational technology course?
3. Does RPT have an effect on undergraduate students’ total motivation toward the educational technology course?
4. Does RPT have an effect on the motivational factors (attention, relevance, confidence, and satisfaction) among undergraduate students in an educational technology course?
5. What are students’ attitudes toward reciprocal peer tutoring?

This study has educational implications for reciprocal peer tutoring practices. The results of this study will provide guidance for educators, instructional designers, and course developers to improve course delivery methods. Educators delivering multimedia courses will benefit from this study in that it could help them decide whether to adopt reciprocal peer tutoring during the whole class period or in teaching specific software. In addition, this study could provide guidelines for instructional designers and course developers in terms of designing and developing courses that effectively integrate reciprocal peer tutoring.

2. Methods

2.1. Participants

The participants were 105 undergraduate students who took a Technology in Education course at a university in the western United States. The participants were from a western city with a population of approximately 84,000 people. This course is a one-credit hour course taken by pre-service teachers typically after their sophomore year. Among the 105 participants, 61 were female and 44 were male, 86% of them were Caucasian, 8% were Hispanic, and 6% were others. Participants’ mean age was 22.23 and mean GPA was 3.36. The participants came from 14 different emphasis areas with 19% majoring in history secondary education, 17% majoring in math secondary education, 16% majoring in English secondary education, 12% majoring in social science secondary education, 11% majoring in biology secondary education, 10% majoring in theatre secondary education, and 15% majoring in other emphasis areas.

2.2. Instructional units and course settings

The Technology in Education course is a one-credit hour course that was designed mainly to educate pre-service teachers in a variety of technology tools, such as Microsoft Excel, Inspiration, Adobe Photoshop, Microsoft PowerPoint, advanced Microsoft Word, and Macromedia Dreamweaver. Issues related to the instructional applications of the tools, such as visual literacy and design principles are also explored.
The course is offered every semester for 15 weeks. The instructor (the first author) used a web-based course management system called Blackboard as a supplementary tool to communicate with students, post materials, and record grades for the course. Students taking the course are able to access Blackboard to retrieve the syllabus, class schedule, PowerPoint instructions, grading rubrics, tutorials, and other class related information.

The instructor and students met face-to-face every week for 50 min in a computer lab on campus. Although there are 20 computers in the laboratory, the four classes in this investigation consisted of 25–30 students each. Under such circumstances, students shared computers or took turns using computers. Generally speaking, students who had computers to use in class followed the instruction while students who shared computers took notes or watched other students practice.

2.3. Instrumentation

2.3.1. Assignment scores

Although cooperative learning was utilized in this study, all assignments still required individual work. Five assignments turned in during the experiment were graded according to detailed rubrics. Assignment one (Microsoft Excel) was worth 24 points, assignment two (Adobe Photoshop) was worth 20 points, assignment three (Microsoft PowerPoint) was worth 28 points, assignment four (advanced Microsoft Word) was worth 24 points, assignment five (Macromedia Dreamweaver) was worth 34 points, and the total for these five assignments was 130 points.

While the first author also served as the instructor for the four classes, students' assignments were also graded by a consulting instructor to control for possible experimenter bias. The consulting instructor reviewed all students' assignments based on the same grading rubrics. When the difference between assignment scores was greater than five points, the two instructors discussed the discordant grading until a consensus was determined. The inter-rater reliability for the total assignment scores was .93. An example of the Microsoft Excel grading rubric is shown in Table 1.

2.3.2. Motivational surveys

The pre- and post-motivational surveys both consisted of two sections: personal information and motivational measure. The personal information section required students to report their personal information such as class and section number, student identification number, gender, and GPA.

The motivational measure included 34 Likert-type motivational measure items ranging from 1 (not true) to 5 (very true). The motivational measure was adapted from the Keller and Subhiyah (1993) Course Interest Survey (CIS). The survey was designed using the ARCS model as the theoretical foundation (Keller, 1987a, 1987b). The ARCS model is a holistic model of motivation and all of the four factors – attention, relevance, confidence, and satisfaction – represent aspects of total motivation. CIS is comprised of four subscales and there are a total of 34 items in the instrument. Attention and confidence subscales have eight items each while relevance and satisfaction subscales have nine items each. Nine survey items were reverse-coded because they are stated in a negative manner.

The post-motivational survey had an additional section for the RPT students. Students in the RPT group were asked to respond to the following six open-ended questions: (1) Use one word to describe your peer group experience. (2) What did you like most about reciprocal peer tutoring? (3) What did you like least about reciprocal peer tutoring? (4) Have you benefited from reciprocal peer tutoring? Why or why not? (5) What worked well in your group? (6) What did not work well in your group?

2.3.3. Peer requirement guidelines

A hard copy of the peer requirement guidelines was distributed to the RPT students and explained by the instructor when the study began. The guidelines listed four requirements that RPT students needed to follow in order to tutor and support their peers: (1) The groups with three students need to share two computers and the groups with four students need to share three computers. Students have to discuss how to rotate the schedule so everyone has equal hands-on opportunities throughout the semester. (2) Every week the two or three students who have hands-on practice in class are required to tutor and support the one student who has not. (3) Students are encouraged to meet outside of class to tutor each other and work on assignments together. However, students are required to submit assignments individually. (4) If students have questions and need further tutoring, they should contact their peers before meeting with their instructor. When their peers cannot solve their problems, then they are encouraged to meet with the instructor as a group.

2.3.4. Interview questions

At the end of the semester, two groups of students (N = 12) from each of the two sections assigned to the RPT treatment were interviewed individually. The interview questions included the following: (1) What worked well in your group? (2) What did not work well in your group? (3) What suggestions would you provide to improve reciprocal peer tutoring?

2.4. Procedures

During the first two weeks of the semester, the class lists were still tentative so no data was collected in those two weeks. After the instructor received the final class lists during the third week, she distributed information and facilitated students' informed consent to participate in the study. All students enrolled in the four sections agreed to participate in the study. They returned the consent form and completed the pre-motivational survey.

The researchers began the study in the fourth week of class. Four intact classes taught by the same instructor were randomly assigned to one RPT (two classes) and one non-RPT group (two classes). As a result, the RPT group had 56 students while the non-RPT group had 49 students. For the RPT group, students were randomly assigned to groups of three (or four) students, resulting in a total 16 groups of three students and 2 groups of four students. Students in the RPT group were assigned seats in the computer laboratory so they could sit with their groups. The peer requirement guidelines were distributed to students during the fourth week of class. Students were asked to support and tutor their peers by meeting the peer requirement guidelines. Whereas students in the RPT group fulfilled peer responsibilities, students in the non-RPT group simply took turns using computers.

During week 4 through week 14, the instructor taught Microsoft Excel, Inspiration, Adobe Photoshop, Microsoft PowerPoint, advanced Microsoft Word, and Macromedia Dreamweaver. Students in both RPT and non-RPT groups were exposed to the same course instructions, tutorials, resources, grading rubrics, and so forth. All assignments were due the week following the instruction, with the exception of the Macromedia Dreamweaver assignment which was due during finals week. The instructor and the consulting instructor evaluated students' work according to the detailed grading rubrics. During finals week, students completed the post-motivational survey. Furthermore, two peer groups with the highest and lowest average assignment scores from each of the two classes assigned to the RPT treatment were selected. A total of 12 students were interviewed individually. Each interview lasted approximately 10 min and was tape-recorded.
The Microsoft Excel grading rubric

<table>
<thead>
<tr>
<th>Category</th>
<th>Non-proficient 1 point</th>
<th>Partially proficient 2 points</th>
<th>Proficient 3 points</th>
<th>Advanced 4 points</th>
<th>Score</th>
</tr>
</thead>
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<td>Data is placed haphazardly throughout the spreadsheet; row or column headings are poorly chosen or non-existent; Only one worksheet is used to organize data</td>
<td>Multiple worksheets are used, but may not be labeled or in logical order</td>
<td>Multiple worksheets are used, labeled and ordered logically. Placement of data is logical, but could be improved</td>
<td>Multiple sheets are labeled and ordered. Placement of data shows planning and facilitates easy reading and comprehension. No empty rows or columns between data fields or records</td>
<td>1</td>
</tr>
<tr>
<td>Data input and calculations</td>
<td>Data provided is incomplete or entered incorrectly, formulas and functions are used incorrectly or not at all, several mathematical errors</td>
<td>Data provided is entered correctly, formulas and functions are used (or attempted) sporadically, use of functions is not attempted, 2–3 mathematical errors</td>
<td>Data provided is entered correctly, formulas AND functions are used wherever appropriate, with no more than 1 mathematical error. Formulas do not link sheet to sheet</td>
<td>Data provided is entered correctly, formulas AND functions are used wherever appropriate without error. Formulas include links between sheets of the workbook whenever possible</td>
<td>2</td>
</tr>
<tr>
<td>Formatting</td>
<td>Cell and text formatting options are not utilized</td>
<td>Cell and text formatting options are used, but not effective in emphasizing data</td>
<td>Cell and text formatting options (like font size, bold, justification and text color) effectively emphasize important values. Formatting of decimal places is not done</td>
<td>Cell and text formatting options are used wherever possible to organize and emphasize data (including extras like borders, number and special formatting and input masks)</td>
<td>3</td>
</tr>
<tr>
<td>Tools</td>
<td>Data on each sheet is not sorted alphabetically by students’ last name. AND . Custom Filter has not been used to display only the students whose 4th Quarter average is below 85 (on the Q4 Summary Sheet)</td>
<td>Data on each sheet is not sorted alphabetically by students’ last name. OR . Custom Filter has not been used to display only the students whose 4th Quarter average is below 85 (on the Q4 Summary Sheet)</td>
<td>Data on each sheet is not sorted alphabetically by students’ last name. AND . Custom Filter is used to display only the students whose 4th Quarter average is below 85 (on the Q4 Summary Sheet)</td>
<td>Sort is used to order the data on each sheet alphabetically by student’s last name. AND . Custom Filter is used to display only the students whose 4th Quarter average is below 85 (on the Q4 Summary Sheet)</td>
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<td>Chart info</td>
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<td>The source data is correct, but the chart lacks one or more of the following: title, axis labels, legend. Data series have not been renamed or are non-descriptive</td>
<td>The source data is correct and the chart has a title, axis labels, and legend; data series have been named</td>
<td>The data source is correct and the chart has a title, axis labels, and legend; data series have been named</td>
<td>5</td>
</tr>
<tr>
<td>Chart aesthetics</td>
<td>Chart elements are completely illegible</td>
<td>Text and numbers are legible, chart size is inadequate, making the data difficult to read; chart type does not suit the topic</td>
<td>Text and numbers are legible; chart size and type are adequate. Data labels used ONLY if they improve usability</td>
<td>Selection of chart type, and chart placement within the workbook (to minimize scrolling) as well as the choice of font, font size, and color of chart elements show careful consideration</td>
<td>6</td>
</tr>
</tbody>
</table>

2.5. Data Analysis

The answers to research question one and research question two regarding student achievement were obtained through the test of the main effect and interaction effect between treatment and software conditions. The data analysis for student achievement measured by their total assignment scores and the five assignments was a 2 (treatment: RPT versus non-RPT) × 5 (assignments: Microsoft Excel, Adobe Photoshop, Microsoft PowerPoint, advanced Microsoft Word, and Macromedia Dreamweaver) repeated-measures analysis of variance (ANOVA). Each assignment score was converted to a z-score in order to perform ANOVA. While repeated-measures ANOVA examines the same construct using the exact same test on different occasions (Glass & Hopkins, 1996), in this investigation the same construct with different tests was observed at various points to measure student achievement. Therefore, profile analysis (Tabachnick & Fidell, 2001) was applied for this study where different assignments were measured on five occasions on the same participants. The assumptions of normality, homogeneity of variance, independence of samples, and sphericity were examined prior to analysis.

Research question three was obtained through the test of the main effect and interaction effect of treatment on motivation. The statistical analysis for student total motivation was measured using a 2 (treatment: RPT versus non-RPT) × 2 (test occasions: pre-versus post-motivational surveys) repeated-measures ANOVA. Research question four was answered through the test of the difference in scores between the pre- and post-motivational surveys on the four motivational factors. The data analysis for the difference scores between the pre- and post-motivational surveys on the four motivational factors was a one-way multivariate analysis of variance (MANOVA). The assumptions of normality, homogeneity of variance-covariance, linearity, absence of outliers, and multicollinearity were examined prior to analysis. Because multiple statistical tests (two repeated-measures ANOVAs and a MANOVA) were conducted for the study, Bonferroni-adjusted alpha (.05/3 = .017) was used for all analyses in order to control for potential type I error.

Research question five concerning students’ attitude toward RPT was answered through examining the open-ended questions in the post-motivational survey and interviews. Thematic analyses (Creswell, 1998) were conducted where the researchers looked for themes of information. Recurring responses were classified and served as the framework for discussion.

3. Results

3.1. Student Achievement

Before the statistical analysis was performed to test research questions one and two, an independent samples t test was used...
ability coefficients were obtained for each motivational subscale.

Descriptive statistics for the RPT and non-RPT groups on the total assignment scores were small (<.30). Descriptive statistics, salient loadings of ≥ .3, residual correlation less than .3, and interpretability of components suggested that three factors should be extracted in this study. By using the pattern matrix, five items were excluded from the original Course Interest Survey which resulted in 29 items remaining. The revised motivational survey was used to test research questions three and four. Based on the survey items that loaded on each factor, the three subscales were named into Expectancy, Interest, and Outcomes. The Expectancy, Interest, and Outcomes subscales have 15, 7, and 7 items each and the three factors explained 43.67% of the common variance. Cronbach’s alpha reliability coefficients for the revised pre- and post-motivational surveys were .90 and .92, respectively.

Research question three (Does RPT have an effect on undergraduate students’ total motivation toward the educational technology course?) was obtained through the test of the main effect and interaction effect of treatment on motivation. Examination of the main effect was evaluated first and the result indicated that the mean total motivation ratings were 3.68 for the RPT group and 3.77 for the non-RPT group. No significant difference was found, F(1, 97) = 0.12, p = .74. The interaction effect was evaluated next and was also found to be not significant, F(1, 97) = 0.11, p = .74. Effect sizes for the difference scores between the pre- and post-motivational surveys, respectively. The result showed that different treatments had no effect on student motivation. On the contrary, the non-RPT students had slightly higher motivation than the RPT students both before and after the course.

For research question four, the assumption of normality within each group was found not to be violated. The assumption of homogeneity of variance-covariance was assessed using Box’s test and found not to be violated as well. The assumption of linearity was examined where scatter plots were used to determine linearity. No curvilinear pattern was found for the three factors. The assumption of absence of outliers was checked using histograms, standardized z-scores, box plots, and Cook’s Distance > 1. No potentially influential cases were identified as outliers. The assumption of multicollinearity was satisfactory.

Research question four (Does RPT have an effect on the motivational factors among undergraduate students in an educational technology course?) was answered through the test of the difference scores between the pre- and post-motivational surveys on the motivational factors. The finding yielded no significant difference. F(1, 97) = 0.1, p = .96. Effect sizes for the difference scores between the expectancy, interest, and outcomes subscales were .08, .11, and .09, respectively. While both groups increased on the motivational factors of expectancy and outcomes from pre-motivational to post-motivational survey to post-motivational survey, the score dropped slightly from pre- to post-survey for the motivational factor of interest. The descriptive statistics for the RPT and non-RPT groups on the total motivation and three subscales for the pre- and post-motivational surveys are summarized in Table 3.

3.2. Student Motivation

3.2.1. Three factors extracted from factor analyses

Before student motivation was examined, Cronbach’s alpha reliability coefficients were obtained for each motivational subscale (attention, relevance, confidence, and satisfaction) and the total scale. The reliability coefficients on the confidence subscale for both the pre- and post-motivational surveys were low (.37 and .52, respectively), suggesting that the proposed four subscales in the motivational survey might not hold true for the participants in this study.

After reliability analysis was performed, factor analyses with 99 valid subjects were conducted using data from the post-motivational survey to determine whether the four subscales were valid tests of the constructs. The examination of scree plot, parallel analysis, salient loadings of ≥ .3, residual correlation less than .3, and interpretability of components suggested that three factors should be extracted in this study. By using the pattern matrix, five items were excluded from the original Course Interest Survey which resulted in 29 items remaining. The revised motivational survey was used to test research questions three and four. Based on the survey items that loaded on each factor, the three subscales were named into Expectancy, Interest, and Outcomes. The Expectancy, Interest, and Outcomes subscales have 15, 7, and 7 items each and the three factors explained 43.67% of the common variance. Cronbach’s alpha reliability coefficients for the revised pre- and post-motivational surveys were .90 and .92, respectively.

Research question three, no violation was found when looking at the assumption of normality within the treatment and control groups. Equality of variances and sphericity were found not to be violated in these data as well. Because of the use of a convenience sample of intact groups in the study, the assumption of independence of observations might have been violated.

Research question three (Does RPT have an effect on undergraduate students’ total motivation toward the educational technology course?) was obtained through the test of the main effect and interaction effect of treatment on motivation. Examination of the main effect was evaluated first and the result indicated that the mean total motivation ratings were 3.68 for the RPT group and 3.77 for the non-RPT group. No significant difference was found, F(1, 97) = 0.12, p = .74. The interaction effect was evaluated next and was also found to be not significant, F(1, 97) = 0.11, p = .74. Effect sizes for the difference scores between the pre- and post-motivational surveys, respectively. The result showed that different treatments had no effect on student motivation. On the contrary, the non-RPT students had slightly higher motivation than the RPT students both before and after the course.

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### Table 3
Descriptive statistics for the RPT and non-RPT groups on the total motivation and three subscales for the pre- and post-motivational surveys

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Survey</th>
<th>RPT (n = 54)</th>
<th>Non-RPT (n = 45)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Expectancy</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pre-motivational</td>
<td>3.86</td>
<td>0.61</td>
<td>3.85</td>
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<tr>
<td>Post-motivational</td>
<td>3.98</td>
<td>0.75</td>
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<td>Interest</td>
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<tr>
<td>Pre-motivational</td>
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<tr>
<td>Post-motivational</td>
<td>2.79</td>
<td>0.78</td>
<td>2.84</td>
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<tr>
<td>Outcomes</td>
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<tr>
<td>Pre-motivational</td>
<td>3.91</td>
<td>0.48</td>
<td>3.85</td>
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<tr>
<td>Post-motivational</td>
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<td>Pre-motivational</td>
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<td>3.75</td>
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<tr>
<td>Post-motivational</td>
<td>3.69</td>
<td>0.48</td>
<td>3.80</td>
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</tbody>
</table>

Note. 1 = not true; 5 = very true. Maximum mean score = 5.

### 3.3. Student attitudes

The third section of the post-motivational survey and further individual interviews assessed students’ attitudes toward RPT and were used to answer research question five (What are students’ attitudes toward reciprocal peer tutoring?). The themes that identified in the open-ended questions on the post-motivational survey were reiterated by the interviewees, except some interviewees provided additional suggestions to improve RPT.

#### 3.3.1. Peer group experiences

When asked to use one word to describe their peer group experiences, 78% of students chose positive words to delineate the process of RPT. The most frequently used word was “helpful” (16%), followed by “good/great/awesome” (13%), “fun/interesting” (7%), and “cooperative” (3%). It is noteworthy that words such as “friendly,” “comforting,” “caring,” and “encouraging” were also used to depict RPT. Six percent of students who held neutral attitudes toward RPT used words such as “experiential,” “normal,” “fair,” and “okay,” whereas, the 6% of students who felt negative about RPT chose “unnecessary,” “unhelpful,” and “futile” to portray their experiences.

#### 3.3.2. Liked most about reciprocal peer tutoring

The aspects of RPT that students liked most were helpful group members, opportunities to work in groups, feedback from peer groups, and the comfort that RPT provided.

Fifty-four percent of students suggested that they liked RPT because their peer groups were helpful. They were able to get help from their peers when needed. Some positive comments from students were, “I like the ability to ask my peers for help instead of always bothering the teacher. It starts to build bonds between people,” “How you didn’t have to interrupt the teacher in the middle of class to get help, just ask peers,” and “It isn’t as intimidating to ask questions, and it gives you a link or connection to the class, someone you can go to if you need help.”

Twenty-one percent of students appreciated the opportunities to work with peers and make new friends. One student revealed that RPT allowed him to make friends to help him in other classes. Another student pointed out that “I liked the fact that I had a group to sit with, go to if I needed help, and to be a part of.” Students also liked “the chance to get to know and work with other students,” and they believed RPT “created friendships that normally wouldn’t have been.”

Fourteen percent of students enjoyed receiving feedback or comments from peers. They liked the fact that they could get other people’s opinions. Some positive comments from students included, “They were able to give me good ideas and ways to get my assignments done,” “It provides helpful feedback about projects and my colleagues can provide helpful and positive suggestions,” and “I liked having second opinions on work I had done or questions I had.”

Nine percent of students mentioned that they enjoyed the comfort of working with peers. Some positive comments were, “I don’t feel stupid when I asked questions,” “Always sitting by the same people and knowing it was ok to ask them questions if I got lost,” “I enjoyed having someone to talk to and the comfort that if I missed a class or got behind I could contact someone,” “I loved the comfort of knowing that I had people available to help me if I needed it,” and “I think it is easier to ask a peer questions than a teacher.”

#### 3.3.3. Liked least about reciprocal peer tutoring

The aspects of RPT that students liked least were the unnecessary work, lack of interaction, and not enough computers. They also expressed other concerns regarding why they did not enjoy RPT.

Twenty-one percent of students considered RPT as unnecessary, busy work. They thought that “it did not serve me. I never called for help – all instructions were posted online,” “I didn’t feel like it was very necessary to the subject matter,” and “I didn’t like the fact that we didn’t really need each other. . . . It could have been better if we had done more complicated things that we would have needed our groups for.”

Sixteen percent of students disliked the lack of interaction among group members. Not knowing their group members well concerned them. There were also concerns about the trouble with trying to schedule a time to meet. Some students commented, “Finding time to meet outside of class is often difficult with everyone’s busy schedule,” and “There was additional difficulty because of the coordination needed to study together after hours.”

Thirteen percent of students felt that there were not enough computers for the class. Some comments from students were, “[I disliked] rotating computers so every time I wasn’t on I had to stay after to catch up even though I was in class,” and “Sharing computers (not that we weren’t good at sharing) was just inconvenient.”

Some students had unpleasant experiences with RPT as they had difficult group members who made the process less enjoyable. They underscored, “You have to depend and work with people who might not take the class as seriously as you,” and “One of the other students made it hard to enjoy the class and get the most out of it.” Additionally, it was also commented by students that what they liked least about RPT was how groups were assigned. For example, they did not get to pick their own groups. One student noted that “If you assign groups based on content areas, people are more likely to have time to get together and work on projects.”

#### 3.3.4. Benefits and drawbacks

Students were asked if they benefited from RPT and the reasons why they did or did not. Seventy-two percent of students indicated that they did, 9% held their opinions as neutral, and 19% indicated that they did not.

Students benefited from RPT mostly because their peers were helpful. Students also benefited from RPT in that it gave them opportunities to meet new friends and get acquainted with them. Another benefit that students mentioned was the comfort of working with peers. They found it easier to ask questions which they thought were silly, and they could refer to their groups without interrupting the instructor or the class. Additionally, students benefited from RPT during the process of sharing knowledge, learning from peers, and teaching others.

Students who held their opinions as neutral stated that it was good to know that peers were available to help had there been any questions or to provide help to peers when needed. RPT also offered great opportunities for students to get to know people they otherwise would not have. Students benefited from working with
peers on unfamiliar software programs as well. On the other hand, many students pointed out that the course instructions were self-explanatory which made RPT less essential.

Students who believed they did not benefit from RPT thought that they were proficient in computers and did not need additional help. Moreover, some students indicated that they have not benefited from RPT because their groups never got together outside of classes.

3.3.5. Things that worked well

When asked what worked well in their groups, students thought rotating computers, providing help, getting along, and sharing knowledge among group members worked well.

Most students indicated that sharing computers seemed to work well in their groups. This can be found from their comments such as, “No problems with computer usage, and we all were cooperative and pleasurable to be around,” “Our sharing of computers and respect. I believe we all got along well, and it was fun,” “We rotated who uses the computer each week, this allows everyone a chance to use one,” and “Our computer rotation schedule. Every third week I don’t use a computer and we never have to remind each other about whose turn it is.”

Some students pointed out that the help offered by peers was also a big part that worked well for their groups. They commented, “All members were motivated and self-sufficient, but willing and capable of helping each other when necessary.” “Answering another’s questions and making sure everyone knew what was going on,” “Working on our own for the most part but knowing if we had any questions we could ask each other.” “Staying after class a few minutes to help explain the day’s material to the member without a computer for the day,” and “Coming a few minutes early to make sure everyone was ok and didn’t need help.”

Another aspect that worked well for peer groups was that students got along with each other. Some of the comments were, “Everyone was kind to each other and shared computers fairly. They were also nice about answering questions I had. It made the class more fun too,” “I think simply being friendly and making yourself available is the key to a successful group,” “We got along well and were able to respect each other’s differences,” and “Group understanding, if we need help we ask, if we don’t we work side by side.”

The fact that students were able to share knowledge among group members also worked well. Some students commented, “Everyone seemed to be very knowledgeable about all the programs,” “Each of us helps the others in the group in different ways because we bring different attributes to the group,” “Our laid back demeanors, willingness to cooperate and share, and good knowledge base,” and “We were all knowledgeable about computers and we had different experiences.”

3.3.6. Things that did not work well

When asked what did not work well in their groups, some aspects such as the inability to meet or communicate outside of classes and lack of computers were mentioned.

Students pointed out that they encountered difficulties trying to keep in touch with each other outside of classes. Some of their comments were, “Communication outside of class was hard with different schedules,” “The distance and conflicting schedules between us. We never really got together outside of class aside from e-mail and phone calls. It could be better to pair people up with similar class schedules/contents,” “No time outside of class to get together as a group,” and “Trying to find times when we could get together outside of class, all three of our environments are different. So, that was difficult.”

Although sharing computers seemed to work well for most of the groups, some students disliked the fact that they did not have enough computers to use. They commented that “Not everyone had a computer of their own. It’s hard for visual people to not work on a computer of their own,” “I think it is very important for everyone to have their own computer otherwise it is a lot of work to catch up,” “It would be more beneficial if there were enough computers for everyone in the class,” and “It is hard to share computers. When you are not on a computer you get left behind, and this is frustrating because you were in class but you are still behind.”

3.3.7. Suggestions to improve reciprocal peer tutoring

Among the 12 interviewees, seven provided some constructive ideas that could improve RPT, including designing cooperative projects, allowing students to pick own groups, and facilitating group cooperation.

One interviewee contended that students should get together after hours to help those who miss course instructions. In that case, students do not have to worry about catching people up during classes. Two students suggested that assignments should facilitate working together. They thought although RPT called for cooperation, a lot of what went on in the classes did not cultivate group efforts. Besides the Inspiration project, all of the assignments completed in the course required individual endeavors. Therefore, it would be better if projects could be designed to involve students working together outside of classes.

Three interviewees believed that RPT could be improved if students got to pick their own groups. They stated, “Maybe if they [students] are with friends they are more likely to get more involved with their friends or help more or share more because there will be friendship connection,” and “Most of us are going though educational classes and we met people through those classes. So maybe we would feel more comfortable working with someone that we probably worked with before.”

Another interviewee suggested allocating time in class to get students in the habit of meeting with each other. He pointed out: “I think maybe having 10 min at the end of classes or maybe two or three class periods at the beginning of the semester to get students in the habit of meeting together.”

4. Discussion and conclusions

This study investigated the effects of reciprocal peer tutoring on student achievement, motivation, and attitudes in four sections of an undergraduate educational technology course. The results suggested that the RPT and non-RPT groups did not differ on student achievement and student motivation. Findings concerning student attitudes suggested that the participants liked the learning method, but there were also problems that hindered them from enjoying RPT. From students’ comments, it was discovered that RPT helped them conceptualize the idea of being responsible to self and peers. On the other hand, students were concerned about being responsible for someone else when there was too much dependence from peers.

4.1. Student achievement

Contrary to the positive findings reported in previous studies that evaluated the effects of RPT (e.g., Choudhury, 2002; Fantuzzo, Dimoff, & Fox, 1989; Fantuzzo, Riggio, Connelly, & Dimoff, 1989; Fantuzzo et al., 1992, 1995; Ginsburg-Block & Fantuzzo, 1997; Heller & Fantuzzo, 1993; Malone & McLaughlin, 1997; Mastroianni et al., 2001; Pigott et al., 1986; Riggio et al., 1991, 1994), the statistical analysis on research questions one and two reveals no significant difference between the RPT and non-RPT groups. The reason that the difference in student achievement was not significant
might have been due to the fact that RPT was implemented for a course that lasted only 50 min each week. The class sessions were too short for RPT to take place spontaneously. Some students pointed out that there should be time allocated so students can get used to RPT. Falchikov (2001b) contended that peer tutoring is an unfamiliar intervention for students; therefore, they need time to adjust to new ways of interacting with one another. While the U.S. Department of Education (2001) remarked that frequent and regular tutoring sessions result in greater gains, it is conjectured that more positive results might be discovered when RPT is incorporated in courses that meet for a longer period when students can spend more time in RPT activities.

Further, the relatively high scores on all assignments (\(M = 22.94\) out of 24 [96%] for Microsoft Excel, \(M = 18.89\) out of 20 [94%] for Adobe Photoshop, \(M = 25.98\) out of 28 [93%] for Microsoft PowerPoint, \(M = 23.05\) out of 24 [96%] for advanced Microsoft Word, and \(M = 28.83\) out of 34 [85%] for Macromedia Dreamweaver) suggests that a ceiling effect might have attributed to the non-significant result. Students' comments also support this finding where they stated, “I know most of the programs really well,” “It could have been better if we had done more complicated things,” and “None of the course work was difficult enough for me to need to rely on other students in my group.”

Although the RPT students did not perform statistically better than their non-RPT counterparts, it can be speculated that incidental learning might have occurred in this study since students thought RPT was beneficial, and they enjoyed knowledge sharing among group members. Rittschof and Griffin's (2001) notion can help interpret the finding in this investigation. They indicated in their study that RPT might have resulted in learning of relevant incidental information that could not be detected in the tests. They asserted that regardless of test performance, students' satisfaction and perceived benefits resulted from the depth and breadth of understanding that they obtained after engaging in RPT.

For the repeated-measures ANOVA performed to test research questions one and two, the assumptions of normality, homogeneity of variances, and independent samples were violated. According to Glass and Hopkins (1996), “Non-normality and heterogeneous variances appear to combine additively to affect either level of significance or power” (p. 404). Non-independence of samples also affects significance and power of the F-test. Consequently, it is possible that the non-significant difference on student achievement resulted from violation of the assumptions. What's more, the effect sizes for total assignment scores as well as the five individual assignment scores were relatively small (<.30). Cohen (1988) proposed that an effect size of .20 is small, .50 is medium, and .80 is large. Considering his theory, the effect sizes in this investigation indicate that the sample size (\(N = 105\)) might not be large enough to detect a significant difference.

4.2. Student motivation

In this study, the revised motivational subscales were named into Expectancy, Interest, and Outcomes, where the names were derived from Keller's (1979, 1983, 1987a) original model of motivation. The ARCS model of motivation is grounded in expectancy-value theory, which states that people will be motivated to engage in the activities if they perceive there is a positive expectancy to be successful and if the activities are linked to the satisfaction of their needs. In its original form, expectancy and value were expanded to interest, relevance, expectancy, and outcomes. After several years of research and application, the original model was revised to the ARCS model (Keller, 1984, 1987a). Although factor analyses supported three factor extraction, which contradicted the four constructs in Keller's ARCS model, the expectancy-value theory in which the three factors were grounded in was the same theory that ARCS originated from.

The statistical analyses on research questions three and four reveal no significant difference between the RPT and non-RPT groups. The RPT treatment did not have an effect on student total motivation in an undergraduate educational technology course. In contrast, students in the non-RPT group had slightly higher total motivation scores than students in the RPT group before and after the course. Interestingly, although both groups increased on the expectancy and outcomes subscales from pre- to post-motivational surveys, the result on the interest subscale shows a slight decrease from pre- to post-surveys for both groups.

Similar to the ceiling effect that caused overall high assignment scores, it is possible that students lost interest in the course because most of them were proficient with technology. For instance, students expressed that “Our group did not tutor outside of class because we all understand the content,” and “This class doesn’t really need too much help.” Keller (1983) stated that when tasks are easy, a person may feel uninterested because the tasks are not challenging enough. In other words, easy tasks bring about low interest and high expectancy for success. This might also explain why the other two subscales (expectancy and outcomes) increased at the end of the course in this study. As the semester progressed, students discovered that they had no problems handling the course content. Consequently, they began to perceive that there was a positive expectancy to succeed and react positively to reinforcements, which resulted in the increment on the expectancy and outcomes subscales.

It is also possible that the RPT students had slightly lower motivation than the non-RPT students at the end of the course because the treatment was too cumbersome as supported by the qualitative data. Johnson, Johnson, and Holubec (1998) contended that cooperative learning is more complicated than individualistic learning since students are engaging in academic tasks and teamwork simultaneously. From qualitative analysis, it was found that students considered RPT as unnecessary, busy work, given that they knew the course materials well. The RPT students expressed, “I didn’t feel it [RPT] was very necessary to the subject matter,” “We didn’t really need each other,” and “At times, it [RPT] was unnecessary.” They also had problems keeping in touch with each other and scheduling times to meet outside of classes, were dissatisfied with how groups were assigned, and were affected by unmotivated group members. For instance, several students mentioned that they were affected by their peers' behaviors and attitudes. These could bring down student motivation and account for the result of RPT not having a significant effect.

Another factor that might have led to the non-significant difference was that CIS might not be measuring particular student motivation in this course. CIS is grounded in well-rounded theories and has been tested with over 200 graduate and undergraduate students. It is a situational instrument that measures students' motivation to learn in a specific course setting (Keller & Subhiyah, 1993). However, the results in previous literature did not sustain in this study. The confidence subscale had poor reliability and factor analyses did not support four factor extraction as posited in existing theories.

For the repeated-measures ANOVA conducted to test research question three, the assumptions of normality and independent samples were violated. Under such circumstance, the non-significant result might be due to underestimate of the F-test. Besides, with regard to research questions three and four that examined student motivation, effective sizes were rather small (<.20) when compared to Cohen's (1988) criteria. The sample size (\(N = 99\)) in this investigation might also have been too small to discover any significant difference.
4.3. Student Attitudes

Approximately three-fourths of students in the RPT group (78%) used positive words to describe their RPT experiences. In addition, 72% of students in the RPT group indicated that they have benefited from RPT. These findings are consistent with previous research, which suggested that students working cooperatively with computers held more positive attitudes than students working individually (Hooper, Temiyakarn, & Williams, 1993; Lou, Abrami, & d’Apollonia, 2001). Johnson and Johnson (2004) also asserted that cooperation at a computer seems to be more enjoyable for most students.

From the open-ended questions which assessed what students liked most and least about RPT, it was found that students generally held positive attitudes toward the learning method. There were three reasons why students enjoyed RPT. First of all, they were able to rely on others and receive assistance when necessary. They felt relieved knowing that help was always available if problems arose in the process of learning. The one-on-one help provided by peers made learning easier and less intimidating, as Miller, Barbetta, and Heron (1994) argued that peer tutoring is a useful resource that provides more individualized instruction to students.

Second, working with peers provided a comfort zone for most students. Fifty-four percent of students valued peer help highly. They felt comfortable receiving and providing assistance within groups. That way, they did not have to worry about bothering the instructor or interrupting the whole class. They also felt less intimidated to ask questions and thought it was easier to refer to peers when problems came up, a finding that echoes what Ormrod (1999) advocated that peer tutoring allows students to feel more comfortable asking questions.

Third, students appreciated sharing ideas with each other and learning new perspectives from peers. They stated that group members contributed different knowledge and experiences to the group, which allowed them to draw on each other’s understanding. This reflects what Good, McCaslin, and Reys (1992) identified as a benefit of cooperative learning, where the researchers proposed that group knowledge is always greater than the knowledge of any individual student. Further, Johnson and Johnson (2004) suggested that individualized instruction lacks the cognitive gains associated with explaining ideas to peers. By the same token, students in this study expressed that it is important to elaborate on course instructions when their peers didn’t get the concepts. In that case, students could learn through teaching and tutoring.

Two major factors regarding what students liked least about RPT were the unnecessary work and difficulties of coordinating meetings after classes. Students thought RPT was not a crucial element for the subject matter because they understood the content well. They also believed that RPT was not needed for the course, given individualized assignments, and self-explanatory instructions. This result is consistent with Gokhale’s (1995) finding that group learning was more beneficial in enhancing critical-thinking skills such as those involving synthesis, analysis, and evaluation, as well as problem-solving skills. Moreover, students also were concerned about the lack of time to implement and utilize RPT. Al-Hassan (2003) speculated that greater gains might result if more time could be spent in peer tutoring activities. Nevertheless, as much as students wanted to support and tutor each other after classes, they found it extremely difficult to schedule meeting times after class.

When it came to benefits of RPT and things that worked well in the process, the themes identified in the questions which assessed what students liked best about RPT were reiterated. While students mentioned that they liked RPT because it made them become responsible for their own learning, students also remarked that RPT also made them responsible for someone else’s learning. The give and take in RPT has reconstructed traditional classroom settings in which the instructors are responsible for students’ learning. It is encouraging to note that RPT has helped students conceptualize the idea that through supporting and tutoring one another, students could take the responsibility of their own learning and keep their peers on task at the same time. This finding is consistent with Houston and Lazenbatt (1996) suggestion that offering peer support enables students to take more responsibility for their learning techniques. From students’ comments, it could be found that cooperative base group was utilized in this course, where group members became responsible for ensuring that everyone was making progress and holding each other accountable to learn (Johnson, Johnson, & Smith, 1998).

On the other hand, students described the concern about being responsible for someone else. When a student missed a class or two and expected assistance from his or her peers, it became more difficult for the group members to focus on course materials while helping one student catch up. The same difficulty was discovered in the study conducted by Kowalsky and Fresko (2002) in which tutees were overly dependent on tutors. Furthermore, one of the problems Good et al. (1992) specified that may take place in group settings is that the dependence on teacher is shifted to peers. Thus the benefits of cooperation are minimized because the shift to group learning becomes an authority figure change rather than an instructional change.

The problem of peer responsibility might be solved when time is allocated for in-class group meetings, as some students suggested. Mickelson et al. (2003) proposed that students need time to practice and experience the RPT intervention before the treatment effect can be observable. If time could be designated at the beginning and end of each class session for group discussion, students would have more opportunities to catch up, check on each other, and find out how things are going. This could also address the potential problems of lack of interaction between groups and difficulties meeting outside of classes since there would be time provided in class to communicate and reconnect.

Based on the findings in this study, the researchers provide recommendations for future research that may contribute to the literature of cooperative learning and reciprocal peer tutoring. Many students in this study reflected that they would prefer to pick their own groups and work with someone they were acquainted with. It was also suggested that groups should be formed so that students with the same emphasis area were put together. Future investigations can compare the effects of RPT when students are allowed to form their own groups or when groups are formed based on students’ content areas. Furthermore, the ceiling effect might have accounted for the non-significant difference on student achievement between the RPT and non-RPT groups in this study. Future research can investigate the effect of RPT by adopting challenging projects that call for group problem solving and critical thinking. While Ahuja and Thatcher (2005) contended that differences exist across gender when it comes to innovating with technology, further examinations can build on this study to compare the effects gender might have on RPT involving technology.

References


