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ONLINE STUDY GROUPS: RECIPROCAL PEER QUESTIONING VERSUS MNEMONIC DEVICES

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ABSTRACT

One hundred sixty students in an educational psychology course used WebCT Discussions to satisfy one of two study group conditions, reciprocal peer questioning or mnemonic devices. Students made postings according to their assigned study strategy in order to facilitate the learning of their group. At the end of the academic term, student permission was obtained to use three types of data for purposes of the investigation: 1) course grades; 2) WebCT records; and 3) rating scale responses that assessed personal evaluation of the virtual study groups. There were no differences between the two study conditions in terms of academic achievement. However, students in the reciprocal peer questioning condition made more postings and read more articles than students in the mnemonics group. Correspondingly, students in the reciprocal peer questioning group reported higher levels of satisfaction with the virtual study experience.

The relationship between college student success and effective study strategies is well established (Long, 2003; Waugh, 2003). Jones, Slate, and Kyle (1992) reported that college students with the highest levels of academic achievement tended to engage in the most effective study strategies. Differences in college student study behavior account for as much as one-fifth of the variation in undergraduate grades (Bailey & Onwuegbuzie, 2002). Furthermore, the link between study skills and academic performance is suggested by the finding that study strategies training significantly increased the retention rate of high-risk college students (Polansky, Horan, & Hanish, 1993). Approximately 50% of undergraduate students engage in effective study behavior (Agnew, Slate, Jones,

& Agnew, 1993; Slate, Jones, & Harlan, 1998). Consequently, facilitating student study skills is of concern to all individuals focused on college student learning. Learning technologies provide opportunities to support effective student study behavior (Crook, 2002; Grabe & Sigler, 2002; Prestera & Moller, 2001).

ONLINE STUDENT STUDY SUPPORT

According to a survey of institutes of higher learning (Miller & Lu, 2003), online services directed toward promoting effective student study skills are common. Online learning support in the form of links to study skills sites was reported in 93% of the cases, online study skills assistance was provided in 61% of the cases, and online peer tutoring occurred in 72% of the cases. Luca and Clarkson (2002) described "how easily and effectively the basic principles of peer tutoring can be adapted and implemented" in online learning environments (p. 1). "Capitalising on the interactive capabilities of new learning technologies, some distance education providers are starting to behave more like conventional educational institutions in terms of forming study groups" (Shale, 2002, p. 1).

While cooperative approaches to learning are supported by the research literature (Lou, Abrami, & d'Apollonia, 2001; Springer, Stanne, & Donovan, 1999), there is evidence that university students typically engage in independent study (Crook, 2001). An important consideration in promoting effective student study strategies is the development of a context for collaborative learning. Web-based technologies are ideally suited to cooperative human endeavors (Trentin, 1997). Research and practice on the formation, utilization, and effective features of online study groups is increasingly common (Tait & Mills, 2003). Crook (2002) suggested that "new technology may become a lever on what is otherwise a failure by students to take advantage of collaborative opportunities" (p. 66), and reported that when students were assigned to a cooperative online study group, 71% said that it was helpful or very helpful.

Numerous study strategies exist and most are easily adapted to e-learning environments (Lou et al., 2001; Miller & Lu, 2003; Saba, 1999). Which specific study strategies would be most readily accepted and endorsed by students in e-learning contexts? In contrast to real learning environments, virtual environments may change the nature of the study strategy which may, in turn, modify study skill effectiveness. From a research perspective, two particularly popular study strategies are *reciprocal peer questioning* and *mnemonic devices.* Neither study strategy has been systematically implemented and evaluated in an e-learning environment.

Study Strategy: Reciprocal Peer Questioning

Reciprocal peer questioning provides students with open-ended questions intended to generate focused discussion in small groups (King, 2002). Students

individually prepare content-specific questions and then take turns asking and answering each others' questions. Developed on the basis of the higher levels of Bloom's (1956) taxonomy, such questions encourage synthesis, comparison, and extrapolation of information to other contexts (e.g., explain why . . . , explain how . . . , what is the meaning of . . . , what is the main idea of . . . , what is the solution to the problem of . . .).

King (1989, 1990, 1991) compared the effectiveness of reciprocal peer questioning, unstructured group discussion, and independent review of course material. College students listened to a series of five lectures on topics in educational psychology and after each lecture studied the content using one of the three conditions. King (1992) reported that students in the reciprocal peer questioning group demonstrated comprehension superior to that of students who discussed the lecture material in small groups or independently reviewed the lecture. King proposed that such learning benefits were the result of active student involvement in the lecture content (1993) and the high level cognitive processing required to generate and respond to questions (2002).

Reciprocal peer questioning, however, is not unanimously endorsed. Rosenshine, Meister, and Chapman (1996) conducted a comprehensive review of the literature on the effectiveness of student generated questions, including research on reciprocal peer questioning. Meta-analytic effect size demonstrated clear learning benefits for reciprocal peer questioning. The median effect size was 0.36 when standardized tests were used as the criterion measure and 0.86 when experimenter-developed tests were used. However, "traditional skill-based instructional approaches and the reciprocal teaching approach yield similar results" (p. 195). Foote (1998) argued that there were no valid studies that clearly established the superiority of reciprocal peer questioning as a study strategy. In an attempt to overcome what he identified as the methodological weaknesses associated with King's (1989, 1990, 1991) research, Foote conducted a highly controlled study in which university students were randomly assigned to one of three conditions—reciprocal peer questioning, unstructured peer questioning, and fact listing. Results failed to identify a positive effect for student-generated higher order questioning.

Study Strategy: Mnemonic Devices

Mnemonic devices refer to organized learning strategies designed to function as memory aids (Carney & Levin, 2003). Mnemonics are "learning strategies that make elements of abstract information more familiar (e.g., visualization) and encourage students to form meaningful associations to these familiar elements (i.e., chunking and semantic organization)" (Wang & Thomas, 1996, p. 104). Common mnemonic devices include: acronym—an invented combination of letters with each letter acting as a cue to an idea or piece of information; acrostic—an invented sentence where the first letter of each word is a cue to an

idea or piece of information; loci method—visualization of items in familiar locations (Keeley, 1997).

The effectiveness of mnemonics in helping students remember information and enhance examination performance, at least with regard to certain types of content, is well-established (Tuckman, 2003). Mnemonic devices have repeatedly been found to improve vocabulary development in foreign language learning (Gruneberg & Sykes, 1996; van Hell & Mahn 1997). In an experiment by Rummel, Levin, and Woodward (2003), college students were randomly assigned to one of two instructional conditions mnemonics or free-study. Mnemonics group participants remembered more information than did free-study group participants. With regard to reading, Lipson (1994) compared a no-strategy control condition to a mnemonic imagery condition. She reported that both remedial and non-remedial readers scored significantly higher through exposure to mnemonics. Stephens and Dwyer (1997) presented university students with a module concerning the structures and functions of the human heart. Results "indicated that the use of embedded mnemonics with visuals can significantly improve student achievement" (p. 75). Mnemonic devices are routinely recommended to college students as essential learning strategies (Dembo, 2004; McWhorter, 2004).

Some studies, however, have challenged the learning benefits of mnemonic devices (Wang & Thomas, 1996). In three experiments involving 176 college students, the keyword mnemonic produced superior immediate performance but, after two days, higher levels of recall were associated with the non-mnemonic comparison condition that emphasized understanding (Wang & Thomas, 1995). Campos, Gonzalez, and Amor (2003) conducted a series of experiments in which participants were required to learn the first-language equivalents of a list of 30 second-language words. "In all experiments, the rote method was significantly more effective than was the keyword method" (p. 399).

The current investigation sought to determine the relative advantages of reciprocal peer questioning and mnemonic devices in online study groups. Is one approach superior in facilitating college student learning? When applied online, which study strategy is most readily endorsed by college students? Does study group condition affect student evaluation of study strategy? Does study group condition affect student online behavior?

METHODS AND PROCEDURES

Online Study Groups

As part of required coursework, students in four sections (40 students per section) of an educational psychology course made postings in online study groups. Within each course section, students were randomly assigned to one of two study group conditions—reciprocal peer questioning or mnemonic devices. Early in the academic term, five students were randomly assigned to each study group. Group membership did not change during the term, although student

withdrawal from the course slightly altered group composition. By making postings in WebCT Discussions, students shared their study strategies with members of their online group.

Regardless of study condition, required group postings corresponded to the course content for each of three midterm examinations. The online study rooms opened approximately 10 days prior to each midterm examination and closed the day of the examination. E-study group members had 10 days to make a minimum of four postings according to the study strategy described in their instructor's initial posting. Once the e-study rooms closed, student online postings were individually marked (i.e., independent of other group members' postings). This process occurred three times in preparation for each of the midterm examinations, contributing, in total, 20% to the final course grade. The study groups re-opened for final examination preparation, although postings at that point were optional and did not contribute to student grades.

Participants

At the end of the academic term, student permission was obtained to use three types of data for purposes of the investigation: 1) course grades; 2) WebCT records; and 3) rating scale responses that assessed personal evaluation of the virtual study groups and study strategies. Due to student withdrawal from the course as well as absenteeism on the day that the questionnaire was administered, 112 students participated in the study (56 students in each of the two study conditions). Students ranged in age from 18 to 33 years (mean 21.1 years). Approximately 77% of the sample was female, which is characteristic of the student population in the participating college. Students reported an average of 18 college credits complete (range 0 to 147). With regard to intended plans for Bachelor of Education degree completion, 48.7% of participants were focused on elementary education, 37.6% on secondary education, 6.8% were undecided, and data were missing for 6.8% of the students.

Measures

To address the research questions, four variables were measured. First, student satisfaction with online study groups was determined with four rating scale items. Second, student evaluation of the two study strategies was assessed with six questionnaire items. Third, student academic achievement was measured via in-class examinations. Fourth, WebCT records were examined in order to determine patterns of student use.

Student Satisfaction with the Online Study Experience

Four rating scale items assessed student interpretation and evaluation of the virtual study group experience. Items were rated by participating students on a

5-point Likert scale ranging from 1 (not at all) to 5 (absolutely). The four items included:

1. My virtual study group helped me do well in educational psychology.
2. The members of my online study group made good postings.
3. The members of my online study group benefited from my postings.
4. I prefer face-to-face study groups rather than online study groups.

Student Evaluation of Study Strategies

Six rating scale items assessed student interpretation and evaluation of reciprocal peer questioning and mnemonic devices as study strategies. Items were rated by participating students on a 5-point Likert scale ranging from 1 (not at all) to 5 (absolutely). Three items assessed evaluation of reciprocal peer questioning (e.g., When I am teaching, my students will use reciprocal peer questioning) and three items assessed evaluation of mnemonic devices (e.g., When I am teaching, my students will use mnemonics).

Student Academic Achievement

Student achievement was measured with the objective test items on three midterm examinations and one final examination. The midterm examinations were not cumulative, assessing student knowledge of a relatively limited amount of course material. The final examination was cumulative, assessing mastery of all course content. Each midterm examination contained 24 multiple choice items and the final examination contained 80 multiple choice items (36 items assessed knowledge of previously tested material and 44 items assessed mastery of course material covered subsequent to the third midterm examination). While the midterm and final examinations included case study analyses that contributed to examination marks, due to the subjective nature of the marking of these items, they were not included in any metric of student achievement.

Student Use of WebCT

Track Students is a WebCT function that records the number of times each student accesses course areas (WebCT, 2005). Three measures of student use of WebCT were obtained via Track Students and one measure of WebCT use was obtained by inspection of study group postings. These four WebCT use criterion measures included:

1. *WebCT Hits:* The number of times each student accessed the Homepage (first page accessed after sign on), any tool (from the options provided), or a Content Module page.
2. *Articles Posted:* The number of articles each student posted in Discussions. This reflected both required and optional online study group postings.

3. *Articles Read:* The number of articles each student accessed in Discussions. This reflected the opening of any online study group posting.
4. *Posted without Marks Incentive:* All students were provided with the option of continuing to post in the online study groups without marks incentive. That is, there were three occasions (i.e., in preparation for the three midterm examinations) in which student postings were marked and contributed to the final course grade. There was one occasion (i.e., preparation for the final examination) in which postings were possible (i.e., the study rooms were open) but not marked by the instructor and thus not contributing to the final course grade. Visual inspection of the WebCT study rooms revealed the exact number of students who continued to post without marks incentive as well as the number of postings made by each of these students.

Data Analysis

T-tests for independent samples were used to determine significant differences between students in the two study group conditions and between students who continued to post without marks incentive and those who did not. Group means were compared in terms of student academic achievement, interpretation of the online study experience, evaluation of study strategies (i.e., reciprocal peer questioning and mnemonic devices) and WebCT hits, articles read, and articles posted.

RESULTS AND DISCUSSION

No significant achievement differences emerged between the two online study group conditions (i.e., reciprocal peer questioning and mnemonics). That is, the study condition had no impact on student grades; in every case, student grades were similar across online study conditions. However, differences in student attitudes and online behavior were apparent across study group conditions. Table 1 presents study group means for WebCT hits, articles posted, and articles read. Students in the reciprocal peer questioning group, in general, made more postings and read more articles than students in the mnemonics group. Although instructions to all students specified a minimum of four study strategy postings, students in the reciprocal peer questioning group made significantly more postings than students in the mnemonic devices group. Reciprocal peer questioning is more cooperative and interactive than the simple sharing of mnemonics study strategies. In this regard, more cooperative and interactive study strategies may influence online student behavior by increasing asynchronous communication events.

Students in both study conditions rated their perception of the learning effectiveness of reciprocal peer questioning and mnemonic devices. As presented in Table 2, all students, regardless of study condition, rated mnemonics as effective

Table 1. Online Study Group Differences: WebCT Hits, Articles Posted, and Articles Read

	Online study strategy			
WebCT use	Peer questioning	Mnemonic devices	*t*	*p*
WebCT hits	296.9	252.7	–1.88	.063
Articles posted	22.2	17.7	–2.22	.028
Articles read	87.7	73.5	–2.12	.036

Table 2. Online Study Group Differences: Evaluation of Study Strategies

	Online study strategy			
Questionnaire item	Peer questioning	Mnemonic devices	*t*	*p*
Evaluation of Reciprocal Peer Questioning				
When I am teaching, my students will use reciprocal peer questioning.	4.0	3.4	–3.42	.001
Reciprocal peer questioning increases student learning in school.	3.9	3.4	–3.07	.003
In the future, my students will benefit from reciprocal peer questioning.	4.0	3.7	–2.01	.047
Evaluation of Mnemonic Devices				
When I am teaching, my students will use mnemonic devices.	3.7	4.0	1.50	.136
Mnemonic devices increase student learning in school.	3.8	3.7	–0.78	.673
In the future, my students will benefit from mnemonic devices.	3.8	3.9	0.29	.769

Note: Questionnaire items were rated on a 5-point scale ranging from 1 (not at all) to 5 (absolutely).

and beneficial (i.e., approximately 4 on a 5-point scale). However, there were significant differences in student rating of the effectiveness of reciprocal peer questioning. Students in the reciprocal peer questioning online study group had more favorable evaluations of that strategy than did students in the mnemonics group. College students may have considerable experience with mnemonic study

devices and thus further exposure to the strategy did not influence ratings. Conversely, students may not be as familiar with reciprocal peer questioning and thus exposure to that study strategy influenced ratings. Online experience with certain study devices facilitates the development of attitudes supportive of those devices.

Table 3 presents group differences in student personal evaluation of the virtual study group experience. Regardless of study condition, approximately 40% of students reported a preference for face-to-face study groups. This suggested that online study condition did not influence student overall reaction to the virtual study experience. However, students in the online reciprocal peer questioning group reported more positive interpretation of study group features. Students assigned to the reciprocal peer questioning condition were more likely to report that the study group facilitated their achievement and that group postings were beneficial and of high quality. In this regard, specific study strategy influenced college student subjective interpretation of the value of the virtual study experience and, perhaps, that more interactive study devices (i.e., reciprocal peer questioning) are viewed more positively than strategies not requiring interaction (i.e., mnemonic devices).

Of the 112 students who participated in the study, 12 students continued to make postings without marks incentive. That is, 12 students continued to post in their online study groups in preparation for the final examination, although such

Table 3. Online Study Group Differences: Evaluation of the Virtual Study Experience

	Reciprocal peer questioning		Mnemonic devices	
Questionnaire item	Agree	Disagree	Agree	Disagree
My virtual study groups helped me do well in educational psychology.	41.1%	28.6%	30.4%	39.3%
The members of my online study made good postings.	62.5%	17.9%	44.6%	17.9%
The members of my online study group benefited from my postings.	57.1%	12.5%	41.1%	8.9%
I prefer face-to-face study groups rather than online study groups.	38.2%	30.9%	39.3%	33.9%

Note: Questionnaire items were rated on a 5-point scale ranging from 1 (not at all) to 5 (absolutely). Proportion of students agreeing includes students who rated the item as 4 or 5. Proportion of students disagreeing includes students who rated the item as 1 or 2.

postings were optional and not marked by their instructor. In the reciprocal peer questioning groups, four students continued to post without marks incentive (mean number of postings 1.25, *SD* = 0.50). In the mnemonic devices groups, eight students continued to post without marks incentive (mean number of postings 2.25, *SD* = 1.49). As presented in Table 4, those who continued to post without marks incentive were generally more active in WebCT than students who stopped posting upon removal of the marks incentive. Superficially, we may conclude that college students who are heavy users of instructional technology are also those who engage in online study behavior for its own sake. If this were the case, given random assignment to study conditions, we would expect an equal number of heavy technology users in both study conditions. In fact, this is not the case.

Those students in the reciprocal peer questioning group who posted without marks incentive and those who did not differed only in terms of number of online postings read. It would appear that a few students in the reciprocal peer questioning condition perceived a value in reading study postings and engaged in the

Table 4. Mean Differences in WebCT Use: Students Who Did and Did Not Post Without Marks Incentive

	Without marks incentive			
WebCT use	Posted	Did not post	*t*	*p*
Both Study Group Conditions (12 students posted and 100 students did not post)				
WebCT hits	364.0	264.1	2.66	.009
Articles posted	30.6	18.7	3.77	.000
Articles read	122.4	75.5	2.64	.000
Reciprocal Peer Questioning Condition (4 students posted and 52 students did not post)				
WebCT hits	371.8	291.2	1.12	.266
Articles posted	28.5	21.7	1.13	.263
Articles read	129.5	84.5	2.27	.027
Mnemonic Devices Condition (8 students posted and 48 students did not post)				
WebCT hits	360.1	234.8	3.27	.002
Articles posted	31.6	15.4	5.27	.000
Articles read	118.9	65.9	5.63	.000

behavior extensively. Perhaps such students used the online postings as primary mechanisms of examination preparation. Those students in the mnemonic devices group who posted without marks incentive and those who did not differed in all measures of technology use. In general, the eight students in the mnemonics group who continued to post without marks incentive appeared to be heavy users of instructional technology. Comparison of patterns of significant mean differences in student online behavior (i.e., Table 4) suggests that reciprocal peer questioning as an online study strategy causes students to use instructional technology, while mnemonics has no effect on extent of student technology use.

CONCLUSIONS AND IMPLICATIONS FOR ONLINE INSTRUCTIONAL PRACTICE

There are a range of situations, not the least of which is distance education, in which online study groups are necessary and helpful. However, because the current investigation did not include a control group (i.e., no online study group condition), conclusions regarding the effectiveness of online study groups on student achievement are not possible. The only legitimate comparison is between reciprocal peer questioning and mnemonic devices as online study tools. Significant group differences emerged between these two online study conditions. Given random assignment to study groups, casual inferences are warranted.

Academic achievement is generally conceptualized as the ultimate metric of instructional utility. From such a perspective, the finding that study group strategy was not significantly related to student achievement is interpreted as evidence of equivalency. That is, reciprocal peer questioning and mnemonic devices are equally effective or ineffective online study group strategies. Given such equivalence, instructional implementation of one study strategy over the other is justified and student preference is a reasonable criterion for strategy selection.

While study strategy was not related to student achievement, there were differences between students who used reciprocal peer questioning and those who used mnemonics to master course material. In online study groups, reciprocal peer questioning was more powerful than mnemonic devices in modifying college student attitude and online behavior. Reciprocal peer questioning caused students to engage in increased use of a range of WebCT learning events. Correspondingly, reciprocal peer questioning caused students to development more supportive attitudes toward that study strategy. Reciprocal peer questioning, but not mnemonics, caused students to interpret their virtual study groups more positively. In this regard, the superiority of reciprocal peer questioning over mnemonics may guide online study group implementation.

Pedagogical features (e.g., study strategy selection) influenced student attitudes and online behavior. Across study group conditions, there were no differences in student achievement but there were differences in student satisfaction, attitude, and use of instructional technology. If the objective is to increase students'

repertoire of study strategies, then online study groups are effective. Students who were exposed to reciprocal peer questioning rated it as more beneficial than students who did not experience such exposure. If the objective is to satisfy student socio-emotional functioning, then reciprocal peer questioning is more effective than mnemonic devices. If the objective is to increase student use of online resources, then reciprocal peer questioning is more effective than mnemonic devices. However, the relationship between WebCT use and student achievement is complex; moderately high levels of use are associated with the highest levels of student achievement (Johnson, 2005). In this regard, arbitrary attempts to maximize student use of online instructional resources may not be in the best interest of students.

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