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Enhancing Peer Interaction and Learning in the Classroom Through Reciprocal Questioning

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A guided reciprocal peer-questioning procedure was used by college students for learning expository material presented in classroom lectures. Students worked individually, using investigator-provided generic questions to guide them in generating their own task-specific questions. Following this self-questioning phase, they worked in small cooperative groups, taking turns posing their questions to each other and answering each other's questions. This procedure was designed to promote the kind of verbal interaction that has been found to benefit learning in small groups, namely, giving elaborated explanations. Results indicated that students using this guided reciprocal peer-questioning procedure asked more critical thinking (vs. recall) questions, gave more explanations (vs. low-level elaboration responses), and demonstrated higher achievement than students using a discussion approach (Experiment 1) or those using an unguided reciprocal peer-questioning approach (Experiment 2). Guided reciprocal peer-questioning appears to promote peer interaction and learning in cooperative groups by controlling the quality of questioning, which in turn shapes peer responses.

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Over the past decade there has been a great deal of research on the nature of peer interaction and its effect on student achievement. Some of the ways in which students in small learning groups verbally seek help, respond to requests for help, and otherwise interact with each other have been found to enhance achievement while other patterns of verbal interaction apparently do not (e.g., Hertz-Lazarowitz, 1989; King, 1989a; Palincsar & Brown, 1984; Swing & Peterson, 1982; Webb, 1982, 1984; Webb, Ender & Lewis, 1986; Webb & Kenderski, 1984).

For example, on the basis of extensive research in small group learning, Webb (1989) reported that an individual student's achievement is consistently related to the level of elaboration of help *that student gives to others* in the group. Specifically, Webb found that giving elaborated explanations (such as how to solve a problem) is positively related to the explainer's achievement, while giving non-elaborative help (simply providing the correct answer or giving information without explanation) is not. She also found that *receiving* explanations was *not* consistently related to achievement, and that receiving low-level elaboration or no response had negative effects. Because these relationships between behavior and achievement were determined by partial correlations controlling for ability, Webb (1989) argued that these findings indicate that *verbal behavior influences learning* rather than that such behavior is a function of students' achievement level. This is an important distinction because it suggests that if verbal behavior can be altered through some form of classroom intervention, then, as a result, achievement could be improved.

In a related line of research, King (1989b, and in press) studied the effects of a reciprocal peer-questioning strategy on student achievement. In these studies students were trained in question generation by using *generic* questions such as "What is the main idea of. . .?" and "How does. . . differ from. . .?" to create their own *specific* questions pertaining to material presented in class. Then, working in small groups, they posed their questions to their peers (and answered their peers' questions) as a way of helping each other monitor their comprehension of the material. This procedure established a context of reciprocation and shared responsibility. In that context, asking and answering each other's questions functioned as a form of self- and peer-testing which allowed students to check their understanding and remedy any comprehension problems. High school and college students who used this reciprocal peer-questioning strategy performed better on subsequent achievement tests than did students who simply discussed the material in small groups in an unstructured manner.

These findings are clearly consistent with Webb's. Students using the reciprocal peer-questioning strategy were required to ask each other comprehension questions and were provided with explicit guidance in doing so. Such guided questioning probably elicited more explanations and other highly elaborated responses from peers than was the case in the discussion groups where questioning and responding were left unstructured and were not even required.[1] According to Webb's findings, such explanation-giving by peers would improve their achievement.

From a theoretical perspective, the achievement effects observed in both the King and Webb studies can be accounted for by theories of the social construction of knowledge (e.g., Bearison, 1982; Damon, 1983; Mugny & Doise, 1978; Vygotsky, 1978). According to this view, an individual gains understanding by constructing new knowledge or transforming old knowledge into new, and this process is facilitated through peer interaction during which differing individual perceptions arise and are reconciled. (Differing perceptions can range from simply having more or less information about a topic to holding completely opposing and contradictory viewpoints.) It is the resolution of these "socio-cognitive conflicts" (see Mugny & Doise, 1978) that results in the social construction of knowledge, and the social coordination of conflicting individual perspectives is the process through which new understanding is formed. Thus, these theories emphasize the cognitive advantages of peer interaction; and, in this view, cognitive discrepancies arising in a social context are seen as having *greater* cognitive benefit for an individual than the conflict of ideas that an individual might experience alone.

From this theoretical perspective, the reciprocal peer-questioning strategy could be expected to promote the social construction of knowledge because it provides a context which fosters the emergence and resolution of socio-cognitive conflict. First of all, being required to ask and answer thought-provoking questions in a group setting would compel students to externalize their thoughts, making their ideas explicit and accessible both to themselves and to others in their group. The guided high-level questioning and responding would undoubtedly cause group members to think about the material in new ways because they would be confronted with a variety of differing peer perspectives on the content being studied. Continued questioning and responding could guide group members to resolve these socio-cognitive conflicts by providing them opportunities to fill in gaps in their knowledge structures, correct misunderstandings, discover and resolve discrepancies in information, and reconcile conflicting views (Mugny & Doise, 1978). Research has shown that such social coordination of conflicting cognitions can lead to the restructuring of knowledge (Bearison, 1982; Doise & Mugny, 1979; Glachan & Light, 1982). In particular, providing explanations to one's peers in the group context of the reciprocal peer questioning strategy should enhance understanding for the one doing the explaining because, as Webb (1989) pointed out, in order to explain something so that another can understand it, the explainer often must think about and present the material in new ways such as: relating it to the other's prior knowledge or experience, translating vocabulary into terms familiar to the other, noting relationships among ideas, or generating new examples. In doing so the explainer must clarify concepts, reorganize information, resolve inconsistencies, develop rationales, or in some manner reconceptualize the material (Bargh & Schul, 1980). According to Bearison (1982) as well as Doise and Mugny (1979), as a result of engaging in such socio-cognitive activities the individual learner constructs new meaning and gains deeper understanding.

These notions are consistent with information-processing theories. For example, Mayer (1984) has argued that when individuals engage in the kinds of cognitive activities indicated above (such as noting relationships among ideas and linking new information with old) they are making internal connections among the ideas and making external connections between those ideas and their previous learning. According to Mayer, making internal connections causes learners to organize the material in meaningful ways, while making external connections helps them to integrate the new information into their existing knowledge structures. Both of these processes enhance encoding and retrieval of the new material.

Thus, in summary, the process of elaborating on and explaining material in the social context of the reciprocal peer-questioning strategy could be expected to promote understanding and improve achievement by helping learners to construct and elaborate on their representations of that material. Furthermore, the reciprocal peer-questioning procedure itself should provide a context which guides students to construct knowledge representations which are appropriate, accurate, and well-elaborated.

The present investigation was an attempt to modify the reciprocal peer-questioning strategy in such a way as to induce students to give explanations and other high-level elaboration responses and to determine whether they actually do so. It was expected that if students could be trained to ask each other appropriate task-related questions, those questions might elicit effective explanations and other highly elaborated replies (the peer responses that, according to Webb's model, mediate achievement gains) and discourage low-level elaboration and no response (the peer responses found to be detrimental to learning). What better way is there to prompt elaborations and explanations than to ask the kinds of questions that require such responses?

Therefore, for the present investigation, the reciprocal peer-questioning strategy was modified to include only higher-order questions based on the application, analysis, and evaluation levels of Bloom's taxonomy of thinking (1956). Those questions were designed specifically to prompt group members to reconceptualize the material in the ways indicated above, that is, explaining an idea or relationship, applying a concept in a new situation, relating new material to known material, providing justifications, drawing conclusions, and the like.

Furthermore, for the present study, in order to increase the likelihood that group members would respond to the questions, the reciprocal peer-questioning strategy was structured so that students would be assigned interchangeable roles of questioner and explainer and required to take turns asking questions and answering each other's questions fully. Thus, the present investigation differed from previous studies using reciprocal peer-questioning in that the strategy was modified to include a different set of generic question prompts and a structured questioner-explainer role-taking format. Because the format of this questioning-answering strategy required students to ask only high-level questions and give high-level elaborations in response (the kind of verbal interaction that Webb found beneficial to learning), use of the strategy was expected to elicit these verbal behaviors and therefore promote achievement.

Experiment 1

The purposes of this study were to assess the effects of the guided reciprocal peer-questioning procedure on the quality of verbal interaction and to compare the interaction and task achievement of students using guided reciprocal peer-questioning with that of students working in discussion groups. The verbal interaction of the guided questioning groups was expected to differ from that of the discussion groups because the high-level questions were expected to control peer interaction. Specifically, students in the guided questioning condition were expected to give more explanations and other high-level elaborations, give fewer low-level elaboration responses, and receive more high-level elaboration responses to their questions than were discussion students. Because of the mediating effect of these verbal interactions, questioners' post-treatment achievement was expected to be superior to that of the discussion students.

Method

Sample and design. Twenty-six graduate and upper level undergraduate students in two sections of the same education methods course at a small university in southern California participiated in the study. The ratio of graduates to undergraduates was three to one. The mean age and grade point average of the students were 25.0 and 3.12, respectively, for one class and 25.5 and 3.16 for the other. The two classes were not statistically different on these two variables, nor did they appear to differ with regard to student ethnicity, gender, or academic background. Students in both classes were experienced with working in small cooperative groups on in-class learning tasks.

One class was randomly assigned to the questioning treatment ($n = 13$) and the other to the discussion condition ($n = 13$).[2] Within each class, students were randomly assigned to small learning groups. This procedure resulted in three groups of three and two groups of two in each class.

Procedure. Students in the reciprocal peer-questioning condition were trained to generate questions using the generic questions and then they practiced the reciprocal peer-questioning and responding strategy. Following this training, students used their strategy in conjunction with a classroom lecture and were immediately tested for comprehension of the lecture content. The discussion students heard the same lecture, discussed it, and took the same test under the same conditions. All verbal interaction was tape recorded.

Training materials. The guided reciprocal peer-questioning students used a set of generic questions designed to elicit explanatory replies. These questions were in the form of question stems (adapted from Ryan, 1971) and are displayed in Table 1.

The goal of fostering explanations per se was central to the present investigation; however, Webb (1989) also pointed out the importance of encouraging students to produce *effective* explanations. It was assumed that the variety of the questions would influence the effectiveness of the elaborated response. For example, a question such as "How would you use. . . to. . . ?" requires application of information in a specific context, whereas "What is a new example of. . . ?" stimulates generation of novel examples. "Explain why. . ." calls for analysis of processes and concepts and involves translating terms into different vocabulary. "How does. . . affect. . . ?" prompts responders to examine relationships among ideas. "Do you agree or disagree with this statement:. . . ? Support your answer." asks for evaluation based upon criteria and evidence. These questions were expected to promote peer responses which were both highly elaborated and effective.

The set of questions included those which required responders to make internal connections among ideas presented and ones which prompted external connections to prior knowledge (Mayer, 1984). For example, questions such as "What is the difference between. . . and. . . ?" and "What con-

Table 1
Generic Questions Used in Experiments 1 & 2

How would you use. . . to. . . ?
What is a new example of. . . ?
Explain why. . . .
What do you think would happen if. . . ?
What is the difference between. . . and. . . ?
How are. . . and. . . similar?
What is a possible solution to the problem of. . . ?
What conclusions can you draw about. . . ?
How does. . . affect. . . ?
In your opinion, which is best,. . . or. . . ? Why?
What are the strengths and weaknesses of. . . ?
Do you agree or disagree with this statement:. . . ? Support your answer.
How is. . . related to. . . that we studied earlier?

clusions can you draw about. . . ?" require the responder to integrate several concepts and draw conclusions based on the content presented (make internal connections). In contrast, a question such as "How is. . . related to. . . that we studied earlier?" activates prior knowledge and helps the learner to integrate the new information into existing knowledge structures (make external connections).

Thus, it was expected that these generic question stems would, by controlling peer responses, foster the kinds of peer interaction beneficial to learning.

Strategy training. Prior to the beginning of this study, the topic of classroom questioning had been introduced to both classes as a required component of the education course these students were taking. Therefore, all participants in the study had learned to differentiate between recall questions (ones which simply require the learner to recall information presented or material previously memorized) and critical thinking questions (ones which require the learner to recall the facts and ideas but also to engage in application, analysis, interpretation, or evaluation of those ideas). Students in the discussion group received no further information or training in questioning.

Following this introduction, students in the guided reciprocal peer-questioning condition were provided with direct instruction in generating questions using the set of question stems in conjunction with class material. The students wrote questions, shared them with their classmates, and received feedback. They continued generating questions with peer modeling, teacher guidance, and feedback until they had reached proficiency (approximately 30 minutes).

Next, the reciprocal nature of the peer-questioning and responding strategy was demonstrated to those students, and they worked in pairs or triads to practice applying the strategy in conjunction with a classroom presentation of approximately one hour in length. Specifically, in this procedure students first listened to the class lecture and then, using the question stems provided, each student independently generated two or three questions pertinent to the presented material. The reciprocal roles of questioner and explainer were described, and students practiced taking turns asking and answering each other's questions. When one member posed a question to the other members of the group, they assumed the role of explainers and provided answers. Then a different member of the group took a turn in the role of questioner, and the others in the group became explainers. During training and practice sessions, the list of question stems was displayed by overhead projector so that students could refer to it.

In place of the training and practice received by the questioning group, students in the discussion condition simply listened to the same lecture and then discussed the material presented without receiving any guidance in discussion techniques.

Task. A 90-minute scripted lecture on the topic of "Methods of Evaluating Student Learning" was presented to both the guided questioning and discussion classes. This introductory presentation on evaluation covered several types and uses of classroom assessment devices and reporting to parents.

During this lecture, students were not allowed to take notes, ask questions, or interrupt the presentation. These precautions were taken in an attempt to control initial processing and encoding effects across conditions as well as to avoid confounding note-taking with treatment. In particular, freedom from note-taking would presumably reduce the information-processing burden involved in attending to the lecture while simultaneously taking notes (Kiewra & Benton, 1988) and at the same time control for both the encoding effects due to the act of note-taking per se (e.g., Kiewra, 1990) and the encoding/storage effects of note-taking methods. Since some methods of note-taking, such as matrix and linear, have been found to be more effective than others because they promote making connections among topics and across topics (Kiewra, 1990), note-taking methods could be confounded with the type of review strategy used.

Following the lecture, students in both the questioning and discussion conditions were instructed to work cooperatively in their assigned small groups for 10 minutes to help each other learn the material presented in the lecture. In the questioning condition, students were reminded to use their reciprocal questioning strategy, but the question stems were not displayed. In contrast, students in the control condition were simply asked to discuss the material as a way of helping them to learn and remember it. The students were not told that they would be tested on the lecture content immediately afterward. This approach was used to foster incidental (vs. intentional) learning. Presumably when students are not concerned about being tested on the material, they are more likely to use the strategy they have been trained in rather than other strategies that they would normally use and that they might believe would be more effective (Pressley, Symons, McDaniel, Snyder, & Turnure, 1988).

Tests. A comprehension posttest was administered immediately after the post-lecture review session. The test contained 10 multiple-choice items and five open-ended items which assessed understanding and application of types and uses of techniques and instruments for evaluating student learning.

Prior to the beginning of the study, a pretest had been administered to both classes to assess students' lecture comprehension skills. That test followed a 60-minute scripted lecture on the topic of instructional planning which covered the purposes, forms, and uses of long-term instructional plans. The pretest contained 10 multiple-choice items and five open-ended items which assessed understanding and application of the material presented. This test was not a pretest of students' prior knowledge of course content, but rather it assessed their ability to comprehend material presented in lecture format.

Thus, both the pretest and posttest contained a combination of multiple choice and open-ended questions. On each test, two items required only recall of material presented while all others required integration of several pieces of information, elaboration of ideas, analysis of information, or application of that information in a new context. For both tests, the difficulty level of test items was set high in order to avoid the possibility of a ceiling effect.

Using the lecture as an indicator of content covered, two independent raters, blind to student identity and experimental condition, scored the open-ended questions. The inter-rater reliabilities were .92 and .94 for pretests and posttests, respectively. In all cases of discrepant scores, an average was taken.

Coding of group interaction. The post-lecture review session was audiotaped, and peer interactions within the cooperative learning groups in the questioning and discussion conditions were coded using a variation of Webb's categories (1989). To ensure that verbal utterances were attributed to the appropriate individuals, after completion of the study students listened to their tapes while following along on the transcripts and identified the speakers for all sequences.

The dual focus was on both the *giving* and *receiving* of explanations and information. That is, the aspects of verbal interaction that were of primary interest in this study were the effects of giving explanations (vs. low-level elaboration) and the effects of getting one's questions well-answered. Therefore, the verbal interaction was coded into four categories. The first two categories were instances of giving explanations and low-level elaboration. These categories included both solicited and unsolicited responses. Solicited responses were those explanations and low-level elaborations given in direct reply to a question asked. However, responses were often unsolicited, that is, they were provided as a way of clarifying a misunderstanding or adding information to the discussion. Therefore, the category "total explanations given" included all high-level elaboration provided, such as giving a detailed description of how to do something, clarifying a concept, providing rationales, generating examples, or relating new material to prior knowledge. Likewise, "total low-level elaboration given" consisted of all instances (solicited and unsolicited) of giving a pat answer or providing information without any explanation, rationale, or example.

The other two verbal interaction categories were instances of receiving solicited responses. These categories included only those explanations and low-level elaborations which were received directly in response to questions asked. "Asks a question and receives an explanation" occurred when a student received an explanation in response to a question asked; however, when students answered their own questions, the interaction was not coded as receiving an explanation. Rather, it was coded only as giving an explanation. "Asks a question and receives a low-level elaboration response" included receiving superficial information or pat answers in response to a request. When a question was ignored, such instances were coded as "asks a question and receives no response"; however, there was so little data for this category that this variable was dropped from analysis. Procedural questions such as "Can you please read your second question, Kelly?" were not coded.

An unsolicited comment was coded as the speaker *giving* an explanation (or low-level elaboration response) but was not coded as the questioner *receiving* an explanation (or low-level elaboration response) because it was not in response to a question asked. Further, when more than one response was given to the same question, all solicited responses (ones which were directed to the question) were coded as explanations (or low-level elaboration) given by the responder and as asking a question and receiving an explanation (or low-level elaboration response) for the questioner. However, an unsolicited response (one not directly related to the preceding question) was coded only as giving an explanation (or low-level elaboration response) for the responder. These verbal interaction categories are shown in Table 2.[3]

Sample verbal interactions from one questioning group and one discussion group can be found in the Appendix. These excerpts constitute the beginning few minutes of the interaction and show qualitative differences between the groups, particularly with regard to the level of elaboration in responses and to the focus of discussion.

In addition, questions were coded as to type. Specifically, a question was coded as "recall" if it simply required recall of information, ideas, procedures, explanations, or examples covered in the lecture. A question was coded as "critical thinking" if it asked the responder to go beyond recall to integration, comparison/contrast, application to a new situation, generation of a new example, generalization, analysis, or evaluation. An additional measure of the total number of questions asked was also computed.

Frequency of the two question types and four kinds of verbal interaction occurring during the complete 10-minute time frame was recorded for all students individually. The interaction was coded by two judges independently. Inter-judge reliabilities for the seven variables ranged from .90 to .99, and the judges met later to resolve discrepancies.

Results and Discussion

Achievement. No significant differences were found between the questioning and discussion groups on the pretest (means = 69.3 & 68.5, respectively). Analysis of covariance was used to determine effects of treatment at posttest, adjusted for pretest performance. Table 2 shows posttest and adjusted means for this analysis. Significant group differences were found for achievement, with the reciprocal peer-questioning strategy group outper-

Table 2
Means, Standard Deviations, and F-tests for Verbal Interaction, Question Type, and Achievement in Experiment 1

	Strategy							
	Guided reciprocal peer-questioning (N = 13)			Discussion (N = 13)				
	Mean[a]	S.D.		Mean[a]	S.D.		F	p
Verbal interaction								
Providing solicited and unsolicited explanations and low-level elaboration								
Total explanations given	5.07	2.06		2.54	2.22		9.12	.01
Total low-level elaboration given	3.23	2.55		7.77	7.01		4.81	.04
Receiving solicited responses								
Asks a question and receives an explanation	2.00	1.35		.31	.63		16.69	.001
Asks a question and receives a low-level elaboration response	1.00	1.55		.39	.65		2.80	.11
Question Type								
Recall	.31	.48		.39	.65		.12	.73
Critical thinking	1.92	1.32		.08	.28		24.34	.0001
Total questions	2.23	1.53		.46	.66		14.56	.0008
	Mean	S.D.	Adj. Mean	Mean	S.D.	Adj. Mean		
Achievement								
Comprehension posttest	77.80	(11.74)	77.39	70.90	(10.32)	71.30	12.81	.002

[a]Average per student during the 10-minute interaction session

forming the discussion group on lecture comprehension.

Verbal interaction. Separate one-way analyses of variance were used to analyze data for the verbal interaction variables. Means and standard deviations for these data along with results of F-tests are shown in Table 2. Significant differences were found between the reciprocal peer-questioning and discussion groups on three out of four variables. As Table 2 indicates, the peer-questioning students gave significantly more explanations and significantly fewer low-level elaboration responses than the discussion students. Peer-questioning students also received significantly more explanations in response to requests than did the discussion students.

Questions. Analyses of variance on question types showed that the reciprocal peer-questioners asked significantly more critical thinking questions than did the discussion students (see Table 2). This finding is not surprising since these were the types of questions the strategy trained for; however, this is an indication that the question stems were internalized by the students and that the strategy was applied. It is interesting to note that in the untrained discussion condition very few questions of any sort were asked, resulting in a significant difference between the two groups on total questions asked.

In this study, the reciprocal questioning strategy appears to have facilitated the giving of high-level elaboration responses and limited the giving of low-level elaboration responses. Furthermore, since previous research suggested that these verbal interaction patterns mediated achievement (Webb, 1989), it was not surprising to find that students in the reciprocal peer-questioning condition did better than the discussion students on the comprehension posttest.

One point that is unclear in this study is the relative role of the questioning per se versus the specific question stems. Presumably the question stems gave students the guidance they needed to generate the sort of questions which tend to elicit high-level elaborative explanations on the part of responders. On the other hand, since the questioning students asked a much greater number of questions than did the discussion students, an alternative explanation could be that *just the process of asking questions in and of itself* accounted for the differences in verbal interaction and learning for the two groups. Perhaps the stems are not really a necessary component of this questioning procedure, particularly for students (such as those who participated in this study) who have some prior experience with question writing. Simply telling students to ask each other questions and answer each other fully may have resulted in the same peer interaction and achievement outcomes.

Experiment 2

To help clarify the role of the structured question stems in this procedure, a second study compared guided vs. unguided reciprocal peer-questioning.

It was hypothesized that use of the explicit question stems would control both the level and the effectiveness of the elaborations students made during learning. That is, it was presumed that the question stems guide the students to generate critical thinking questions which elicit elaborated explanations; to provide these elaborations, students must think extensively about the material, organize it, and integrate it into their existing knowledge structures, and this in turn promotes comprehension (see King, 1989b and in press). Specifically it was thought that the stems play a focusing role in this questioning strategy by eliciting from students elaborations appropriate to the lecture material.

Some support for this line of thinking can be found in Pressley's work (e.g., Pressley, et al., 1988; Woloshyn & Pressley, 1989) on elaborative interrogation. In the Pressley et al. (1988) studies, adults worked independently to learn factual material presented in text format. When these learners answered "why" questions (such as "Why do women have more surgeries than men?") for to-be-learned facts (such as "Females have more surgeries than males."), they learned the facts better. Pressley et al. argued that one reason why fact learning was enhanced is that the "why" question focused the learner's attention on the fact *exactly as presented,* asking for an explanation or justification for the fact (vs. challenging its accuracy). Such a focus stimulated production of a *precise* elaboration of that fact, which in turn facilitated recall. Pressley et al. also suggested that the "why" questions promote fact learning because, in generating their justification/explanation, students need to relate the to-be-learned fact to prior knowledge. Although the elaborative interrogation paradigm differs substantially from reciprocal peer-questioning, it seemed reasonable to expect that in the present study the reciprocal peer-questioning strategy might operate in a similar manner. That is, the question stems could guide students to generate and pose questions which focus on the content of the lecture, and these questions would induce peers to respond with elaborations specific to that content.

On the other hand, the spontaneous *un*guided generation of questions (a no-stems unstructured approach) in which the learner is free to decide exactly what questions to ask, may be more intrinsically motivating and may therefore produce elaborations which are more relevant to the learner's comprehension needs (and consequently result in better comprehension). The freedom of choice in such learner-controlled contexts has been found to increase students' intrinsic motivation to learn because it enhances their sense of self-determination or agency (see Thomas, 1980, for a review of this topic).

Method

Sample. Thirty-nine college students enrolled in two sections of another education methods course participated in this second study. The mean age and grade point average of the students in one class were 26.0 and 3.14, respectively, and 25.5 and 3.05 in the other class. In one class there were 17 females and four males versus 15 females and three males in the other. Participants were graduate and upper-level undergraduates, and the approximate ratio of graduate students to undergraduates was three to one in both classes.

Procedure. This experiment was conducted in a manner similar to Experiment 1. One of the two classes was randomly assigned to the guided reciprocal peer-questioning treatment ($n = 21$) and the other to the unguided reciprocal peer-questioning ($n = 18$). Students within each treatment condition were randomly assigned to learning triads.

Students in both conditions received the same introduction to questioning described in Experiment 1. In addition, students in the guided reciprocal peer-questioning condition were trained to generate questions using the set of question stems from Experiment 1. Those in the unguided reciprocal peer-questioning condition followed exactly the same training procedures as the guided questioners, including peer modeling of questions, guided practice in generating questions, and feedback on questions generated; however, they were not provided with the set of stems to guide them in question-generation.

Students in both conditions practiced their respective reciprocal questioning strategies in their small groups in conjunction with classroom lectures. As in Experiment 1, the guided peer-questioners were told to take turns in the roles of questioner and explainer. The unguided peer-questioners were instructed to take turns asking each other questions and answering each others' questions fully.

Finally, a 60-minute scripted lecture on classroom climate was presented in both of the reciprocal peer-questioning conditions. This presentation covered physical and psychological characteristics of positive classroom climate and ways in which to establish such a climate.

Following this lecture, students in both conditions worked in their assigned learning triads to help each other learn the material presented. All students were reminded to use their reciprocal questioning strategies; however, as in Experiment 1, the question stems prompt was removed. Students were not told they would be tested on the material. The post-lecture questioning-answering session lasted for seven minutes and was followed immediately by the comprehension test.

Tests. A pretest and posttest for lecture comprehension (similar to those used in Experiment 1) were administered to students in both experimental conditions. Again, two independent judges scored the answers to the open-ended questions, and inter-rater reliabilities were .91 and .90 for the pretest and posttest respectively.

Coding of interaction. Four triads in each condition were randomly selected for observation of peer interaction during the post-lecture questioning and responding session. Peer interaction within triads was audiotaped and coded using the same procedures and the same four verbal interaction categories as in Experiment 1.

As in Experiment 1, questions were coded according to type: recall or critical thinking. These same questions were also coded as either internal (if they referred only to material provided within the lecture) or external (if they went beyond the lecture content by relating it to prior knowledge or application to external contexts).

Again, all interaction was coded by two judges independently, with inter-judge reliabilities ranging from .92 to .99, and the judges met later to resolve discrepancies.

Results and Discussion

Results of this study were generally consistent with those of Experiment 1.

Achievement. No significant differences were found between the guided questioning and unguided questioning groups on the lecture comprehension pretest (means = 57.23 & 63.00, respectively; $p = .27$). Analysis of covariance was conducted on the posttest scores, adjusted for pretest performance. Table 3 shows posttest means and F-test results for this analysis. Results indicated that guided questioners outperformed unguided questioners on comprehension of the lecture material.

Verbal interaction. Means, standard deviations, and results of F-tests for verbal interaction and question types are also displayed in Table 3. Analyses of variance on the verbal interaction data revealed that the behavior of the guided questioners was strikingly different from that of the unguided questioners. As Table 3 indicates, students in the guided questioning condition gave significantly more explanations and received significantly more explanations in response to their questions than did those in the unguided group. Guided questioners also gave *fewer* low-level elaboration responses than did unguided questioners; however, this difference did not reach statistical significance.

Students in the unguided questioning condition asked about as many total questions and received about as many responses as did the guided questioners. These findings can be attributed partially to the asking and answering sequence inherent in the reciprocal peer-questioning strategy which requires students to ask questions and also requires some sort of response. Casual observation of the responses made by students in the unguided condition indicated that not all of their explanations were directed toward the questions asked, but rather were unsolicited summaries of parts of the lecture or mini-presentations of somewhat related information, usually from personal experience.

These findings lend support to the importance of the stems in the reciprocal peer-questioning strategy. However, to determine *why* the stems are important, the actual questions asked by the two groups were examined.

Table 3
Means, Standard Deviations, and F-tests for Verbal Interaction, Question Type, and Achievement in Experiment 2

	Strategy							
	Guided reciprocal peer-questioning (N = 12)			Unguided reciprocal peer-questioning (N = 12)				
	Mean[a]	S.D.		Mean[a]	S.D.		F	p
Verbal interaction								
Providing solicited and unsolicited explanations and low-level elaboration								
Total explanations given	3.00	1.90		1.58	1.00		5.20	.03
Total low-level elaboration given	2.67	2.93		5.00	3.04		3.65	.069
Receiving solicited responses								
Asks a question and receives an explanation	1.91	.79		1.00	1.12		5.30	.03
Asks a question and receives a low-level elaboration response	1.08	.99		1.75	1.60		1.49	.23
Question Type								
Recall	.25	.45		1.00	1.04		5.21	.03
Critical thinking	1.75	1.13		.58	.67		9.37	.006
Internal	1.17	1.03		1.42	.99		.36	.55
External	.85	1.19		.16	.39		3.39	.079
Total questions	2.00	1.41		1.58	.90		.74	.39
	(N = 21) Mean	S.D.	Adj. Mean	(N = 18) Mean	S.D.	Adj. Mean		
Achievement								
Comprehension posttest	66.57	(10.55)	68.63	63.94	(14.51)	61.54	48.47	.0001

[a]Average per student during the 7-minute interaction session

Questions. As Table 3 indicates, the quality of the questions generated by the two reciprocal peer-questioning strategy groups differed significantly. Analyses of variance on the question types revealed that, although there was no difference between strategy conditions in the total number of questions asked, students guided by the structured stems asked significantly more critical thinking questions and fewer recall questions than the unguided questioners did. The guided questioners also asked more external questions than did the unguided questioners, but this difference did not reach statistical significance. Asking such external questions may have activated responders' prior knowledge and prompted them to give explanations which helped them to integrate the new material into their existing knowledge structures (Mayer, 1984). In contrast, the unguided questioners tended to ask questions which focused on what was presented in the lecture and which resulted in responses which were summaries of main ideas and descriptions of relationships among concepts presented; that is, they emphasized making internal connections within the lecture content. Apparently without the guidance of the stems, students tend to ask more recall type questions. Clearly the type of questions most often generated by using the stems are critical thinking questions and apparently such questions are the type that elicit high-level elaboration responses in these peer learning contexts.

General Discussion

These studies indicate that the guided reciprocal questioning strategy is a way to elicit the kind of peer interaction Webb (1989) found effective in small-group learning, i.e., the giving of high-level elaboration responses, and to discourage peer interaction found to be detrimental to learning, i.e., low-level elaboration. These patterns of interaction were significantly more prevalent in the guided reciprocal peer-questioning condition than in either the discussion or unguided questioning conditions; furthermore, the achievement of the guided questioners was superior to that of the students in the other two groups. It must be noted that one limitation of this study is the shortness of the treatment; it is not known whether longer use of the strategy would enhance or deteriorate its effects on achievement and verbal interaction. On the other hand, results of a previous study with this strategy (King, 1989b) indicated that comprehension effects showed up after only one practice session with the strategy and remained stable over the span of five sessions. This earlier finding suggests that one practice session may be adequate for enhancing achievement, and that achievement can be sustained, at least for these adult students; however, that study did not examine verbal interaction, and it is not known what the effects of this strategy on peer interaction would be over time.

In the guided reciprocal peer-questioning strategy, the question stems seem to provide the guidance that students apparently need to generate effective questions in a consistent manner (such questions appear to be critical thinking ones and perhaps, to a lesser extent, those which are externally-oriented). Moreover, those questions appear to control both the *level* of elaborated responses and the *effectiveness* of those elaborations; that is, they elicit the giving of *explanations*, the one kind of response that Webb (1989) consistently found to be related to achievement.

Furthermore, the built-in reciprocal characteristic of this strategy may also contribute to improving peer interaction. When group members assume alternating roles of questioner and explainer, the shared responsibility inherent in this procedure undoubtedly makes the responder accountable for giving some sort of explanation in response to a question (and virtually eliminates the option of not responding).

Thus, use of the question stems in conjunction with the reciprocal peer-questioning procedure may structure the group discussion so as to create a learning context which encourages elaborated responses (and thereby discourages low-level elaboration responses), controls the effectiveness of peer responses, and greatly reduces the possibility of no response. This is exactly the sort of context Webb (1989) suggests is most effective for enhancing learning in small cooperative groups.

But *why* do students learn better using this guided questioning approach? It should be noted that it is not the reciprocal peer-questioning and responding procedure per se that accounts for the effects obtained in this study. This procedure *does* foster the externalization of students' cognitions, encourage socio-cognitive conflict and the social coordination of conflicting individual perspectives, and provide all the other cognitive benefits of a social context for learning discussed earlier; however, it was the question stems which actually elicited the high level of questioning and responding (and consequently the high level of thinking) observed in these groups. In fact, the stems can be used successfully by students working *alone* without the benefits of peer interaction. In studies of high school and college students' comprehension-monitoring, a similar set of stems facilitated learning both for students who worked independently and for those studying in small groups (King, 1989b and in press).

The Role of the Stems

From the present study it is clear that the question stems play an important role in facilitating students' learning. First of all, the stems stimulate extensive thinking about the material to be learned. Asking questions which require organizing the information and integrating it with prior knowledge or experience may promote peer explanations which also do just that, causing the explainer to process the material more thoroughly (see Mayer, 1984). Such processing would tend to improve encoding and subsequent retrieval on an achievement test. Thus, the question stems not only affect the quality of questions asked but also improve the quality of responses given, and, in so doing, influence the cognitive processing of the explainer.

In terms of cognitive processing in general, there could be a number of ways in which the stems help students to construct effective representations of a lecture for storage in long term memory. Perhaps using a *variety* of questions forces students to think about the material in different ways and thus forges more paths between students' current knowledge and prior knowledge (as well as further elaborating their knowledge structures). In studies exploring the conceptual structures of learners who listened to or read prose passages, Graesser and Goodman (1985) reported that individuals probed with "why" and "how" questions constructed a large number of different inferences for each explicit statement in a passage. In a similar manner, the variety of question stems used in the reciprocal peer-questioning procedure may provide students the opportunity to probe themselves (and their peers) to tap into the rich *potential* of inferences inherent in the explicit information presented in a lecture. The resulting inferences would certainly elaborate students' existing knowledge structures and would probably create several alternate links to prior knowledge. Such questioning and responding might also make the links between a student's existing knowledge structures more *meaningful,* thus building and strengthening the complex sort of "cognitive network" described by Black (1985) as important for memory and retrieval.

Questions generated by the stems would also force students to think about the material in *specific* ways, depending on the form of the stem. For example, comparison/contrast questions undoubtedly elicit a specific sort of thinking quite different from, for example, evaluation questions (cf. comparison networks vs. argument response networks, Mayer, 1981). This issue could be explored in research comparing the use of different combinations of stems.

The stems may also assist students to focus their questions on specific aspects of the material to be learned and, as a result, help them to give and receive elaborations more specific to that material. Pressley's "why" questions (e.g., Pressley, et al., 1988) appear to have played a similar role in inducing students to provide precise elaborated explanations/justifications for to-be-learned facts.

Some kinds of stems may be more effective than others for certain learning objectives and with particular grade levels. For example, comprehension stems may be more effective than critical thinking stems with students in the primary grades. Also, different stems may have different effects on immediate vs. long-term retention of material studied; for example, integrative question stems which lead the learner to combine ideas across content may promote the development of more extensive cognitive networks containing more cues for recall, thus making the information more accessible over time. Research is currently underway with fifth graders comparing their use of recall (literal comprehension) question stems, critical thinking stems, and a mixture of these two kinds of stems.

Classroom Applications

Results of these studies support the feasibility of implementing this guided reciprocal peer-questioning and responding strategy in real-world classroom settings. Specifically, in these studies use of the strategies after the lectures was accepted as a normal part of the course, according to informal student feedback.

In addition to facilitating peer interaction and learning in a lecture setting, the guided reciprocal peer-questioning strategy could also be used with teacher-led expository lessons in elementary classrooms. Because of the generic nature of the question stems, it is likely that the same set of stems could be applied to any topic in any content area (such as social studies, math, science, literature) to promote thinking and discussion about that topic.

The strategy could be used *prior to* instruction as well as after. For example, students could generate prediction questions at the beginning of an instructional unit or pose questions they would like to see answered during their study of a particular topic. Alternatively, pre-lesson questions such as "What do I already know about. . .?" could be used to activate prior knowledge about the topic. In any classroom application, reciprocal peer-questioning could be particularly beneficial for students who are reluctant to ask the teacher "stupid" questions but are less hesitant about posing such questions to their peers in a small group setting.

This reciprocal questioning strategy could also be adapted to a variety of other collaborative learning situations. For example, classroom cooperative work groups could use reciprocal peer-questioning and responding to help them complete daily class assignments; problem-solving groups could use the strategy to guide their problem-solving process (see King, 1990); and study groups could engage in reciprocal questioning using these stems to test each other on expository material in preparation for exams. The effectiveness of these and other applications of this strategy has not yet been explored.

Although the reciprocal peer-questioning strategy appears to facilitate peer interaction and learning for adult university students learning expository material presented in lecture format, these findings are not necessarily generalizable to other learning contexts. The kind of elaborations elicited by the stems and the kinds of questions on the tests used in this study are characterized by high-level thinking, and represent the type of learning commonly emphasized at the college level. However, focusing solely on this type of learning may be less appropriate for other age-grade levels where there is also concern for the importance of fact and concept learning. Additional research is currently underway to determine the effectiveness of this strategy with normally-achieving and learning-disabled students in elementary and high school classrooms.

APPENDIX
Sample Verbal Interaction

Sample verbal interaction from one questioning and one discussion group, each consisting of the beginning few minutes of the interaction and the same number of interactions. Type of interaction is indicated and, when the rationale for coding an interaction in a particular way is not obvious, that rationale is included in parentheses.

Interaction	Type
Questioning Group	
Mandy: What are the strengths and weaknesses of report cards?	*asks high-level question*
Janet: I think the weakness is that it labels the children and once you get that first "A" you think you're great and then if you get a "C" or a "D" then you don't think that highly of yourself after that—especially if your parents say "A"s and "B"s are all that are accepted in your house.	*gives explanation*
Mandy: I think the only strength is relative to the way our system is set up. You need a report card to get into college or whatever. When you set up that kind of system you need to have report cards. So that's why report cards are good; but I personally think they are harmful. But how are you going to do these things if you don't have the grades to show? But, when I went to that open classroom, I was thinking, "We should change the system".	*gives explanation* *(relates to prior experience)*
Janet: Also, if you don't have report cards, the kids won't label *themselves*; you know, "This is a bad group, this is a low group, this is the high group." I think it would be a better atmosphere in the classroom. You don't have to get to a place where you will fail things. It is such a threat and kids will get to the point where they say "I don't care if I do it or not, so fail me. I can't do any better, you know, it won't make any difference."	*gives explanation*
Marla: Yes. Immediately you are setting up either success or failure with a report card. And nobody wants a "C"—that's not a success or a failure, but nobody wants one. So, I mean, what is a "C" anyway?	*gives explanation* *(asks high-level question)*
Janet: And another thing, it's a "C" average. Well, it was never accepted in my family as an average. It was always...	*gives explanation*
Mandy: ...the things that *measure* you! I read an article about how people have three different types of skills that they learn: creative, practical, and analytical. Well, basically report cards reflect only the analytical measures. I mean, some kids, even though they may be bright and able to learn things, they aren't being tested fairly. So their	*gives explanation* *(relates to prior knowledge)*

Interaction	Type
grades aren't really fair. They don't really assess the other skills.	
Janet: I always got good grades, but that was more the luck of the draw than anything else.	*gives low-elab. response*
Marla: Right. And I think back now that we are learning all these things that I got good grades because I learned to succeed at the system, not that I learned the lesson.	*gives explanation (relates to prior experience)*
Janet: That's why grades are so biased by the teacher too. If you like a little kid, you'll go easier. It's just human nature to do that. And if some little kid is being really bad in your class, you're always going to give him the lower grade. It's real biased. It's not objective.	*gives explanation*
Discussion Group	
Katherine: Well, we learned about testing. You know, one thing that I noticed really made sense to me. I've always had trouble with that criterion-referenced and norm-referenced stuff. This is really the first time it made sense.	*gives low-elab. response*
Gretchen: Yeah. It was very useful. I think when I'm out there in the classroom teaching I am really going to try desperately not to depend so much on those paper and pencil tests. I really think teachers put too much emphasis on that.	*gives low-elab. response (statement without explanation)*
Jan: I like the picture test that she showed us. That's super!	*gives low-elab. response*
Gretchen: Yeah. That first one with the snowman. My son is in kindergarten and in kindergarten and first grade they do a lot of that. It's for preparing them for reading comprehension and sequencing.	*gives explanation*
Katherine: That's right. And it looked like it would be simple to set up.	*gives low-elab. response*
Gretchen: Yeah.	*gives low-elab. response*
Katherine: You could make it as long or as short as you want to.	*gives low-elab. response*
Gretchen: And they also probably consider graphs and charts to be pictures.	*gives low-elab. response*
Jan: Yeah, because she showed us the maps.	*gives low-elab. response*
Gretchen: Yeah, she had the map there, so that would apply to it too.	*gives low-elab. response*
And the teacher conferences. I should have brought this up because my daughter is in the fourth grade and the teacher, before Christmas vacation, said he was going to call every parent for a phone conference, and send home a note to this effect and he never followed through. Never followed through at all!	*gives low-elab. response (relates to prior experience, but doesn't explain)*

Notes

[1]Because verbal interaction was not the focus of these early studies, data was not collected to support this speculation.

[2]Although the use of intact classes is a limitation to this study because of the potential confounding of class with treatment, the alternative of assigning half of each class to each treatment was considered a more serious threat because of the likelihood that students within a class would observe or discuss their differing treatments with each other.

[3]Obviously there is some overlap between the giving and receiving of explanations (and low-level elaboration), in that *solicited* explanations (or low-level elaboration responses) are both given and received; however, receiving solicited explanations and low-level elaboration responses were considered important variables in the present study because asking questions and getting one's questions well-answered might be beneficial to learning in this context.

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