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Designing Collaborative Learning Contexts

As THIS ISSUE ATTESTS, the social aspects of learning command considerable attention in contemporary discussions of schooling. Consistent with the emergence of social constructivist learning theories, concomitant with educational reform efforts that aspire to shape classrooms as learning communities (Brown & Campione, 1994), and spurred on by the design of new technologies that lend themselves to collaborations within and across contexts (Salomon, 1994; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989), there has been a growing interest in the role that interactions with others play in academic engagement and learning. Despite this enthusiasm, orchestrating productive peer learning remains a complex undertaking. In this article, we summarize lessons learned across two programs of research, each of which featured peer collaboration for the purpose of promoting advanced literacies, including text comprehension and scientific reasoning.

While *peer learning* refers to a host of learning experiences (O'Donnell & King, 1999)—including peer tutoring, cooperative learning, and peer response groups—our interest is peer learning that is designed to promote collaboration. The essence of collaboration is the construction of shared meanings for conversations, concepts, and experiences (Roschelle, 1992). Given this definition, there are certain conditions necessary for promoting collaboration. One such condition is that the thinking is distributed among the members of the group. All members of the group work on the same aspect of the problem at the same time, sharing cognitive responsibility for the task at hand. Furthermore, group members are encouraged to share their thinking as they work together (Brown & Palincsar, 1989). While there are certain forms of cooperative learning that can occur without collaboration, collaborative learning is generally assumed to include cooperation (Chan, Burtis, & Bereiter, 1997).

Given the complexities inherent in collaborative learning, there are many features of the instructional environment to which one could attend. We nominate three such features: the support of interactive patterns, the nature of the problem space, and the process of creating a shared social context. We begin by identifying lessons learned from *reciprocal teaching (RT)* research and the ways in which this research influenced the design of the second context, *cognitive tools and intellectual roles (CTIR)*, which was designed to enhance student's ability to engage in scientific problem solving.

Two Contexts for Collaborative Learning

Reciprocal teaching (RT)

Reciprocal teaching (RT) was designed as an educational intervention for students who demonstrate

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significant disparities between their ability to decode and comprehend text. Typically, the participants in RT have fallen below the 35th percentile on standardized assessments of comprehension. During RT, students and teachers take turns leading discussions about shared text. These dialogues are structured using four strategies. Specifically, before reading the text, the group generates predictions regarding the upcoming content. Following the reading of the initial portion of the text, the discussion leader raises questions about the content of the text. The group discusses these questions, raises additional questions, and in the case of disagreement or misunderstanding, rereads the text. Whereas the questions are used to stimulate discussion, summarizing is used to identify the gist of what has been read and discussed and to prepare the group to proceed to the next segment of text. The next strategy, clarification, is used for the purpose of restoring meaning when a concept, word, or phrase is unfamiliar to someone or is a source of confusion to the group. Finally, the discussion leader proposes new predictions for the upcoming text, based on prior knowledge of the topic of the text, personal questions regarding the topic, or based on clues that are provided in the text itself (e.g., embedded questions). This leads to the selection of a new discussion leader and the reading of the next portion of text.

The value of RT as an intervention for poor comprehenders has been documented in many sources (Brown & Palincsar, 1989; Palincsar & Brown, 1984, 1989; Rosenshine & Meister, 1994). In the next section, we identify features of RT that are critical to its role of fostering collaboration by drawing upon a decade of RT research and literally hundreds of conversations with teachers engaged in RT dialogues.

The support of interactive patterns. Rogoff, Matusov, and White (1996) have argued that to promote collaboration there must be the development of an intersubjective attitude—a commitment to find a common ground on which to build shared understanding (Crook, 1994; Rommetveit, 1974). RT's dialogic nature and the explicit goal of making sense of the text provide the context for this interaction. Furthermore, the specific strategies used to scaffold the dialogues both invite alternative views of the text and encourage the participants to achieve consensus regarding the text. For example, the questions and predictions students raise in the course of RT dialogues may be relatively unconstrained by the text. They represent not only what the students have identified as information acquired in the course of reading the text, but also include issues that students perceive as related to the text, assorted recollections that have been triggered by their reading, or wonderings that may, in fact, never be addressed in the text. In contrast, when the students are summarizing or clarifying the text, they are asked to come to agreement regarding issues such as the "big ideas" in the portion of text under discussion and to use the text to support their interpretations.

The relationship of the strategies to the process of developing an intersubjective attitude became clear early in the RT research program. Initially, rather than beginning the dialogues with questions of the text, followed by summaries, clarifications, and predictions, students were first invited to clarify what they found confusing. Typically, they would identify isolated "hard words." This led to a fragmentation of the text and of the conversation, with the teacher being viewed as the sole authority in the group and the translator of difficult words. When the order of the strategies was transposed, the participant structure changed to the extent that there was a sharing of the process of making sense of the text. Furthermore, it was determined that "hard words" were actually less problematic, and the focus turned to the bigger ideas that had emerged in the course of generating questions and summarizing the text.

An additional feature of RT that promotes the development of an intersubjective attitude is the expectation that every participant in the group will be responsible for leading the dialogue and will receive the assistance necessary to do so. As a form of collaborative learning, we have been intrigued with students' ability to provide assistance for one another. For example, in the process of helping a peer address a confusion in the text, students construct metaphors drawing upon action heroes, computer games, song lyrics, and other contemporary popular media about which adults may know very little.

The nature of the problem. The nature of the problem clearly influences the activity of constructing meaning and promoting opportunities for attaining consensus. In RT, the nature of the problem is defined both by the demands of the text as well as the purposes for reading the text. The relationship between the problem and the demands of the text became quite clear to us when we introduced RT teaching at the first-grade level. At this level we were confronted with the challenge of finding text that was suitable. The types of text available to young students often place a priority on controlling the vocabulary or rendering the text highly predictable. While these are important attributes, when the goal is to enable young students to read with fluency, they are not necessarily attributes that lend themselves to rich conversation. Hence, rather than use text that was designed to support independent reading, we turned instead to children's periodicals that had short informational articles and engaging narratives with interesting plot structures (e.g., surprise twists) that were read aloud by the teacher.

The nature of the problem is also a function of how the text is being used. One use is simply to figure out what the text is about, and in the initial studies of RT this was the primary purpose. Students read disconnected texts and little reference was made across texts. A second use of the text is to enhance one's understanding of a specific topic or domain of knowledge. For example, the RT dialogues with the first graders (Palincsar, Brown, & Campione, 1993) were used to learn simple science concepts related to animal survival themes, such as protection from the elements and protection from enemies through camouflage and mimicry. These themes were represented across the texts used in the dialogues and gave rise to interesting outcomes. For example, there were now opportunities for students to bring the shared knowledge they were developing to the dialogues. There were multiple occasions for referencing earlier texts and discussions. In addition, there was greater clarity regarding the purposes for discussing the meaning of the text to the extent that the students and teachers focused more of the discussions on how new information in the stories was advancing what students already knew about the topic at hand.

The process of creating a shared social context. The process of learning to engage in collaborative learning is, in many respects, a process of creating a shared social world. For the students and teachers "trying on" RT dialogues, this has often meant cultivating a new pattern of instructional discourse in the classroom. The pattern may be new to the extent that the activity of RT engages students and teachers in making their thinking public as they apply the strategies to understanding the text. It may be different because students are called upon to share their own expertise and knowledge in making sense of the text, and to assist one another in doing so. Perhaps the change is greatest in that the final authority for coming to consensus regarding the meaning of the text rests with the group and not solely with the adult member of the group.

Clearly, teachers' experiences introducing RT dialogues vary—in part, as a function of the ways in which this form of dialogic collaboration reflects or departs from their prior experience, and, of course, their beliefs about teaching and learning. There are similar issues for older students as well. One example that comes to mind is the seventh grader who, when she was the dialogue leader, wanted to write her questions down and show them only to the teacher, rather than contribute them to the dialogue. Her reasoning was that if she said them aloud, everyone would know what to study as they read the text.

In contrast to the second context described in this article, the teacher's role in this process is prominent and sustained in RT teaching dialogues. While the teacher is consciously attempting to cede more responsibility to the students for leading and sustaining the dialogue, this occurs through a process in which the teacher is initially engaged in instruction, explaining the use of the strategies and modeling their appropriate use relative to the demands of the texts. Over time, active teaching is reduced to coaching, at least until such time as the group reaches an impediment in the dialogue, or the text poses challenges that exceed the group's ability to proceed.

Thinking about learning as a process of creating a shared social world has been useful in thinking about the nature of the changes that one can

anticipate over time when instituting RT teaching dialogues in a classroom. Initially, the dialogues are rough and stilted. The strategies drive the dialogues, and what is celebrated is the production of a question or the refinement of a summary. Teachers are initially surprised at how dependent the group is on their support. In addition, the strategies are quite salient; for example, the wording of a question receives considerable attention, while identifying main ideas in the text receives less attention. Over the course of time, the discussions are increasingly focused on the meaning of the text; that is, the strategies are used flexibly, the dialogue becomes less routine, and the conversation becomes more free-ranging. In the next section of this article, we proceed to a second collaborative learning context, one designed to promote conceptual understanding in science.

Cognitive tools and intellectual roles (CTIR)

This project focused on the design of a context to promote student engagement and collaboration during inquiry-based science instruction. A common participant structure seen across inquiry-based methods of science instruction is a *reporting* phase in which students, who have worked together in small groups to conduct an investigation, present the results of their activity to the whole class. This phase of instruction places enormous demands on students and teachers alike. It is the phase of instruction where students, who may have had disparate experiences in the course of their investigation, share and compare their data and, as a class, determine how these data serve to support or refute claims and advance explanations for the phenomena they are attempting to understand. This instructional context provides a classic opportunity for student collaboration.

In order to address the challenge of creating a classroom environment that invites collaboration among students at the level of constructing and discussing ideas, two sets of mechanisms for supporting student collaboration were developed. These supports were informed by some of the guiding principles involved in RT. While in RT, the focus is on guiding students to use strategies expert readers employ spontaneously, in CTIR the emphasis is on the processes scientists use in formulating explanations of phenomena.

The design of these processes was influenced by the literature pointing to the central role that argument plays in science, as well as the research disclosing the challenges students confront when learning how to engage in scientific argumentation. For example, Kuhn (1992, 1993) has demonstrated that both students and adults have a tendency to confuse theories with evidence and, therefore, construct insufficient arguments. Duschl (1990), discussing what he calls the "rational feedback mechanisms of science" (p. 53), suggests that there are two mechanisms of change in science that operate through a feedback system. Specifically, new theories can be generated from existing data or from new data. These perspectives emphasize the need to engage students in practices designed to explicitly differentiate and coordinate theories with supporting evidence.

Reflecting the emphasis on coordinating theories with evidence, three strategic steps were developed to guide students in developing explanations about scientific phenomena. These steps include: (a) predicting and theorizing, (b) summarizing results, and (c) relating predictions and theories to results. These three steps comprised a set of cognitive tools that were used to support student collaboration by promoting a common focus for their interactions.

The next procedure employed to encourage student collaboration involved the transformation of this set of strategic steps into a set of audience roles that would support productive interaction during whole-class reporting. The idea of cognitive role-taking was influenced by the success of role-taking in RT. Given that the reporting phase of instruction is a significant departure from the ways students typically interact in class (Cazden, 1988; Lemke, 1990), it was assumed that these audience roles would offer guidance to students entering a participant structure that might be unfamiliar to them. While some cooperative learning programs do attend to roles students might assume in the course of their interactions, these are typically procedural roles (i.e., facilitator, materials coordinator, etc.) that do not speak to the issue of intellectual engagement. Hence, the cognitive tools identified above to provide a focus for students during small-group time were translated into assigned roles. Some audience members were responsible for checking the reports for clarity regarding

the relationship(s) between predictions and theories, others were responsible for ascertaining the clarity of the summary of findings, and some were responsible for determining if the reporter discussed the relationship(s) among their group's prediction, theory, and findings.

The value of CTIR has been investigated in several sets of studies (Herrenkohl & Guerra, 1998; Herrenkohl, Palincsar, DeWater, & Kawasaki, 1999). The results indicated that the use of these tools: (a) supported classroom dialogue, (b) advanced student theorizing, (c) influenced student thinking about the nature of scientific problem solving, and (d) promoted conceptual understanding. In the next section, we analyze CTIR using the same features introduced in our discussion of RT.

The support of interactive patterns and norms. In order to encourage students to work collaboratively to establish shared understanding in their classroom, the cognitive tools were not presented and defined by the teacher alone. Students contributed their perspectives on each of the three strategic steps as well. This provided the starting point for conversations to begin in the classroom. Although the teacher offered a good deal of support to students at the beginning of the intervention, students gradually took on the responsibility for guiding each other. The meaning of the three strategic steps was revisited and renegotiated repeatedly throughout the intervention. For example, at first, the distinction between prediction (i.e., "what you think is going to happen") and theory ("why you think that is going to happen") was difficult for students to remember and put into practice. Although they were capable of defining these terms, students had more difficulty when they tried to apply these concepts to specific activities. In addition, their knowledge and practices with regard to predicting and theorizing shifted as they progressed through the intervention. What began as more of a process of guessing and offering a reason to support the guess, shifted to a more scientific notion of predicting based on a theoretical stance.

The audience roles further contributed to the need to share meanings of the three strategic steps as "common knowledge" (Edwards & Mercer, 1987) within their classroom. Without a shared understanding regarding what would constitute a satisfactory prediction, theory, etc., reporters and audience members would be unable to communicate their ideas clearly to one another.

A final strategy for facilitating collaboration involved allowing students to nominate themselves for participation in the conversation. Both Phillips (1972) and Au and Mason (1981) have noted that the physical and social organization of the classroom can impact students' willingness and ability to participate in the classroom. In the CTIR research, when students had access to controlling their own entry into the conversation, they were more likely to engage with others. In cases where teacher nomination was required, students felt less comfortable participating. Allowing audience members to ask question of reporters encouraged the student audience members to nominate themselves for participation in the process.

Problem-solving opportunities. There were two main contexts that provided different opportunities for student problem solving. The first involved the actual completion of the small-group activities. During this time, students worked in groups of four to complete a given problem. Students cooperated to complete the activity using the three strategic steps as a guide, and then used chart paper to prepare some supporting materials for the reporter to use when presenting orally to the class. This context allowed students to focus on presenting their problem from the perspective of using the three strategic steps with teacher supervision, but not necessarily direct teacher guidance.

The second problem-solving opportunity occurred when students in the audience assumed the role of examining reports for the inclusion of the three strategic steps. In this context, students were not asked to apply the three strategic steps to a problem themselves; instead, they were asked to examine another group's representation, determine if all steps were included, and whether they understood what the group was saying. In this context the teacher first acted as a facilitator and guide and, later, as more of a conversation moderator.

These two problem-solving contexts allowed students to practice many thinking skills. First, they were creators of predictions and theories, summarizers of results, and relaters of predictions, theories, and results in the small-group context. Then, as audience members, they were required to listen and evaluate their understanding of others' perspectives under

the expert guidance of the teacher and other tools that bridged both contexts.

Students participated in these problem-solving contexts with the extensive support of linguistic tools such as activity cards, charts that displayed the three strategic steps, and chart paper representations used by reporters during reporting time. A "theory chart" that became a collective representation of all of the theories offered by small groups during the unit, and a "questions chart" that outlined the kinds of questions that students could ask when they assumed their audience roles were also used. The theory chart became a crucial resource for students to use when completing their activities and while questioning reporters. Since theories were added to the chart each day, students could derive their group theory by examining the chart and recalling the context in which another group presented that theory on a previous day. There were cases when theories developed on one day by one group were appropriated by another group the following day.

The process of creating a shared social context. As was true with RT, creating a shared set of classroom values that established understanding others' perspectives as an essential aspect of participation was critical to the successful implementation of CTIR. Constructing such a classroom community required patience, time, and collaboration among all classroom members.

During reporting time the teacher frequently monitored audience member understanding and attempted to establish whether students were "satisfied" that the reporter addressed all three steps in a manner they understood. There were numerous examples of students supporting other students to take on roles that were particularly difficult for them. There was an ethos of respect for others' ideas, and a realization of the importance of the contributions of all classroom members. This does not mean, however, that the classroom functioned smoothly at all times. There were tense moments of working through the important distinction between challenging people versus challenging ideas. These distinctions tied the community together and identified it as a lively and intellectually stimulating environment where both debate and consensus were welcomed.

Conclusion

The two programs of research discussed in this article span more than a decade. In some respects, the story of the development of these two collaborative learning contexts reflects the maturation of inquiry regarding collaborative learning. When we began the research on RT, the principle question was whether participation in these dialogues would provide an appropriate context for students to acquire ways of interacting with text that reflected the ways skilled readers interact with text. The focus was on the strategies as a means of supporting students' interactions with text and how students' participation in these learning dialogues would influence their acquisition of these strategies and their independent learning from text.

Interest in RT as a form of peer collaboration emerged from patterns of findings about the relationship between the quality of the interactions between teachers and students, as well as among students, and the nature of the learning that occurred. For example, students who participated in groups that were heterogeneous with regard to comprehension ability attained competence more quickly than students in groups that were homogenous. These patterns raised questions about how collaboration occurred in the context of the dialogues and, in turn, how collaboration influenced cognitive development.

The CTIR research exemplifies the increasing interdependence of research on collaboration and research that is domain-specific. This research made salient the cognitive tools that would both aid the co-construction process in scientific problem solving and become the means by which students engage in future scientific problem-solving activities. The intersection between the design of collaborative contexts and the study of domain-specific reasoning and problem solving continues to be an area ripe for study.

Another focus of inquiry, reflected particularly in the CTIR program, is the question of structuring group activity so that responsibility is shared among all members, expertise is distributed, and there is an ethos of building upon one another's ideas. The CTIR research illustrates one viable means of engaging students in knowledge-building discourse in a fashion that also attends to the distribution of responsibility for learning.

Finally, the development of these two programs of research illustrates the ways transforming school practices must be considered—not just in terms of different teaching methods but also in terms of different cultural systems (e.g., representing different educational, social and communicative norms and priorities). In contrast to the majority of the early research on RT, the CTIR research program has been conducted at the classroom level, raising a host of complex issues that address the culture of the classroom. New sets of issues emerged that demanded attention, including the individual histories of students and how these histories influence their subsequent experiences working with others, the collective history of the members of a classroom, and the norms in a classroom regarding listening to one another. No matter how smart we become about the domain-specific and knowledge-building issues identified above, until we understand more fully how to socialize students into new ways of dealing with peers as intellectual partners, it is unlikely that this research will make much of a difference in the real-world experiences of teachers and students.

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