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USING RESEARCH ON LEARNING FROM TEXT TO INFORM ONLINE DISCUSSION

FEI GAO
RALPH T. PUTNAM
Michigan State University

ABSTRACT

Drawing on research literature on online discussion and on reading and learning from the text, we argue that research on learning from text has much to offer but has been largely absent in informing the design and study of online learning environments. We propose several key issues to be considered in research and development of online discussion, and a framework for examining the goals and features of online discussions. We then report on an exploratory study of an online discussion environment informed by this framework.

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Asynchronous online discussion has played an important role in supporting students' interaction in online learning environments (Joeng, 2003). Online discussion, some argue, offers several advantages over traditional classroom discussion by freeing learners from time and space constraints and supporting cost-effective global communication (Anderson, 1996). More importantly, the argument goes, online discussion forums potentially allow for more in-depth discussions and more thoughtful learning than are possible in traditional face-to-face settings. In online discussion forums, the entire discussion is available

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for perusal, providing learners with opportunities for identifying, examining, making connections among, and reflecting upon ideas (Anderson, 1996; Collison, Elbaum, Haavind, & Tinker, 2000).

In reality, however, online discussion forums often have not lived up to these expectations. At least three problems with online discussion have emerged in the research and teaching-oriented literature: (a) lack of learner-content interaction (Collison et al., 2000); (b) lack of meaningful learner-learner interaction (Larson & Keiper, 2002); and (c) lack of in-depth discussion (Gunawardena, Lowe, & Anderson, 1997). In this article, we examine research literature on online discussions that addresses how participants learn through online discussions and how to improve the quality of that discussion. Then we argue that an extensive body of research on learning from text has much to offer but has been largely absent in informing the design and study of online learning environments. By reviewing relevant research on learning from text, we argue that such research should be considered more carefully in understanding and promoting productive online discussions. Building on this conceptual work, we propose several key issues to be considered in research and development of online discussion, and a framework for examining the goals and features of online discussions. Finally, we describe an exploratory study informed by the framework.

RESEARCH ON ONLINE DISCUSSION

We draw on several recent reviews of literature on online discussion, participation, and interaction (Hammond, 2005; Hrastinski, 2008; Maquire, 2005; Spatariu, Quinn, & Hartley, 2007; Tallent-Runnels, Thomas, Lan, Cooper, Ahern, Shaw, et al., 2006; Wallace, 2003) to consider research addressing two major questions: (a) how do participants learn through online discussion? and (b) what steps have been taken to improve the quality of online discussion?

How Do Participants Learn Through Online Discussion?

Researchers have focused on three major aspects of online discussion: (a) social community and engagement; (b) social knowledge construction, and (c) cognitive processes.

Social Community and Engagement

One sizable line of research on interaction in online courses extended earlier work on distance education (e.g., Moore, 1989) and has focused on conceptualizing the nature of social interactions online and how online discourse differs from that in face-to-face settings (Wallace, 2003). This work has identified a number of important characteristics of online learning, such as transactional distance, interaction, and social presence. This work has not examined directly the role of online interactions in supporting learning, focusing rather on the social

and structural characteristics of online discussions. An implicit assumption is that active participation and engagement with others is important for learning, but the kinds of engagement or how it supports learning are not examined.

Morris, Finnegan, and Sz-Shyan (2005), for instance, used a multiple regression analysis to evaluate how well student participation measures predicted student learning, finding that approximately 31% of the variability in achievement was accounted for by student participation measures. Rourke, Anderson, Garrison, and Archer (2001) emphasized the level of social presence in an online community by arguing that social presence supports sustained learning and critical thinking in a community of learners. Though there is little direct evidence about the influence of social presence on learning, research suggests that the strength of a learning community and the closeness of personal relationships with the community are positively related to the frequency and quality of interactions among participants (Rovai, 2003, 2007).

Social Knowledge Construction

Other researchers have focused more explicitly on interaction in support of learning. Many have justified the importance of online interaction from a general social constructivist perspective, arguing that interaction is necessary for groups to construct knowledge collectively (e.g., Gunawardena et al., 1997; Kanuka & Anderson, 1998; Pena-Shaff & Nicholls, 2004). As Cobb (1994) argued, "the sociocultural perspective informs theories of the conditions for the possibility of learning, whereas theories developed from the constructivist perspective focus on what students learning and the processes by which they do so" (p. 13).

A number of researchers have observed and documented the patterns of knowledge construction in asynchronous online discussions (Arvaja, Salovaara, Häkkinen, & Järvelä, 2007; Gunawardena et al., 1997; Hara, Bonk, & Angeli, 2000; Pena-Shaff & Nicholls, 2004; Schellens & Valcke, 2005; Veerman & Veldhuis-Diermanse, 2001; Zhu, 1996). For example, Gunawardena et al. (1997) identified student posts reflecting the five stages of co-construction of knowledge: (a) "sharing/comparing of information"; (b) "discovery and exploration of dissonance or inconsistency among ideas, concepts or statements"; (c) "negotiation of meaning/co-construction of knowledge"; (d) "testing and modification of proposed synthesis or co-construction"; and (f) "agreement statement(s)/application of newly constructed meaning" (p. 414). Pena-Shaff and Nicholls (2004) developed an instrument with 11 categories, such as *question*, *reply*, *clarification*, and *reflection*, to capture the knowledge construction processes. Zhu (1996) analyzed student posts by identifying the types of posts that are *information sharing*, *reflecting*, *scaffolding*, and so on. These studies suggested unanimously that dialogical processes of meaning construction are not as common as expected in asynchronous online discussions; elaboration and clarification dominated the majority of student posts.

This line of work has focused on the interactions of groups as wholes and how those interactions support group knowledge construction. It also assumes a particular set of group activities or functions (e.g., discovery, sharing) believed to foster that joint knowledge construction.

Cognitive Processes

In contrast, some researchers have viewed interactions with others as providing opportunities for individuals to engage in particular cognitive processes. From this perspective, the group is an important site for individuals to interact, but the learning is assumed to take place because of the thought processes in which individual learners engage.

Henri's (1992) multi-dimensional model, for example, specified cognitive skills–*elementary clarification*, *in-depth clarification*, *inference*, *judgment*, and *strategies*—as represented in online posts, taking the occurrence of such cognitive processes as evidence that learning was taking place. Newman, Johnson, Cochrane, and Webb (1995), building upon Henri (1992) and other researchers' work, identified particular kinds of critical thinking processes, such as *linking ideas*, *justification*, and *critical assessment*, and looked for evidence of these processes in the postings of individuals. Their analysis showed that, when compared to face-to-face discussions, asynchronous online discussions had more thought-out comments and more linking between ideas, but less creative ideas. Järvelä and Häkkinen (2000) studied different levels of online discussions using perspective-taking theory. Discussions were coded into one of the following five stages: *egocentric, subjective role taking, reciprocal perspective taking, mutual perspective taking,* and *societal-symbolic perspective*. They found that the stage of perspective taking in online discussion was generally low, and none reached the highest stage, societal-symbolic perspective taking. A model that ideally represents critical thinking processes in computer conferencing is that developed by Garrison, Anderson, and Archer (2000, 2001). Based on their model, critical inquiry is composed of four sequential stages: *triggering event*, *exploration*, *integration*, and *resolution*. This model captures how individual learners construct and confirm meaning through sustained reflection and discourse in a community of inquiry (Garrison et al., 2001).

Improving the Quality of Online Discussion

These conceptualizations of how learners learn from online discussion have led to multiple goals among approaches to improving its quality. Most approaches have aimed primarily at one of the following goals: (a) increasing the sense of social community and engagement; (b) increasing the amount and quality of interaction for knowledge construction; and (c) engaging students in certain cognitive processes. To support these goals, researchers have focused on and modified different features or components of the online learning environment:

(a) structure and features of online discussion tools; (b) online activities in which learners engage; (c) teaching and modeling particular ways of interacting, and (d) instructors' facilitation and moderation.

Increasing Social Community and Engagement

Some developers have focused on the goal of constructing a social community that supports learning (Bielman, Putney, & Strudler, 2003; Palloff & Pratt, 1999). From this perspective, students will get more involved and engaged in online interactions if they feel a higher level of social presence—the awareness of other people and their involvement in the communication process (Tu & McIsaac, 2002). Most research in this area has focused on identifying important factors that impact the sense of online community, such as level of social presence or size of a community; little research at this point has systematically examined the effects of specific approaches on increasing the sense of community and engagement. In working toward the goal of a supportive community, developers have relied on providing facilitation and moderation as well as structuring appropriate online activities. Winograd (2000) examined the effects of a trained moderator in online discussion, concluding that the use of moderation techniques allowed the experimental group to form a community based on camaraderie, support, and warmth, and the experimental group contributed far more posts than other control groups. Mäkitalo, Häkkinen, Leinonen, and Järvelä (2002) explored how students establish and maintain common ground in online discussions, arguing that showing evidence of understanding by providing written feedback and showing support to the peers in the replies is essential to establish common ground in terms of shared mutual understanding, knowledge, belief, and assumptions. From a review of literature, Rovai (2002a) suggested that instructors teaching at a distance may promote a sense of community by attending to seven factors: (a) transactional distance; (b) social presence; (c) social equality; (d) small group activities; (e) group facilitation; (f) teaching style and learning stage; and (g) community size.

Increasing Interactions for Knowledge Construction

A second goal for promoting learning is increasing the amount and quality of interaction for knowledge construction, rather than simply trying to create a sense of community. One approach has been to teach students ways of interacting by providing explicit expectations and guidelines. For example, Gilbert and Dabbagh (2005) tried three types of structures in an online course: (a) offering explicit guideline on how to facilitate the discussion; (b) offering rubrics on how the discussion would be evaluated; and (c) offering posting protocols, such as limiting the length of a post and mandating reading citations. They found that certain elements of structure such as explicit facilitator guidelines and evaluation rubrics had a positive impact on online construction of knowledge.

A second approach has been to structure the discussion activities. Kanuka, Rourke, and Laflamme (2006) studied the relative influence of five discussion activities on the quality of students' online discussions: (a) nominal group technique, where students are asked to generate and prioritize their ideas about a solution to a well-formed problem; (b) debate; (c) invited expert; (d) WebQuest; and (e) reflective deliberation, where students are provided with opportunities to reflect on the abstract material presented in academic settings and to make it relevant to their own worlds. For each activity type, the researchers devised clear role definitions and responsibilities for the instructor and the students, rubrics for student assessment, and specific learning outcomes. They found that students posted a higher proportion and number of messages reflective of the highest levels of cognitive presence when they engaged in the WebQuest and debate activities. In another study, Lebaron and Miller (2005) reported the effect of role play in online discussion, where each participant of the role-playing team assumed a different role, and participated in a synchronous conversation and asynchronous threaded discussion about the issues and challenges associated with each role. They concluded that role play might be a discussion activity that helps to ensure interactions among students, to promote purposeful peer student dialogue, and to encourage construction of knowledge in online learning environment. Another way to structure discussion activities has been to require students to take a more active role in discussions. Rourke and Anderson (2002) studied the effects of asking students to lead discussions. Students perceived these discussions led by their peers as more structured, more fluid, more responsive, and more interesting than those led by the instructor, even though there was little difference in the quality of discussion as assessed by the researchers. A study by Seo (2007) suggested the similar result that when discussions were moderated by a peer, students responded to messages more actively and engaged in more in-depth discussions. Ertmer et al. (2007) examined the effect of using peer feedback on posts to increase their quality. The feedback was based on Bloom's taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) and distinguished between lower-order (knowledge, comprehension, and application) and higher-order (analysis, synthesis, and evaluation) contributions. The goal was to increase the amount of higher-order thinking evident in students' posts. Although the quality of students' posts did not improve during the course, students reported through surveys that the peer feedback enhanced their learning and the quality of online discussion.

A third approach for increasing the amount and quality of online discussion has been for instructors to use a set of facilitative techniques. Beaudin (1999) looked at how instructors could interact with learners in a way to keep the discussions on topic. By surveying 35 online instructors, Beaudin (1999) identified several techniques: (a) designing questions that specifically elicit on-topic discussion; (b) providing guidelines to help learners prepare on-topic responses; (c) rewording the original question when responses are going in the wrong

direction; and (d) providing discussion summaries on a regular basis. Specific questions and guidelines provide the basis and procedures for knowledge construction, rewording the question helps redirecting the knowledge construction processes to the targeted topic, and summary is crucial for a fruitful interaction.

Encouraging Cognitive Processes

A third goal for improving online discussions emphasizes encouraging particular cognitive processes. This goal is realized through using specific discussion environments or teaching particular discussion strategies. A variety of online discussion environments have been designed to scaffold the ways students participate, respond, and interact in the discussion. For example, in a constrained discussion environment, participants must label each of their posts using a predefined set of message types (Cho & Jonassen, 2002; Moore & Marra, 2005). In Guzdial and Turns (2000), students chose for each post a post type or classification, such as *new theory* or *evidence*. Knowledge Forum (previously called CSILE; Scardamalia & Bereiter, 2003) supports both the creation of notes and the ways they are displayed, linked, and made objects of further work. The rationale is that a prompt suggesting a specific type of post will support students' metacognitive thinking, helping them engage in certain cognitive processes (Scardamalia & Bereiter, 1994). Similarly, Nussbaum and colleagues (2004) encouraged counter-argument in online discussion by asking students to choose such note starters as "on the opposite side" or "I need to understand," which increased the frequency of disagreement and student willingness to consider other points of view. Another type of discussion environment supports graphical representations of different viewpoints and their relations, such as concept maps or tables (Ertl, Kopp, & Mandl, 2008; Suthers, Vatrapu, Medina, Joseph, & Dwyer, 2006; Suthers, Weiner, Connelly, & Paolucci, 1995). These studies concluded that students benefit from co-constructing graphical representations because the processes of construction may prompt for the externalization of particular cognitive processes, such as linking new claims to an existing argument graph or filling in cells of a table (Andriessen, Baker, & Suthers, 2003).

A different approach has been to teach students specific cognitive strategies or provide students with specific goals. In online discussions studied by Choi, Land, and Turgeon (2005), the instructor provided guidelines for generating three types of questions to promote peer interaction and enhance the quality of online discussion: (a) clarification or elaboration questions; (b) counter-arguments; and (c) context- or perspective-oriented questions. This intervention resulted in an increase in the frequency of questioning, but did not affect the quality of the discussion. Similarly, Yang, Newby, and Bill (2005) had the instructor teach and model Socratic questioning, which students then used in their online discussions. This approach resulted in more posts that demonstrated critical thinking. Nussbaum (2005) explored the effects of goal instructions on students' online

discussion. Students were instructed to achieve one general goal (to persuade, to explore, none), and one specific goal (to generate reason, to provide counter-arguments, none) while participating in the discussion. Results showed that the goal of "generate reason" resulted in deeper and more contingent arguments, and the goal of "persuade" led to more adversarial arguments.

Finally, instructors and moderators can encourage certain cognitive processes. Collison et al. (2000), for example, argued for the critical role of effective moderation in online discussion. They identified several moderating strategies to help learners engage in critical thinking. These strategies include: (a) sharpening the focus of discussion by identifying the direction of a dialogue, sorting ideas for relevance and focusing on key points; and (b) deepening the dialogue by questioning, making connections, and honoring multiple perspectives. Berge and Muilenburg (2002) focused on the role of instructors' questioning in promoting online discussion. They developed a framework for designing questions for starting online discussion and maintaining the discussion.

In sum, researchers have explored and examined a variety of approaches for enhancing student learning through online discussions. Based on their varied understandings of how learning occurs through online discussions, they have tried to improve the quality of learning through actively building communities of inquiry, supporting social knowledge construction, and encouraging specific cognitive processes during group interaction.

Across these studies, however, researchers have paid scant attention to how learners interact with the course materials, another important aspect of learning. As we know, online discussion is commonly used as a way of increasing learners' understanding of the text. One often implicit and little studied goal of such online discussions is to facilitate students' interaction with the text. Moore (1989) defined three types of interactions that were crucial to the quality of distance learning. They were learner-content interaction, learner-instructor interaction, and learner-learner interaction. Learner-instructor interaction and learner-learner interaction has been intensively investigated in online discussion (Swan, 2001). How learners interact with the content during discussion, such as the text read for the course, and how to engage learners in a discussion to better understand ideas in the text has remained largely unexplored in the research on online discussion. We believe it is important to think about learning in online discussion not only from the perspective of person-to-person interaction, but also from the perspective of person-to-text interaction. To facilitate this line of thinking, we consider in the next section research on learning from text, which examines how we learn from text and how to improve that learning.

LEARNING FROM TEXT

Although much online learning involves reading and learning from text, the extensive body of research on how readers comprehend and learn from text has

been largely untapped for its contributions in understanding students' engagement and learning in online environments. Just as online learning researchers have been concerned about the lack of depth in online discussion, researchers studying reading comprehension have noticed that readers tend to process meaningful materials superficially. Readers often fail to figure out why relations in the text are true, fail to relate new input to their prior knowledge, and overlook inconsistencies (Markman, 1977, 1979; Ross, 1984; Schank, 1988). The consequence of this mindlessness is "less complete understanding, learning, and memory" (Pressley, Wood, Woloshyn, & Martin, 1992, p. 92). These concerns prompted reading researchers to explore how people learn from text and ways of improving reading comprehension.

How Do Readers Learn from Text?

Learning from text is different from remembering the text. According to Kintsch (2004), text remembering refers to "the ability to reproduce the text either verbatim, in paraphrase, or by summarizing it" and "may be achieved on the basis of only superficial understanding" (p. 1305). Learning from text, in contrast, is "the ability to use the information acquired from the text productively in novel environments" (p. 1305). This learning requires the reader to integrate text information into an existing knowledge base, so that it helps support problem solving in new situations. According to researchers, several cognitive elements and processes are crucial to successful learning from text: (a) prior knowledge; (b) metacognitive skills; and (c) reading strategies.

Prior Knowledge

During the 1970s and 1980s, researchers found that, during the process of meaning construction, readers' prior knowledge plays a significant role in understanding the new information. Prior knowledge impacts what readers read, their allocation of attention, their interpretation and recall of written text, as well as their subsequent reading performance. The importance and the function of prior knowledge are well captured in schema theory (Anderson & Pearson, 1984; Rumelhart, 1980).

Schema theorists believe that the process of comprehension is an interaction between a reader's existing schema and the printed information on the page. They postulate that knowledge is stored in memory as abstract structures called schemata, which provide frameworks for related concepts. Schemata facilitate readers' comprehension in a number of ways (Anderson & Pearson, 1984; Pearson, Hansen, & Gordo, 1979). First, a schema offers a *framework* for assimilating the text information. Second, it helps to make *inferences*. A schema, once activated, provides a basis for the reader to make predictions, to generate hypothesis, and to fill in the gaps not completed specifically in the text. Third, it facilitates the process of summarizing and *recall*. Since a schema contains within

itself criteria of importance, it enables readers to pay more attention to important information and ignore minor issues. These functions led Bransford (2004) to argue that possessing and activating appropriate knowledge "is a fundamental aspects of the act of comprehending and remembering" (p. 608).

Metacognitive Skills

Along with the exploration of the process of meaning construction, another construct, *metacognition*, was introduced to the field of reading research. The word was first used by Flavell (1979) to refer to the control of memory process. In reading comprehension, metacognition was defined as a reader's ability to think about and control the reading processes. It consists of declarative knowledge—knowing *that*; procedural knowledge—knowing *how*; and conditional knowledge—knowing *why* (Hiebert & Raphael, 1996, p. 555).

Metacognitive skills involved in reading include (a) clarifying the purpose of reading; (b) identifying the important aspects; (c) focusing attention on the major content; (d) monitoring ongoing comprehension activities; (e) engaging in self-questioning; and (f) taking corrective action when failures in comprehension are detected (Baker & Brown, 1984a, p. 354). Baker and Brown (1984a) further distinguished reading for meaning (much like Kintsch's, 2004, learning from text) from reading for remembering, and argued that reading for meaning demands comprehension monitoring activities, including "keeping track of the success with which one's comprehension is proceeding, ensuring that the process continues smoothly, and taking remedial action when necessary" (p. 355).

Reading Strategies

Closely related to research on prior knowledge and metacognition is research on reading strategies used by good readers. Reading researchers have found that skilled readers use their prior knowledge as well as a set of flexible strategies to construct meaning from the text.

Dole, Duffy, Roehler, and Pearson (1991) reviewed strategies that represented the differences between skilled readers and novices. These strategies include: (a) determining importance—differentiating important from unimportant information; (b) summarizing information—synthesizing ideas in the text and creating a new coherent text that stands for the original; (c) drawing inferences—filling in details omitted in the text and elaborating what they read based on prior knowledge; (d) generating questions—asking questions that lead to active comprehension of the text; (e) monitoring comprehension—monitoring, controlling, and adapting the strategy processes while reading.

This literature provides a basic understanding of the critical processes of learning from text. In the next section, we consider what researchers in the field of reading research have done to help readers engage in these processes.

How Can We Improve Learning from the Text?

Reading researchers have studied instructional interventions that improve students' understanding of text, recall, and integration of knowledge. The typical purpose of these interventions is to encourage such cognitive and metacognitive processes as "building background knowledge; activating readers' existing background knowledge and attention focusing *before* reading; guiding reader/text interaction *during* reading; and providing review, feedback, or cognitive stimulation *after* reading" (Tierney & Cunningham, 1984, p. 610). Because of their relevance to thinking about online discussion environments, we focus here on two major lines of research on learning from text: (a) teaching reading strategies to students; and (b) adding comprehension aids to texts.

Strategy Instruction to Empower Students

Reading strategies are "specific, learned procedures that foster active, competent, self-regulated, and intentional reading" (Trabasso & Bouchard, 2002, p. 177). Most research on reading strategy instruction was based on the assumption that students' comprehension will improve if they acquire and use the strategies and processes used by good readers. This assumption has been confirmed by a large body of research indicating that strategy instruction improves students' overall comprehension of text (Duke & Pearson, 2002; Palinscar & Brown, 1984; Pressley, 2000).

Reading strategies that have proven effective in improving students' comprehension of the text include: (a) relating the text being read to prior knowledge and making predictions; (b) constructing mental images of what is being read; (c) summarizing, which helps readers attend to important information; (d) think-aloud and self-explanation; and (e) self-questioning, posing and answering questions about the text (Pressley, 2002; Tierney & Cunningham, 1984; Trabasso & Bouchard, 2002).

An Example of Strategy Instruction: Self-Explanation

One of these successful reading strategies is *self-explanation*, the process of explaining the text to oneself while reading. Research suggests that readers who explain the text either spontaneously or when prompted to do so understand more from the text and construct better mental models of the content than do readers who do not engage in self-explanation (Chi, de Leeuw, Chiu, & LaVancher, 1994; Collins, Brown, & Larkin, 1980; Magliano, Trabasso, & Graesser, 1999; Schank, 1986; VanLehn, Jones, & Chi, 1992). Some readers, however, do not spontaneously self-explain while reading or self-explain poorly when prompted to do so. Therefore, self-explanation is usually supported by other reading strategies, such as questioning, interpreting, and relating ideas to prior knowledge (McNamara, 2004).

Several reasons may account for why self-explanation improves comprehension and learning. First, self-explanation prompts learners to process information more actively. While explaining, the learner actively engages in making sense of the text and constructing meaning (Block & Pressley, 2001; Duke & Pearson, 2002). Second, it encourages learners to self-monitor their comprehension learning. Some researchers have focused on the significant role of metacognition in productive reading and learning, arguing that in order to learn effectively, learners need to know how to check, control, and monitor their deliberate attempts to learn or solve problems (Baker & Brown, 1984b; Brown, 1980). Third, self-explanation provokes learners to consciously make connections between what they are reading and prior knowledge. According to schema theory, the readers' prior knowledge governs their understanding of the text (Adams & Collins, 1979; Anderson, Spiro, & Anderson, 1978; Rumelhart, 1980), so strategies that help activate readers' prior knowledge will promote learning.

Comprehension Aids to Structure Texts

Another approach to supporting comprehension is to provide comprehension aids—various questions or prompts—in the text. Most of the research on structuring the texts was done in the 1970s and 1980s, but is still relevant today. In summarizing this work, Mayer (1984) posited three types of aids for text comprehension: (a) aids for selecting information; (b) aids for building internal connections; and (c) aids for building external connections.

Aids for selecting information serve mainly "to focus the reader's attention on certain target information" (Mayer, 1984, p. 34). Such aids should increase retention of the targeted information. Examples include highlighting text with underlining or bold type, or inserting behavioral objectives before each section of text. Aids for building internal connections help readers make logical connections among ideas in the text. For example, static or animated pictures, geographic maps, thematic maps, and graphs are visual aids used by readers' to understand and organize the text (Robinson, 2002). Research on such aids has revealed that using visual representations of text can facilitate readers' understanding and recall (Mayer & Moreno, 2002; O'Donnell, Dansereau, & Hall, 2002; Shah & Hoeffner, 2002; Verdi & Kulhavy, 2002). Aids for building external connections encourage readers to connect new information to existing knowledge structures. An example is the *advance organizer*, "appropriately relevant and inclusive introductory materials . . . introduced in advance of learning . . . and presented at a higher level of abstraction, generality, and inclusiveness" (Ausubel, 1968, p. 148). Reviews of research on advance organizers (Mayer, 1979; Stone, 1983) suggest that they have a positive effect on learning and retention of text-based learning materials.

An Example of Comprehension Aids—Adjunct Question

One powerful comprehension aid is *adjunct questions*—questions inserted into the text, to which readers are asked to respond while reading. Research on adjunct questions flourished in the 1970s (Anderson & Biddle, 1975), with an emphasis on examining the effects of adjunct questions of varying cognitive levels (i.e., factual questions versus higher-order questions). In typical adjunct question studies, three types of outcome measures were employed to examine the effect of adjunct questions: factual recall of the passage, answering the same questions inserted in the text, and answering new questions involving the transfer of what was read. These studies revealed that higher-order adjunct questions affect both productive and reproductive knowledge when they are placed after, instead of before, the part of the text being questioned (Anderson & Biddle, 1975; Rickards & Divesta, 1974; Shavelson, Berliner, Ravitch, & Loeding, 1974; Watts & Anderson, 1971).

Researchers have suggested that higher-order adjunct questions have two possible functions (Andre, 1979; Hamaker, 1986; Winne, 1979). First, they may direct the learner's attention to more of the information. Having attended more, the learner can therefore recall more. Second, adjunct questions may prompt learners to process the information at a deeper level. It is argued that these questions lead learners to set up complex strategies or programs for processing the information in the text. Because the strategies employed determine the nature of representation of knowledge in the mind (Andre, 1979), questions that lead to reorganization of memory traces and associations are likely to foster deeper learning (Carroll, 1971).

IMPLICATIONS FOR RESEARCH ON ONLINE DISCUSSION

These two lines of research–on online discussions and on learning from text—offer distinct but complementary perspectives on how the study and development of online discussions might proceed. Research on online discussions has a tradition of attending to the interactions among learners, not surprising since an important issue for online learning is how to reduce the psychological distance among learners and instructors. There has been less focus, however, on students' learning of content during online discussions. Research on learning from the text, in contrast, has focused more directly on how learners interact with text to comprehend and learn. This research informs us about how learning takes place as learners interact with the text and about possible ways to promote learning from text. Many online learning environments that include discussion present a unique blend of reading text and interacting with others through text, so attending to both the research on online discussions and on learning from text should inform our thinking about learning in these new environments. From our

examination of these two lines of research, we propose three key issues that researchers and developers of discussion-centered online learning environments should consider; (a) learning of content; (b) varied goals for online discussion; and (c) the technological and instructional design features that can be used to shape online discussion.

Focus on Learning of Course Content

Most research on online discussion has focused on the nature of the discussions and interactions among learners with an emphasis on engagement or social presence. How learners interact with content has been studied only indirectly by looking at the community building (Bielman et al., 2003) or knowledge construction processes (Gunawardena et al., 1997) in online discussion. As Wallace (2003) has argued, however, to understand the learning that does or can take place in online discussions, researchers need to look more directly at how learners interact with content and the learning that results from online interactions. Research on learning from text, by revealing the cognitive and metacognitive processes learners go through while interacting with text, provides possible frames for researchers and online instructors to examine how learners learn content in online discussions.

Attend to Different Goals for Online Discussions

Online discussion can serve different purposes. In some cases discussion is used primarily as a way to build communities where members develop a shared culture or common ground for reaching a deeper level of learning (Mäkitalo et al., 2002). In these cases, online discussion serves as an enabling condition for learning expected to take place. At other times, however, learning content knowledge is the central goal for online discussion, with discussions expected to support the learning of scientific concepts (Hoadley & Linn, 2000), to promote learners' understandings of the course readings (Mikulecky, 1998), or to help learners make conceptual connections between course content and their own experiences and contexts. Although these goals are certainly not mutually exclusive, it is important to consider what goals are in play when planning for online discussions or studying them. Effective tools for online discussions and ways of structuring the interaction may differ, for example, when the primary goal is developing a sense of engagement and community than when the primary goal is having learners focus carefully on a text.

Consider Instructional and Design Features for Enhancing Learning

To address these varied goals for discussions in online learning environments, designers and instructors can manipulate a number of features to support better

discussions. As we have seen from the research and development efforts in online learning, these fall into four clusters: (a) changing the structure of the online environment; (b) changing the activities in which learners engage; (c) modeling or teaching strategies, expectations, and ways of interacting; and (d) changing the way facilitators interact during instruction.

Researchers studying online discussion have already examined the effects of some structural changes to online environments, in particular providing guidance or constraints for the types of posts learners should contribute. The purpose of these structural constraints is to guide learners to participate in the discussion and interact with others in particular ways. The learning from text research reminds us that other structural changes, such as the insertion of adjunct questions into text, could also be used to help students process and discuss texts in certain ways. Such changes can bring together the processes of reading the text and discussing it with others.

In online discussion research, researchers have tried to teach learners strategies such as examining and responding to each others' views and pushing the conversation forward. These are discussion strategies that help learners to interact more effectively. The contribution of reading research is that other types of strategies are also important for learning. In particular, strategies for how to focus on the text and how to critique the ideas in the text while having discussion could be taught to students so that they can engage in more text-focused, substantive discussion.

Research on online discussion has also focused on changing the types of learning activities or changing the way facilitators or instructors interact with learners. A large body of reading research has focused on similar issues, although those studies have not been covered in our review. For example, Palinscar and Brown's (1984) reciprocal teaching and the Concept-Oriented Reading Instruction (CORI) developed by Guthrie and colleagues (1996) demonstrated how learning activities and role of instructors could be manipulated to enhance the learning from text.

STUDY OF A QUESTION-EMBEDDED ANCHORED DISCUSSION ENVIRONMENT

In the remainder of this article, we provide an example of how focusing on these three issues and combining perspectives from research on online discussion and research on learning from the text could influence the way we think about online discussion and conduct research on it. We present an exploratory study of an online discussion environment, which was developed to incorporate insights from self-explanation and adjunct questions research. For a more detailed report of the study, see Gao and Putnam (2007). In designing the new discussion environment, we began with the goal of promoting more focused and deeper learning of course content than is typically afforded by

traditional threaded discussion forums. In considering instructional and design features, we relied on four design principles:

1. Student posts should be entered and displayed close to particular texts being studied. The close proximity of text and posts should help students focus attention on the text and facilitate transition between reading the text and discussing it (Andre, 1979; Hamaker, 1986; Winne, 1979).
2. Students should be expected to explain and comment on the text as they read. The process of recording and clarifying their thoughts as they read serves as a form of self-explanation intended to improve comprehension and learning (Block & Pressley, 2001; Duke & Pearson, 2002; Pressley & Afflerbach, 1995).
3. Higher-order adjunct questions should be used to direct student attention to important issues in the text and prompt students to process the information at a deeper level (Anderson & Biddle, 1975; Rickards & Divesta, 1974).
4. Students should be expected to interact with each other by responding to and commenting on each others' posts. The importance of interaction has been supported by research on online discussions (Hrastinski, 2008; Tallent-Runnels et al., 2006).

Anchored discussion forums are one kind of tool that meets the first two principles. These tools grew out of shared annotation systems such as CLARE (Wan & Johnson, 1994), and CoNote (Davis & Huttenlocher, 1995; Gay, Sturgill, Martin, & Huttenlocher, 1999). In an anchored discussion forum, the text and the discussion are displayed in a linked, yet independent manner (van der Pol, Admiraal, & Simons, 2006). A user can identify a portion of text and type in a comment while reading an online document. The comments are shown alongside the document in a separate frame with a visual indication of the associated text, so all the other users can read the comments and respond to them. The result is a discussion that is *anchored* within a specific content. WebAnn (Brush, Bargeron, Grudin, Borning, & Gupta, 2002; Marshall & Brush, 2004) is such a system that support anchored discussion of online documents.

For our study, we first developed an anchored discussion environment that, like the systems reported by Brush et al. (2002) and van de Pol et al. (2006), satisfies the first two design principles. To meet Design Principle 3, we inserted discussion questions into the text. We developed the discussion environment within the online collaborative text-editing tool Google Docs (http://docs.google.com; see Figure 1). The focal assigned text is presented in a column, with questions to promote student thinking and discussion embedded in the text. To the right of the text is a second column in which students write answers to the embedded questions and comments on the text. Comments might include: (a) asking a question related to the text; (b) making connections to prior experiences or other readings; or (c) making interpretations and judgments about the text. Students can also see the comments and responses posted by other students and are

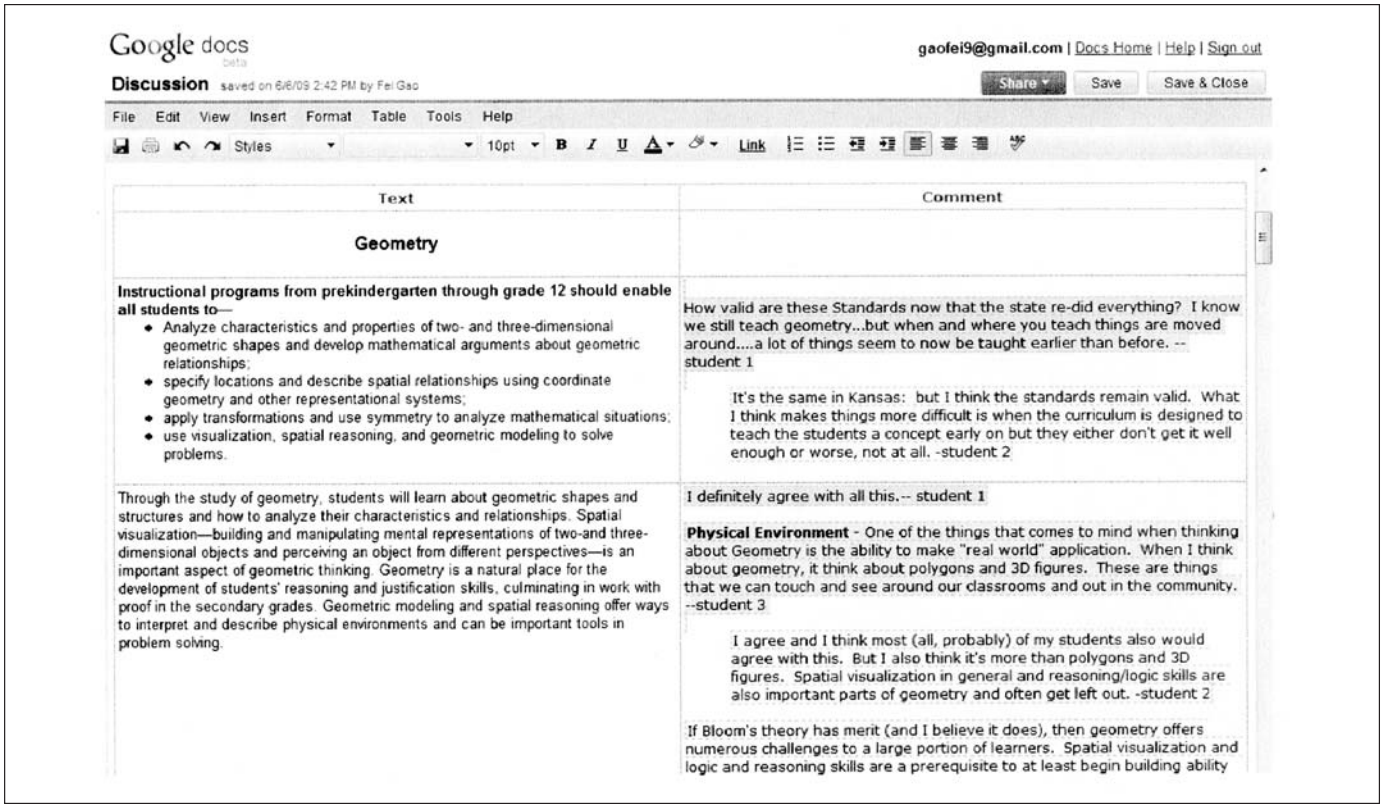

Figure 1. Question-embedded anchored discussion environment.

encouraged to respond to them (Design Principle 4). The environment thus provides opportunities for students to reflect upon and discuss with others the embedded questions as well as the specific text being read. We call this environment a *question-embedded anchored discussion environment* (QEADE).

QEADE differs from traditional threaded discussion environment (TTDE) in: (a) where the discussion questions are placed; (b) when the discussion takes place; and (c) where the discussion takes place. In TTDEs, discussion questions are posed in forums; in QEADEs, they are inserted as adjunct questions in text. Second, in TTDEs, students typically start writing comments after they have read the complete focal text; in QEADEs, they start writing comments while reading the text. Third, in TTDEs, students typically contribute to the discussion without viewing the focal text at the same time; in QEADEs, students can see the focal text as they discuss it. We expected these differences between QEADEs and TTDEs to result in differences in the nature and quality of discussion. We expected student discussion in the QEADE to be centered around and led by text and questions, and to be more focused on the text and course content. We expected discussion in the TTDE to be centered around and led by comments from previous students, and to be broader and more spontaneous.

In an exploratory study to examine the effects of our QEADE, we used it in an online master's-level course, comparing the discussion taking place in the QEADE with that in the TTDE already used in the course. The study focused on the following research questions:

1. How does discussion in the QEADE differ from that in the TTDE in terms of: (a) amount of explaining and commentary; (b) focus of posts on text and course ideas; (c) focus of posts on discussion questions; (d) depth or superficiality of posts; and (e) responsiveness and connection of posts to those of others?
2. How do student perceptions of experiences differ as they participate in the two discussion environments?

Method

Participants and Settings

Participants were students enrolled in an online master's-level course in learning mathematics with technology taught by the second author. Most were practicing K–12 teachers completing master's degrees in education or educational technology. Altogether, 12 out of 14 students agreed to participate. The online course was structured as a series of 2-week units, with each unit including readings, online activities, and small-group discussions on a specific topic. Students were organized into 3- to 4-member study groups for the duration of the semester. For each unit, various online discussions and collaborative activities took place within the study groups.

Materials

The two texts selected for the study were from *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 2000). Text A was the Geometry standards section, and Text B was the Algebra standards section. The two texts were about the same length and structure. Each text contained an introduction and several subsections, elaborating on particular goals for teaching geometry or algebra.

Procedures

The study focused on the reading and discussing of texts during two course units. Pre-existing student study groups were randomly assigned to Group 1 or Group 2. In the first unit, Group 1 students read and discussed Text A within the QEADE; Group 2 students read Text A and discussed it in the TTDE already used in the course: a discussion forum in Moodle (http://moodle.org/), an open source course management system. In the second unit, discussion environments were reversed, with Group 1 students using the TTDE and Group 2 students using the QEADE to discuss Text B.

Students using the TTDE were instructed to read the text and discuss the following questions in their groups: (a) What is the significance of learning geometry/algebra in general? (b) To what degree does your teaching meet the stated goals? (c) How might technology be used to support the stated goals? and (d) Which of these issues do you find most difficult for your students or in your own teaching practice? Students could see these discussion questions before they read the assigned text.

For students using the QEADE, the same discussion questions were embedded in the text. Question A was inserted in each text at the end of the introductory section discussing the significance of learning geometry or algebra. The three other questions were inserted at the end of every subsection elaborating on a particular instructional goal. Students were asked to use the comment function to post their opinions with a unique color (see Figure 1).

To ensure that students had opportunities to think independently about the text before beginning collaborative discussions, students participating in the QEADE were asked to comment first on a copy of the text in the QEADE. Then, the teaching assistant combined the group members' comments into a common document in the QEADE. Students were then able to see and respond to each other's comments. At the end of the two units, students completed a survey focused on their experiences and perceptions in participating and learning within the two discussion formats.

Measures and Analysis

The major data sources, including student online posts and the survey responses, were blindly coded.

Quantity of posts—The assumption that active participation is important for learning has been widely recognized and supported by empirical studies (Hiltz, Coppola, Rotter, Turoff, & Benbunan-Fich, 2000; Morris et al., 2005). Therefore, we decided first to analyze the amount of discussion, which serves as a rough indicator of student participation and engagement. We looked at the quantity of student discussion in the two online environments by determining: (a) the number of posts, (b) the total number of words, and (c) the average length of posts in each discussion. In the QEADE, each student comment was considered a post. In the TTDE, because some single posts contained multiple main ideas, we split those posts so that each post contained a single meaning unit. This splitting was required only for the TTDE posts.

Content analysis of posts—To identify the different patterns of discussion in the two discussion environments, we used a grounded theory approach, in particular, the method of constant comparison (Glaser, 1992). As we assessed and categorized the posts, we were open to unanticipated categories. When the new categories for the online posts were exhausted, we constructed rules to define which posts should be included or excluded from each category. We made many reassessments and revisions before finding that further analysis did not provide new information or insights. We identified two key dimensions: the *focus* of the posts and the *depth* of the posts. Four focus categories captured what the post addressed: (a) responses to a discussion *question*; (b) responses to the *text*; (c) responses to a *person*; and (b) *general* responses (with no clear antecedent). Three categories described the depth of responses: (a) *short* response; (b) *elaborated* response, which builds or elaborates on previous ideas; and (c) *critique*, which explicitly compares ideas or raises questions. An example of each is provided in Appendix 1.

About one-third of the student posts (80 posts) were randomly selected and coded by the first author and the course teaching assistant to determine interrater reliability. The coding resulted in a 93.8% level of agreement (Cohen's Kappa = .91) for the focus categories, and an 86.3% level of agreement (Cohen's Kappa = .79) for the depth categories. The two coders then coded all the discussion transcripts independently and met to reach agreement on each post coded, discussing discrepancies until reaching consensus.

Two posts unrelated to the learning content were not coded, one in which a student asked about who was the team leader, and the other that simply restated the discussion questions posted by the instructor. These two posts, both in the TTDE, were not related to the learning content, and thus not included in subsequent analyses.

Student perceptions of the two environments—The survey (see Appendix 2) focused on students' perceptions of participating and discussing in the two discussion environments. It began with four short open-ended questions asking students to describe their experiences in the two discussion environments. These

questions were followed by seven multiple choice items asking students to compare the two environments on specific aspects. Each item had five possible responses: TTDE a lot better, TTDE a little better, About the same, QEADE a little better, to QEADE a lot better. For analysis, these responses were assigned numerical values of –2 (TTDE a lot better) to 2 (QEADE a lot better), resulting in a scale with 0 representing no difference between the two environments.

Results

Quantity of Posts

Table 1 presents data on the number and length of posts for discussions in the two environments. T-tests revealed that the number of posts in the QEADE were significantly higher than in the TTDE ($p < .001$). Students also wrote more total words in the QEADE ($p < .01$). The length of individual posts, however, was higher in the TTDE than in the QEADE ($p < .001$), even after splitting original posts to focus on single ideas. This trend was consistent across the two topics. The higher level of participation in terms of total number of posts and words is consistent with the anchored discussion environment studied by Brush et al. (2002).

Nature of the Discussions

Table 2 presents the mean number of posts by student for each category in the focus and depth dimensions. Consistent with the overall greater number of posts in the QEADE, there were more posts in the QEADE for all the categories except the *General Response* category. Though the sample size for this study is small, we ran Chi-square tests to provide a sense of the magnitude of differences between the two environments. We tested whether student posts in the QEADE were significantly different from those in the TTDE in focus and depth. To rule out the difference caused by discrepancy in the total number of posts in the two environments, we calculated the Chi-square based on the proportions of posts in each category. The proportions for the focus categories are presented in Table 3.

Table 1. Number of Posts and Words in the Two Online Discussion Environments

Discussion Environment	Number of Posts	Number of Words	Words per Post
TTDE	58	4424	76.3
QEADE	203	7655	37.7

Table 2. Mean (and Standard Deviation) of Student Posts for Focus and Depth Categories

Category	TTDE (*n* =12)	QEADE (*n* =12)
Question	1.50 (2.12)	7.25 (4.88)
Short	.42 (.79)	4.75 (3.84)
Elaborated	1.08 (1.16)	2.50 (2.97)
Critique	--	--
Text	.25 (.45)	3.33 (2.31)
Short	.00 (.00)	.92 (.90)
Elaborated	.17 (.39)	2.00 (1.86)
Critique	.08 (.29)	.42 (.79)
Person	1.67 (1.23)	5.00 (3.81)
Short	.75 (1.22)	2.58 (2.23)
Elaborated	.92 (.90)	2.17 (1.95)
Critique	.00 (.00)	.25 (.62)
General	1.25 (1.06)	.33 (.49)
Short	.17 (.39)	.00 (.00)
Elaborated	1.08 (1.00)	.33 (.49)
Critique	--	--

There was a significant difference between the two environments ($\chi^2 = 34.661$, $df = 3$, $p < .001$). Given our small sample size, we also calculated effect sizes ($d = (M_{QEADE} - M_{TTDE})/\sigma_{pooled}$, M = mean of the percentage of posts for each categories) to examine the magnitude of differences without making claims of statistical significance. The positive effect sizes for question and text, along with the negative effect sizes for person and general, suggest that the QEADE supported discussions focused on specific text content and discussion questions, whereas the TTDE supported general and person-focused responses.

Proportions and effect sizes for the depth categories are presented in Table 4. Here, too, differences between the two environments were significant ($\chi^2 = 10.312$, $df = 2$, $p < .01$). The negative effect size for elaborated responses is likely

Table 3. Proportion (Standard Deviation) of Students' Posts for Focus Categories

	TTDE (total posts = 56)	QEADE (total posts = 203)	Effect size TTDE vs. QEADE
Question	.0321 (.038)	.488 (.024)	.554
Text	.054 (.008)	.197 (.011)	1.264
Person	.357 (.022)	.296 (.019)	–.261
General	.268 (.019)	.020 (.002)	–1.609

Table 4. Proportion (Standard Deviation) of Students' Posts for Depth Category

	TTDE (total posts = 56)	QEADE (total posts = 203)	Effect size TTDE vs. QEADE
Short	.286 (.024)	.488 (024)	.727
Elaborated	.696 (.036)	.473 (.023)	–.648
Critique	.018 (.005)	.039 (.005)	.359

due to the longer individual posts in the TTDE. QEADE posts tended to be shorter, but contained more critique than did TTDE posts.

Interestingly, there were group variations in how the students responded to the adjunct discussion questions in the QEADE. Study Group 3 had little discussion around the text, and almost all posts were responses to the adjunct discussion questions. In Study Group 2, however, only one student answered every adjunct question, and most student responses to the questions were short. Much of their discussion about the text, however, was related to the adjunct questions. It is possible that even though students did not answer the adjunct questions, they remembered the questions by seeing them appear repeatedly. They would thus think about the questions while they were reading the text, and respond when there was a chance. This suggests embedding discussion questions into the text may have a direct impact on the nature of discussion, an issue not examined by previous research on anchored discussion.

Student Perceptions

Means and standard deviations of the seven Likert-scale survey items are presented in Table 5. A negative mean indicates a preference for the TTDE, a

Table 5. Means and Standard Deviations of the Seven Likert-Scale Survey Items

Survey items	Mean (*SD*)
1. Which discussion environment was better for helping you focus the discussion on the course content?	0.75 (1.29)
2. Which discussion environment was better for helping you pay attention to specific issues in the content?	0.83 (1.19)*
3. Which discussion environment was better for helping you focus on discussion questions?	0.84 (1.16)*
4. Which discussion environment was better for helping you develop in-depth understanding of important issues?	0.25 (0.97)
5. Which discussion environment was better for helping you think critically about the ideas in the reading?	0.75 (1.13)*
6. Which discussion environment was better for helping you participate in the discussion actively?	–0.33 (1.67)
7. Which discussion environment was better for helping you engage in the discussion?	–0.42 (1.44)
Overall Mean	0.31

*$p < .05$.

positive mean indicates a preference for the QEADE, and the absolute value indicates the degree of preference.

Focus of discussion—The first three items addressed students' focus during the discussion. The means of these items were positive, with Items 2 and 3 being significant ($p < .05$), suggesting that students thought the QEADE enabled them to focus better than the TTDE on specific issues in the content and discussion questions. In their responses to open-ended questions, six students explicitly wrote that the QEADE enabled them to comment on the specific text more directly and focus more on the discussion questions. One student believed that the QEADE made the discussion "more structured," whereas discussion in the TTDE "was too general to be productive" (Student 11).

Depth of discussion—The next two comparison items asked the students to compare the depth and critical thinking in the discussions. Students appeared to be unsure of whether the QEADE helped them develop more in-depth understanding of the course content, but they believed it provoked them to think critically about ideas in the readings ($p < .05$). This result is consistent with our analysis of the posts, where the mean of individual student critiques related to text was .08 in the TTDE and .42 in the QEADE.

When students were asked through open-ended questions whether the types of discussion environment affected their learning experiences, 4 out of 11 students who answered the questions stated that the two discussion environments did not differ much in their impact on learning. Five students reported learning more in the QEADE. They wrote, for example, "The Google Docs one [the QEADE] forced me to think more about the text and in more specific terms" (Student 4); discussion in the TTDE "was too wide open to be productive" (Student 11); and "It [the QEADE] made it easier for me to think about the discussion rather than to keep track of the information" (Student 1). These comments may explain why some students thought the QEADE was better for developing in-depth and critical understanding of course content. Two students who felt they had better learning experiences in the TTDE stated that the TTDE was "more user-friendly" (Student 3), or allowed her to have more interaction with her group (Student 6).

Participation and engagement—The last two comparison items asked the students which environment supports more active participation and engaging discussion. The negative mean responses suggested that students had a slightly more positive attitude towards the TTDE, but the difference is not statistically significant.

Several reasons might explain some students' preference to the TTDE environment. First, the students were more familiar with the threaded discussion format in the TTDE, and they might encounter "a slight learning curve" (Student 3) in the QEADE. Second, as some students commented (Student 2 and Student the TTDE in Moodle has better technical support for online discussion with its fully developed functions, such as sending e-mail notifications while new posts are created, properly marking the posts as read or unread, and so on. It was also possible that some students perceived the TTDE as more engaging because, as compared to the QEADE, the TTDE was less restricted (Student 8), allowing students more freedom to write about what they wanted to say.

CONCLUSION

We have argued that research on online discussion should draw more directly than it has in the past on research on reading and learning from text. We also

recommended that research should: (a) focus on the learning of course content; (b) attend to the goals of online discussions; and (c) consider instructional and design features to enhance learning. To focus on goals, our framework for online discussions specifies the most prevalent goals for online discussions: (a) increasing social and community engagement; (b) increasing interactions for knowledge construction; and (c) encouraging cognitive processes. To these general goals could be added more specific goals for particular learning contexts. Our development of the QEADE and our exploratory study were motivated primarily by our recommendation of focusing on the learning of course content; they were prompted by our frustration that online discussions, although engaging, often do not seem to promote thoughtful consideration of course content and ideas. This led to the more specific goal of supporting students to focus their thinking and discussion explicitly on the texts being read, primarily by trying to promote particular cognitive processes.

For considering the features of discussion environments and instructional approaches that can influence the quality of discussions, our framework posits four general clusters of approaches: (a) manipulating the structures of online discussion environments; (b) designing various online learning activities; (c) teaching and modeling ways of interaction; and (d) facilitating and moderating. As we developed the QEADE, our consideration of research on reading and learning from text led us to manipulate the structure of the online discussion environment by juxtaposing the focal text and the discussion and incorporating features such as questions embedded in text and prompts for self-explanation.

Our study of the QEADE in a single online course suggested that these features did, in fact, support students in focusing on course content in the texts being read and discussed. For other goals of online discussion, the QEADE did not appear to be as advantageous. Students found the traditional discussion forum more supportive of their sense of active participation and engagement. This outcome highlights the importance of attending to the multiple goals of online discussions; particular instructional and design features may well have different effects on the various goals of online discussions.

It is also important to note that in our design of the QEADE and the study of it, we focused primarily on a single cluster of instructional and design features: the structure of the discussion environment itself. We did not directly teach particular ways of interacting or rely on facilitators to guide students' discussions. In another study (Gao, Putnam, & Wang, 2008) we have explored the direct teaching of particular discussion strategies (derived from research on the teaching of reading and learning strategies) and the use of labels for discussion posts (a feature of the discussion environment) to promote productive discussions.

Thus, our framework for goals and features of online discussions is helping us focus our research systematically on important aspects of online discussions

and learning. We hope the framework will be useful to the research community by providing a structure within which to consider both existing and future research online discussions. For designers of online discussion environments and instructors and facilitators of online discussions, the framework can help structure the design process by focusing attention on the desired goals of online discussions and the features of the environments and instructional tasks that can be used to promote those goals.

APPENDIX 1: Examples of Ten Types of Posts

Response to the Questions

Short Response

The topic I find most difficult to teach would be solving equations through substitution or elimination to find in the end where the lines intersect. It can be long and tedious and the students have a hard time, especially with the substitution method. (Student 6)

Elaborated Response

I think that the technology that is available to our students would be a useful tool, not only because the visuals are instant and accurate, but that most of our children are highly motivated by technology. Writing is such a chore to most 4th graders, but give them the alphasmarts and they want to write for long periods of time. They understand games and how to navigate with ease and they don't see the time and work involved. If it involves technology, it is fun. (Student 12)

Response to the Text

Short Response

I do use the coordinate plane quite a bit in algebra. Finding the shortest route for a vehicle I taught in middle school but not in high school. (Student 6)

(Responding to a paragraph about coordinate plane and finding the shortest route)

Elaborated Response

This paragraph makes me think about several lessons in which I challenge my students to find a way to "carpet" our classrooms. These brainstorm in groups and it is always interesting to hear how they would find the area of the class so they know how much carpet to buy. I believe giving children real-life problems and examples where they use geometry makes the ideas more concrete. (Student 7)

Critique

What I get stuck on when teaching geometry is how much emphasis should be put on proof. The standards seem to lack an explicit answer to this. Does the NCTM want students to be able to prove relationships, or do they want them to just be able to make informal "logical arguments"? For example, do we ask student to prove a certain quadrilateral is a kite, or do we ask them what type of quadrilateral is shown? To me there is a big difference between the two. (Student 3)

Response to People

Short Response

I agree. Technology is a good tool that can be introduced later on to help students check there answers or think about something from a different perspective. (Student 4)

Elaborated Response

I agree with you that Geometry helps students think abstractly and logically. For example, in one of our Geometry units we talk with kids about why triangles are used so often in the design of buildings, bridges, etc. We are trying to get the students to see the geometry goes beyond the classroom and try to get them think more about their surroundings. I feel that because there are so many real world examples we use with our Geometry units that is why so many of my students often find more success with these units then in previous units. (Student 10)

Critique

I agree. But I also think it's more than polygons and 3D figures. Spatial visualization in general and reasoning/logic skills are also important parts of geometry and often get left out. (Student 8)

Response to General Issues

Short Response

What text are you using in your classes? I am looking for a very basic geometry book for my college class. (Student 3)

Elaborated Response

Example 1

I think that the technology that is available to our students would be a useful tool, not only because the visuals are instant and accurate, but that most of our children are highly motivated by technology. Writing is such a chore to most 4th graders, but give them the alphasmarts and they want to write for long periods of time. They understand games and how to navigate with ease

and they don't see the time and work involved. If it involves technology, it is fun. (Student 12)

Example 2

I think one of the bigger problems is that elementary teachers don't like math as much (in general) and don't teach their best while working in the math content. I know they realize the importance, but do they enjoy it enough to make it as meaningful as they could? Not so sure. As for what they "should" be teaching, what the PSSM says and what a district's curriculum says don't always align. Yes, it was nice to read NCTM's view on what kids should know, but that is different. But alas, it's semantics, really. My kids still come to my room not knowing what they should—whether according to my district or the NCTM. (Student 8)

APPENDIX 2: Survey Questions

Section One: Short Answer Questions

1. What is your general experience of participating in the two different types of discussion?
2. What do you think are the differences in participating in the two discussion environments?
3. How did the two discussion environments impact your participation differently?
4. How did the two discussion environments impact your learning of course content differently?

Section Two: Likert Scale Questions

5. Which discussion environment was better for helping you focus the discussion on the course content?
6. Which discussion environment was better for helping you pay attention to specific issues in the content?
7. Which discussion environment was better for helping you focus on discussion questions?
8. Which discussion environment was better for helping you develop in-depth understanding of important issues?
9. Which discussion environment was better for helping you think critically about the ideas in the reading?
10. Which discussion environment was better for helping you participate in the discussion actively?
11. Which discussion environment was better for helping you engage in the discussion?

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Direct reprint requests to:

Fei Gao
2255 University Hills Blvd., Apt. F105
Toledo, OH 43606
e-mail: gaofeil@msu.edu