

CRLT Technical Report No. 2-98

Content Analysis of Online Discussion in an Applied Educational Psychology

Noriko Hara, Curtis J. Bonk, &
Charoula Angeli

November 20, 1998

© 2000 Kluwer Academic Publishers, the Netherlands.
Republished with permission from *Instructional Science*,
28:2, pp. 115-152, 2000, Hara.



INDIANA UNIVERSITY

W.W. Wright Education Building, ED 2201
Bloomington, IN 47405-1006

About the CRLT

The CRLT has as its mission to promote and support a community of scholars dedicated to research on the design, use, and implementation of technology to improve learning. Three primary themes underlie the work at the Center:

- research that contributes to the development of new pedagogical models for continuing professional development in the 21st century;
- research on and evaluation of interactive distance learning environments that inform our understanding of student learning; and
- research on teaching strategies for using current and emerging technologies to support student interaction, collaboration, and engagement in the issues being studied.

This report is one of a series from our on-going research on learning and technology. If you have any questions or comments on this report, or if you would like to find out more about the activities of the CRLT, contact:

The Center for Research on Learning and Technology
W.W. Wright Education Building
201 N. Rose Avenue Room 2201
Indiana University
Bloomington, IN 47405

(812) 856-8200
crlt@indiana.edu

Content Analysis of Online Discussion

In an Applied Educational Psychology Course

Abstract

This study analyzed discussion in an online conference that supplemented class discussion using an instructional method called the starter-wrapper technique within a traditional graduate level educational psychology course. Various quantitative measures were recorded to compare instructor and student participation rates. In addition, Henri's (1992) model for content analysis of computer-mediated communication was employed to qualitatively analyze the electronic discourse. Using this model, five key variables were examined: (1) student participation rates; (2) electronic interaction patterns; (3) social cues within student messages; (4) cognitive and metacognitive components of student messages; and (5) depth of processing—surface or deep—within message posting. Transcript content analyses showed that, while students tended to post just the one required comment per week in the conference, their messages were lengthy, cognitively deep, embedded with peer references, and indicative of a student oriented environment. Moreover, students were using high level cognitive skills such as inferencing and judgment as well as metacognitive strategies related to reflecting on experience and self-awareness. Weekly conference activity graphs revealed that student electronic comments became more interactive over time, but were highly dependent on the directions of discussion starter. To better understand the impact of electronic conferencing discourse, modifications to Henri's model as well as qualitative research suggestions were offered.

Key words: computer conferencing, online learning, technology, cognitive skills, metacognition, social interaction, educational psychology, content analysis.

Introduction

There has been extensive discussion about the advantages of using technology to create a shared space among learning participants (Schrage, 1990). As such, it is important to consider the dynamics of the online discussion and how it may facilitate student's cognitive and metacognitive development. In addition, there is a pressing need to understand how instructors might use computer conferences to design an electronic learning community for their students. The purpose of this study on computer-mediated communication (CMC), therefore, was to explore how students interact online in a student-centered environment. The investigation was not focused on individual student learning and achievement outcomes, but was intended to document how electronic environments encourage higher-order cognitive and metacognitive processing. Since this research explored how online discussion might foster student social interaction and dialogue, various content analyses methods were incorporated to better understand the dynamics of this computer conference.

CMC Advantages and Disadvantages

For the past ten years, computer-mediated communication (CMC) has been seen as a revolutionary tool to support instruction (Kang, 1998; Rice, 1989). Among the consistently cited advantages of CMC is the removal of time and space restrictions (Barnes & Greller, 1994; Harasim, 1993; Henri, 1992; Kuehn, 1994; Rice & Love, 1987). The asynchronous or delayed capabilities of these conferencing tools, for instance, allows learners some control, while increasing "wait-time" and general opportunities for reflective learning and processing of information. Although the benefits of increasing wait-time have been established in traditional classrooms (Berliner, 1987), such findings need to be extended to CMC environments.

In addition to wait-time, researchers such as Newman (1992) advocate giving students ample time to think in order to cultivate classroom thoughtfulness. The combined interactivity and asynchronous nature of CMC should encourage students to reflect on their own perspectives (Harasim, 1993), express their ideas, and learn from the content of the interaction itself (Henri, 1992). Additionally, such technology provides a permanent record of one's thoughts for later student reflection and debate. When participant comments are logged, they can be reused later as an instructional tool to model expected answers and discourse patterns as well as provide a lasting class or group legacy. At the same time, computer logging devices and dialogue transcript records provide researchers with useful tools for tracking student development both over extended periods of time as well as within a single online session. Finally, they can also help determine the factors assisting in the development of learning communities.

Despite these clear advantages, there are also a myriad of disadvantages with CMC. For example, the removal of time constraints can require overload both instructors and students with ceaseless opportunities to learn and work. In addition, the lack of visual communication cues is another significant disadvantage of CMC (Kuehn, 1994). When nonverbal cues—gestures, smiles, or tone of voice—are absent, users are

forced to make certain assumptions about their audience. The other key disadvantage that CMC users often fail to recognize is that "active listeners" or "lurkers" might read but not respond to the conferencing messages (Shapard, 1990). In most computer conferencing systems, users are often not aware of or privy to who is out there lurking in the virtual environment. And when they do know, fictional usernames often grant little insight on their needs or purposes. While such individuals may actually be learning out on the community periphery, other participants do not know if these lurkers agree with the discussion or to what degree they are even reading the messages.

Additional problems depend on the system being used. Most electronic communication tools still limit the channels of input to text only submissions, though some now contain computer graphics and sound options. When the channels of communication are reduced to textual exchanges, however, students with lower verbal skills may be placed at a distinct disadvantage.

Although the benefits and disadvantages of CMC have been widely debated (Kang, 1998), there remains a need for more research on CMC to further inform these debates. The research that does exist, tends to too narrowly focus on accessibility of CMC, the impact of CMC on students' attitudes, and the effects of CMC on society, teaching, and student learning (Romiszowski & Mason, 1996), not on the cognitive processes and products of student electronic interchanges.

Research on CMC

Computer-Mediated Communication (CMC) is an emerging research area in the education, communication, psychology, and technology fields. Research using content analysis during the 1990s has uncovered various virtues and drawbacks in computer conferencing activities (Ahern, Peck, & Laycock, 1992; Henri, 1992; Kuehn, 1994). For instance, past research studies reveal that a moderator's role in CMC is significant for electronic interaction success (Ahern et al., 1992; Feenberg, 1987; Howell-Richardson & Mellar, 1996; Zhu, 1998). In one study, Ahern et al. designed three divergent mediator roles each representing different types of teacher discourse in a computer-mediated discussion: questions-only, statements-only, and conversational. Of the three, they found that the conversational condition produced greater participation and more complex student interaction. However, little mention was made here regarding the quality of student electronic commenting and depth of cognitive processing.

The study cited above by Howell-Richardson and Mellar (1996) also failed to address student cognitive and metacognitive skill taking place during student participation in their CMC conferences. In addition, their differentiation between task focus and group focus was difficult to distinguish because such categories are interrelated and highly subjective. In contrast, Zhu (1998) explicitly analyzed the forms of electronic interaction and discourse (e.g., discussion, information sharing, reflection, high or low level questioning, etc.), the forms of student participation (i.e., wanderer, seeker, mentor, or contributor), and the direction of participant interactions (i.e., vertical or horizontal). In addition, she also created a model for the patterns of knowledge construction in student electronic discussion. In this model, Zhu begins to illustrate

Hara, Bonk & Angeli: Content Analysis of Online Discussion

how new insights, knowledge, perspectives, and understandings result from instructional scaffolding within students' zone of proximal development (Vygotsky, 1978).

During the past two decades, the most popular methodologies used in research on CMC have been survey research (e.g., Grabowski, Suciati, & Pusch, 1990; Hiltz, 1990; Phillips & Pease, 1987) and evaluative case studies (e.g., Mason, 1990; Phillips, Santoro, & Kuehn, 1988). A fairly popular research methodology today is content analysis of the quantitative data recorded in computer systems (Harasim, 1987; Levin, Kim & Riel, 1990; Mowrer, 1996). For example, Henri (1992), a pioneer in the development of criteria for content analysis, developed a useful tool for online discussion analysis. She identified five key dimensions for analysis of online discussion, namely, (1) participation rate (e.g., raw number and timing of messages); (2) interaction type (e.g., direct response: "in response to Sussie's suggestion to..." or indirect commentary: "the problem being discussed in the last few posts requires us to..."); (3) social cues ("This is my birthday, what a great day"); (4) cognitive skills (e.g., Judgment: "I disagree with direction of this discussion so far...") and depth of processing which differentiates surface level processing (e.g., repeating of what was already stated) from deep level processing (e.g., providing of the advantages and disadvantages of a situation); and (5) metacognitive skills and knowledge ("I think the readings beg us to consider the following three key questions first before we plan a solution"). Henri suggests that these five dimension can be used to effectively classify electronic messages. Although her model provides an initial framework for coding CMC discussions, it lacks detailed criteria for systematic and robust classification of electronic discourse (Howell-Richardson & Mellor, 1996). As a result, a key focus of our study was to analyze twelve weeks of electronic collaboration for the purpose of constructing better guidelines on how computer conferencing can be analyzed while building upon Henri's existing framework.

Among our research questions were:

1. How extensive would the social, cognitive, and metacognitive commenting be in structured electronic conversations of weekly course readings?
2. Would students engage in extended social interaction and dialogue when required to participate just once per week? And what level of cognitive processing would be exhibited in their posts, surface or in-depth processing?
3. What are the electronic interaction patterns when students take on the roles of starter and wrapper within weekly discussions?
4. Do interaction patterns change over time? For instance, is there increasing peer interaction and feedback?
5. What is the role of the instructor or facilitator in these weekly interactions?

Methodology Study Rationale and Importance

Whereas many research studies use quantitative methodology for online content analyses (e.g., Mowrer, 1996; Walther & Tidwell, 1995), there is a growing emphasis on qualitative tools such as interviews and observations (Iseke-Barnes, 1996; Riel, 1990; Romiszowski & Mason, 1996). To utilize the benefits of both methods, the present study applied both quantitative and qualitative criteria to analyze the content of computer conferencing and the forms of electronic interaction. While we were ultimately interested in how a community of learning can be built using online discussion, this study was more specifically focused on the social and cognitive processes exhibited in the electronic transcripts as well as the interactivity patterns among the students.

Although content analysis in CMC is arguably "one of the most promising areas for research" (Kuehn, 1994), minimal research exists in this area (Rice, 1989; Romiszowski & Mason, 1996). One reason for this dearth of content analysis research is the time required to perform such analyses. Secondly, researchers still lack a reliable instrument for content analysis of online discussion. In addition, many studies using content analysis have typically used CMC for portions of a case or for research purposes, not for a substantive portion of course requirements (e.g., Ahern et al., 1992; Howell-Richardson & Mellar, 1996; Mowrer, 1996) (see below for an explanation of content analysis and a distinction between content and discourse analysis). In contrast, the study reported here examined the dynamics of an online discussion as a part of the required activities of an actual course. This study, therefore, aims to establish criteria to analyze the content of a computer conference that perhaps will provide an entry point for other work in this area.

Subjects

Our research study took place within an applied cognitive psychology graduate level course at a major Midwestern university in the United States during the Spring of 1997. The class was held for 15 weeks in a traditional college classroom setting. However, this educational psychology class was chosen because, like many current college classrooms, it took advantage of the power of an asynchronous or delayed computer conferencing software system (i.e., *FirstClass*) as a partial replacement for traditional classroom discussion. As pointed out later, an asynchronous conference was selected since our previous research on electronic conferencing revealed that the time and place independence of this type of conferencing would foster more depth and peer responsiveness than synchronous discussions (Bonk, Hansen, Grabner-Hagen, Lazar, & Mirabelli, 1998).

Initially there were twenty-two students in the class, but two students dropped after the second week. The remaining twenty students, 12 males and 8 females, had backgrounds in special education, literature, educational psychology, counseling, and instructional systems technology (note: one of these of these twenty students was an advanced undergraduate; the rest were master's and doctoral students). Each week corresponded to a distinct topic in applied cognitive psychology such as Week 5 on Study Skills or Week 9 on Science Education.

Unlike many other CMC studies, computer conferencing was an integral component of course activities and accounted for slightly over 10% of student final grades. *FirstClass*, mentioned above, was available for students to access from any computer terminal within the university computer network. The computer conference was organized with the same weekly thematic focus as covered during class. Student contributions to the weekly *FirstClass* discussions were based on their required readings which ranged from three to five articles and/or chapters per week and were to be submitted prior to the regular weekly class meeting.

As a part of the basic course requirements, each student signed up at least once for the role of “starter” who initiated weekly discussion by asking questions related to the readings and at least once for the role of “wrapper” who summarized the discussion on the readings for the week. In effect, a starter read the material for the week before the other class members and, then, in the *FirstClass* conference, attempted to summarize what he or she considered to be the key points, issues, and questions for that particular week. A wrapper, on the other hand, waited to contribute to the online discussion until after class lecture, thereby assuring that most students would have posted to conference. A wrapper read all the *FirstClass* postings for a week and attempted to summarize key contributions and point out overlapping ideas, problematic issues, apparent student debates, and future directions for the field.

Data and Instruments

As used in Henri’s mode, content analysis was chosen as the main methodology to analyze the online discussion. Content analysis is a generic name for a variety of textual analyses that typically involves comparing, contrasting, and categorizing a set of data (Schwandt, 1997); in this case, online discussions. According to Schwandt, content analysis can involve both numeric and interpretive data analyses. However, because computer conferencing involves conversations among participants, some researchers have linked their research to the discourse analysis literature (e.g., Yagelski & Grabill, 1998). Since this particular study is more concerned with analysis and categorization of text than with the process of communication or specific speech acts, as in discourse analysis, it primarily relies on content analysis methodology.

By using both quantitative and qualitative measures, we hoped to provide a more comprehensive picture of online discussion in a university-level course than is typically found in the research literature on CMC. Although electronic content analysis schemes are still under development (Henri, 1992; Howell-Richardson & Mellar, 1996), they appear to capture the richness of the student interactions. As indicated, Henri (1992) proposes an analytical framework to categorize five dimensions of the learning process evident in electronic messages: student participation, interaction patterns, social cues, cognitive skills and depth of processing, and metacognitive skills and knowledge. While her taxonomy of skills and processes is interesting and insightful, Howell-Richardson and Mellar (1996) criticized its scoring reliability due to the lack of precise criteria to judge each category. As will become clear, while Henri’s work provides a

way to discuss interesting cognitive and metacognitive variables in computer conferences, aspects of the model are fairly ambiguous and inadequate for capturing the richness of electronic discussion in a clear manner. As a result, we added several categories and examples to her framework to match our needs. In addition, instead of using Henri's model to code interaction type (e.g., direct/explicit, indirect/implicit, or independent response), we decided to incorporate Howell-Richardson and Mellar's (1996) proposal to understand the structure of discourse at both the surface level and deeper underlying patterns of interaction through visual representations of electronic conferencing. By combining Henri's criteria related to message interactivity (i.e., explicit, implicit, and independent commenting) and Howell-Richardson and Mellar's visual representation of message interaction, we created weekly conference activity graphs illustrating the associations between online messages. Quantitative data, such as the number and length of student messages, were also collected.

The twelve weeks of conferencing within *FirstClass* were analyzed quantitatively, including the total number of messages posted during the conference, the average word length of post, and the number of student and instructor participations per week as well as across the twelve weeks of conferencing. Four randomly chosen weeks were analyzed qualitatively using content analysis as well as conference activity graphs drawn to depict referential links between students' messages. Those four discussion topics were: Week 2: Human Information Processing Theory, Week 4: Thinking Skills, Literacy, and Problem Solving Programs, Week 8: Mathematical Problem Solving Strategies and New Standards, and Week 10: Social Science Problem Fuzziness and Classroom Thoughtfulness. These discussions were analyzed using Henri's five dimensions, though, as indicated, her criteria had to be modified slightly to accommodate the data collected here.

Since any message could conceivably contain several ideas, the base "Unit" of the analysis was not a message, but a paragraph. It was assumed that each paragraph in a submission was a new idea unit since college-level students should be able to break down the messages into paragraphs. Thus, when two continuous paragraphs dealt with the same idea, they were each counted as a separate idea unit. And when one paragraph contained two ideas, it was counted as two separate units.

To validate the coding procedures of the modified categories from Henri's model, described later, one rater coded the dialogue for cognitive and metacognitive skills exhibited in the four selected weeks on three separate occasions. Several days elapsed between each analysis. In addition, a second rater separately coded the dialogue for three of these weeks. Interrater reliability was 78 percent for the social category, 75 percent for the cognitive category, and 71 percent for the metacognitive skill dimension of Henri's model. The aggregate interrater reliability across these three categories was approximately 75 percent and was deemed adequate given the subjectiveness of such scoring criteria. In addition to those analyses, the first rater and a third rater coded the messages, not the idea units, for all four weeks for indicators of depth of processing; surface level or in-depth level (criteria are described later). Since interrater reliability was only

Hara, Bonk & Angeli: Content Analysis of Online Discussion

72 percent, all disagreements were discussed until 100 percent agreement was reached. Problems were initially encountered because some messages contained instances of both surface level and deep processing.

Quantitative Data

The total number of messages from students and the instructor for each week were analyzed. The data indicate the frequency of student and instructor participation as well as the total number of weekly messages.

Qualitative Data and Content Analysis Criteria

As indicated, this study paralleled many of Henri's (1992) recommendations for content analysis in online discussions. First, the interaction patterns in the computer-mediated computer conferencing were mapped out. Next, the social cues apparent in the *FirstClass* dialogue were coded. Third, both the cognitive and metacognitive skills embedded in these electronic conversations were analyzed to better understand the mental processes involved in the discussions. Finally, each message was evaluated for the depth of processing, surface or deep.

Electronic Interaction Patterns

In terms of the concept of interactivity, Henri's model consists of three steps. They include: (1) communication of information; (2) a first response to this information; and (3) a second answer related to the first. This process can be represented schematically in the following manner:

A =====> B =====> A =====> B" (Henri, 1992, p. 128).

The interaction in this particular conference appeared to be much more complex, however. For example, since more than two participants were usually involved in each discussion, the interaction or message intent was not always as linear as Henri's (1992) model might suggest. Certainly, student B could respond to Student C, D, and E as well as to Student A. In addition, starter and wrapper roles of this activity were designed to create more complex interactions than the simple concept of interactivity drawn out above. Additional deviations from the above model occurred because most participants attended the conference just once per week. As a result, this participation pattern typically created a one-way, not two-way, interaction, because the students who initially started a discussion (message A) seldom participated a second or third time during a particular week.

Due to these problems, a visual mapping of the messages (i.e., a conference activity graph with each message being sequentially numbered) was used in order to capture the interactive process in online discussion. Messages were identified by one of three categories: "explicit interaction," "implicit interaction," and "independent statement" (Henri, 1992). Explicit interaction was a direct response or commentary to a specific message or person which was noted on the conference activity graphs by drawing a line with an arrow. For example, 5 ==> 2 means that the fifth message is a response to the second message by using a direct reference to an online conference participant. A more implicit interaction

involved indirect responses or commentary, wherein the content of another person's posting was mentioned, but not the name of the contributor. Implicit interaction was linked by a dotted line with an arrow. Lastly, an independent statement was shown as an isolated number since it lacks referential cues to previous messages and does not lead to further statements.

Social Cues

Many studies have attempted to analyze the social effects of conferencing exchange, since social cues are important in this form of analysis (Henri, 1992; Kuehn 1994; Rice & Love, 1987; Walther, 1996). This study also explores the frequency of the social cues or acknowledgments (Bonk, Malikowski, Angeli, & East, 1998). Social messages were defined by Henri (1992, p. 126) as a "statement or part of a statement not related to formal content of subject matter." Social cues might include a self-introduction, expression of feeling (e.g., "I'm feeling great,,,,, "), greeting (e.g., "Hi, everyone"), closure (e.g., "That's it for now"), jokes, the use of symbolic icons (e.g., :) or :-)), and compliments to others.

Cognitive Skills and Depth of Cognitive Processing

The categories shown in Table 1 for identifying cognitive skills embedded in student electronic discussions were adapted and modified from Henri (1992). In response to criticisms mentioned earlier, more indicators specific to this particular conference were added to Henry's model to support our analyses.

Reasoning Skills	Definitions	Indicators
Elementary clarification	Observing or studying a problem identifying its elements, and observing their linkages in order to come to a basic understanding	Identifying relevant elements Reformulating the problem Asking a relevant question Identifying previously stated hypotheses Simply describing the subject matter
In-depth clarification	Analyzing and understanding a problem to come to an understanding which sheds light on the values, beliefs, and assumptions which underlie the statement of the problem	Defining the terms Identifying assumptions Establishing referential criteria Seeking out specialized information Summarizing
Inferencing	Induction and deduction, admitting or proposing an idea on the basis of its link with propositions already admitted as true	Drawing conclusions Making generalizations Formulating a proposition which proceeds from previous statements
Judgment	Making decisions, statements, appreciations, evaluations and criticisms Sizing up	Judging the relevance of solutions Making value judgments Judging inferences "I agree, disagree,..."
Application of strategies	Proposing co-ordinated actions for the application of a solution, or following through on a choice or a decision	Making decisions, statements, appreciations, evaluations and criticisms Sizing up

Table 1. Analysis Framework: Cognitive Skills (adapted and modified from Henri, 1992).

As apparent in Table 1, Henri was interested in how cognitive level of one’s electronic contribution related to student understanding, reasoning, and the development of critical thinking and problem solving skills. It is interesting to point out that Henri’s suggestions are similar to Benjamin Bloom’s (1956) Taxonomy of Educational Objectives for the cognitive domain which has allowed countless researchers to explore the level of questioning and discourse in traditional classroom settings and, more recently, in electronic ones (Bonk & Sugar, 1998). Bloom’s (1956) taxonomy for the cognitive domain describes progressively higher levels of cognitive activity from factual information at the knowledge level to judgment and rating of information at the evaluation level. From our perspective, Henri’s “elementary clarification” is similar to Bloom’s knowledge level, Henri’s “in-depth clarification” is akin to both Bloom’s comprehension level, Henri’s “strategies” categories is like Bloom’s application level, Henri’s “inference” category is similar to Bloom’s synthesis level, and Henri’s “judgment” category is synonymous with Bloom’s evaluation level. There is no level in Henri’s system which relates directly to the fourth level of Bloom’s taxonomy, namely “analysis.” Nonetheless, it is unclear whether Henri intended these five cognitive skills to be hierarchical.

To further understand the presence and frequency of certain cognitive skills, Henri's model also identified the level of information processing, surface or in-depth processing, as adopted from Entwistle and Waterston (1988). According to Henri, surface level processing includes such factors as making judgments without justification, stating that one shares ideas or opinions already stated, repeating what has been said, and asking irrelevant questions. In contrast, in-depth processing was apparent when one linked facts and ideas, offered new elements of information, discussed advantages and disadvantages of a situation, and made judgments that were supported by examples and/or justification. In effect, in-depth statements were more integrated, weighty, and refreshing, while surface level statements were fragmented, narrow, and somewhat trite. Since Henri's criteria for surface and deep processing were fairly subjective, we decided to analyze each message for the level of processing, not each idea unit within these messages. Some messages, however, clearly contained both surface level and deep processing statements and were coded as such.

Metacognition

Henri's model also calls for two distinct classifications of metacognition: metacognitive skills and metacognitive knowledge. Metacognitive knowledge relates to knowledge of one's own cognition and the regulation of that cognition: (1) perceptions and understandings of oneself as a learner and a thinker; (2) analyses of the types of cognitive tasks one may encounter; and (3) the realization of the strategic knowledge, both processes and procedures, needed for more effective learning and thinking (Alexander, Schallert, & Hare, 1991). Inferring one's person, task, or strategic knowledge from electronic conferencing messages was extremely difficult and subjective. Therefore, this analyses was dropped from consideration here after some exploratory codings.

Knowledge	Definitions	Indicators
Person	All that is known or believe about the characteristics of humans as cognitive beings	Comparing oneself to another as a cognitive agent Being aware of one's emotional state
Task	All information acquired by a person in terms of the task or deferent types of task Appreciation of the quality of available information	Being aware of one's way of approaching the task Knowing where the task is new of know "Thanks, Linda, for the good quality questions"
Strategies	Means chosen to succeed in various cognitive tasks	Strategies making it possible to reach a cognitive objective of knowledge acquisition Metacognitive strategies aimed at self-regulation of process

Table 2. Analysis Framework: Metacognitive Knowledge (adapted and modified from Henri, 1992).

On the other hand, the types of metacognitive skills exhibited within the dialogue, such as planning, regulation, evaluation, and self-awareness, were coded. However, we added the category of “reflection” and modified the “regulation” category to include “self-questioning” as well as inserted other more specific criteria to Henri’s model (see Table 2). These processes were added to the existing model since they are deemed essential to self-directed learning (King, 1992; Salomon, 1993; Schon, 1983) and were hoped to increase scoring reliability. Coding was, nonetheless, difficult. For instance, a self-introduction might represent both cognitive skills as well as a social cue or comment; wrapping or summarizing discussion might be considered a form of self-regulated learning; and starting a discussion or providing short message introductions might correspond with ideas of planning.

Results

Electronic Participation Findings

There were a wealth of interesting electronic participation issues here. First of all, students dominated the discussion, not the instructor; a finding that indicated that this conference was at least somewhat student-centered. The instructor was purposefully creating a learning environment wherein students were in charge of their own learning and responsive to each other. From this perspective, the roles of starter and wrapper helped foster student responsibility for each discussion. In forcing students to assume the roles of teacher and discussion participants, it was hypothesized that the students would become more engaged and comfortable with the conferencing system. Simply stated, a starter had to read the material so that he/she could explain it to the others and not look absurd or foolish to his or her peers. In addition, other participants would have a difficult time adding to such discussions without completing the weekly readings.

A second key finding was that most students posted just one message per week in order to satisfy the minimum course requirement. As the quantitative data in Table 3 document, most students did not make extensive use of the conferencing tool, but participated in this online discussion primarily to meet a course requirement. Thus, student interactions were more reflective of one-way than two-way interactions.

Week	Total # of messages	Total # of instructor's messages	Total # of students' messages	Average # of message per student	Discussion period
week 2	22	0	22	1 (n = 22)	1/19 - 4/27
week 3	23	3	20	1 (n = 20)	1/23 - 2/11
week 4	24	2	22	1.1	2/03 - 2/20
week 5	26	7	19	0.95	2/07 - 2/14
week 6	25	1	24	1.2	2/16 - 4/24
week 7	22	2	20	1	2/20 - 4/28
week 8	22	0	21	1.05	2/28 - 4/28
week 9	22	2	20	1	3/12 - 4/27
week 10	23	3	20	1	3/24 - 4/28
week 11	21	2	19	0.95	3/27 - 4/28
week 14	22	1	21	1.05	4/16 - 4/28
week 15	19	2	17	0.85	4/23 - 4/28
total/ave	271/22.6	2.1	20.4	1.01	

Table 3. Weekly Participation in *FirstClass* in Spring, 1997.

We also analyzed the average length of a student's post. For instance, in Week 2, participants wrote about 293 words per post or about 17.4 sentences with a range of 33 to 1,058 words and 1 sentence to 58 sentences. By comparison, in Week 4, participants wrote slightly less or about 252 average words and approximately 14.5 sentences per post. In Week 8, which covered the research on cognitive processes and learning strategies in mathematics, participant contributions jumped to an average of 335 words per post or nearly 20 sentences. The range of a single post in this week was 78 to 686 words or 5 to 37 sentences. Week 10 text generation was even higher with two students writing more than 1,000 words in their posts. Across these four weeks, participants averaged 317 words or about 18 sentences per post. Clearly, this is one sign of depth to student electronic interaction and an indicator that this electronic writing device enabled students to reflect on and discuss their ideas after completing the readings.

Table 3 shows the quantitative data of the weekly online discussion for this entire class. Participant contributions across the 14 weeks of conferencing were fairly consistent.

Electronic Interaction Pattern Findings

Walther (1996), in studies comparing face-to-face to computer-mediated communication, has found that while students in CMC strive to develop similar social relationships to those found in face-to-face settings, such relationships take longer to establish electronically. The present study endorses such findings. After analyzing the conference activity graphs week by week in this study, several unique patterns of interaction emerged: (1) the second week had "starter-centered" interaction; (2) the fourth week had "scattered" interaction, in part, because no one assumed the role of the starter in the discussions that took place that week; (3) the eighth week had "synergistic" interaction (i.e., it had a cohesive feel with the interaction of the participants creating a combined effect that perhaps was greater than the sum of the individual efforts); and (4) the tenth week had "explicit" interaction.

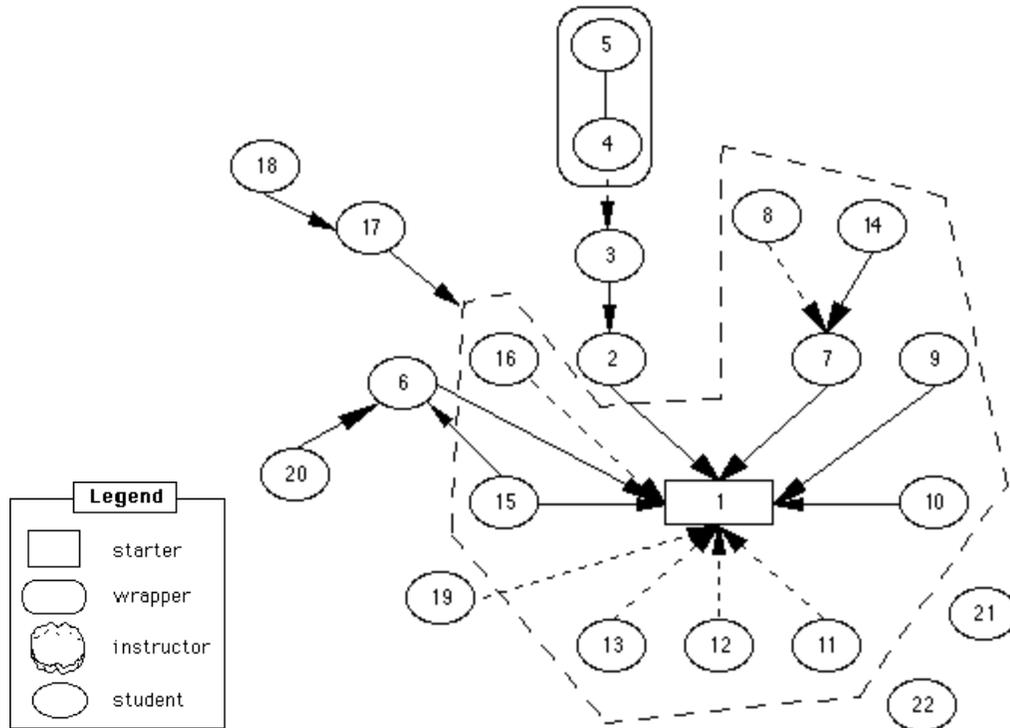


Figure 1. Conference activity graph for week 2 (Starter-Centered).

In Week 2, most messages referred to the starter (#1) (see Figure 1). As a result, participant interactions for Week 2 were labeled as "starter-centered." Although almost all the messages directly or indirectly pointed to the starter's message (nine students directly refer to starter), some refer to several different messages. There were also some isolated or independent messages (#21 and #22). Briefly stated, then, in this starter-centered discussion, students participated as if the starter were the teacher or authority figure.

In Week 4, the wrapper (#15) provided a general descriptive analysis of messages and reviewed the discussion as a whole (See Figure 2), but other messages were scattered in terms of interactions due to the fact that the starter for this week had dropped the course (see Figure 3). Hence, a label of "scattered" was used to describe the comments for this particular week. We also found that student postings were more random and less interactive when the online discussion begins informally without a starter. Just seven students directly referred to others in their content and nearly all the messages (all except #4), refer to just a single message. However, a few of the messages (#2, #3, and #5) received multiple references from one's

peers. There were several isolated messages in this week as noted in Figure 3 (without the wrapper data), illustrating the critical need for integrative starter and wrapper postings in the online discussion.

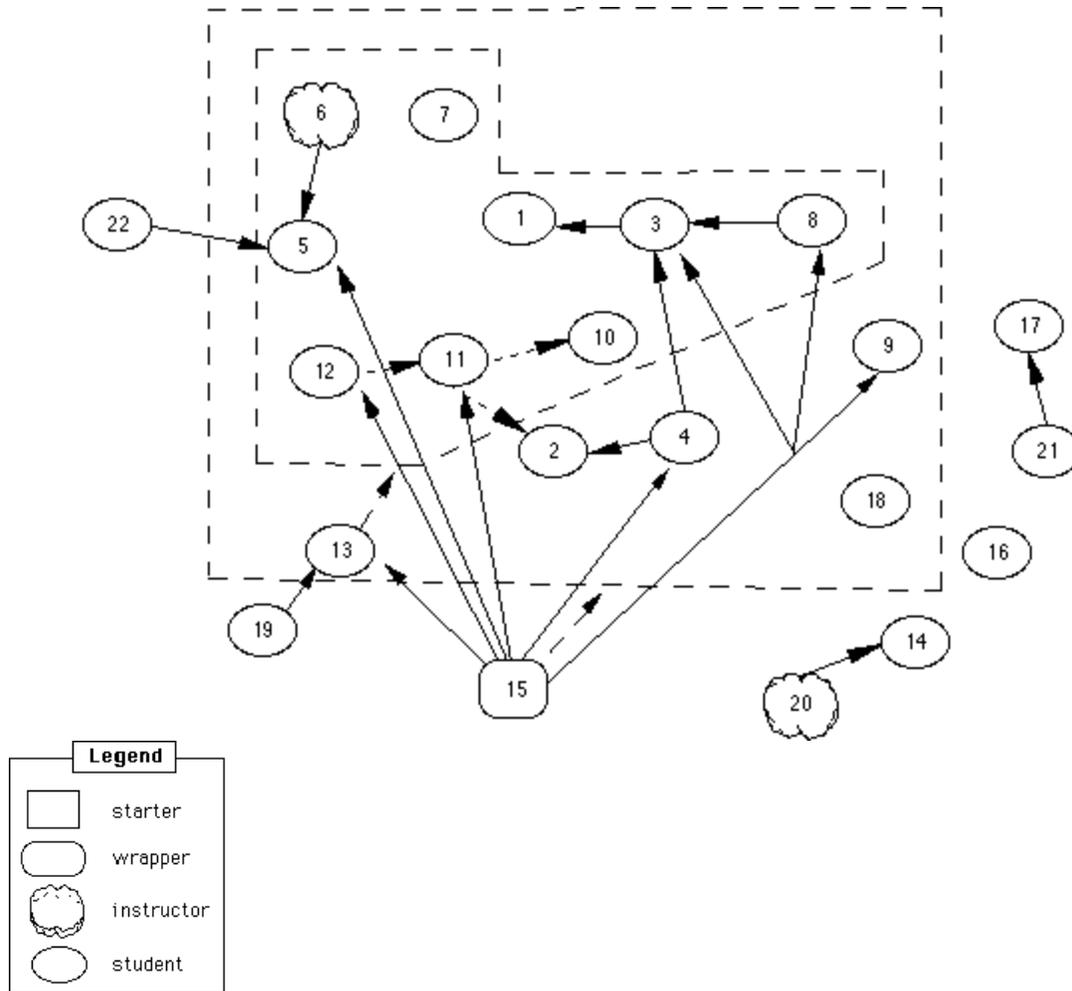


Figure 2. Conference activity graph for week 4 (Scattered).

In contrast to Weeks 2 and 4, in Week 8, every message was connected either directly or indirectly (see Figure 4). In addition, two messages (excluding the wrapper) referred to multiple messages. Some students voluntarily played a role similar to a wrapper or attempted to summarize the previous statements of their peers. Therefore, the interaction during this week was labeled as "synergy." Despite this interactive and synergistic feel, many messages referred to the starter, although less than in Week 2. Once again, such findings were a signal of the strong influence of the starter within electronic discussion. Excluding the starter, a few of the messages (#2, #3, #9, and #15) were referenced by several students. This suggested that students were beginning to pay attention to multiple messages and message threads. In effect, the longest

length of message chain was six messages compared to three messages in Week 2. Thus, the discussion later in the semester was more continuous and engaging.

By Week 10, only two messages (#3 and #22) were considered implicit interactions as indicated in Figure 5 by the dotted line with an arrow. Therefore, this interaction was labeled as "explicit." Almost all the messages were connected except for comments #6 and #10; with comment #10 being a comment to the entire class and comment #6 representing a monologue. While connections exist in Week 10, most of the messages referred to only one message. In addition, the longest length of the message chain was six, matching that observed in Week 8.

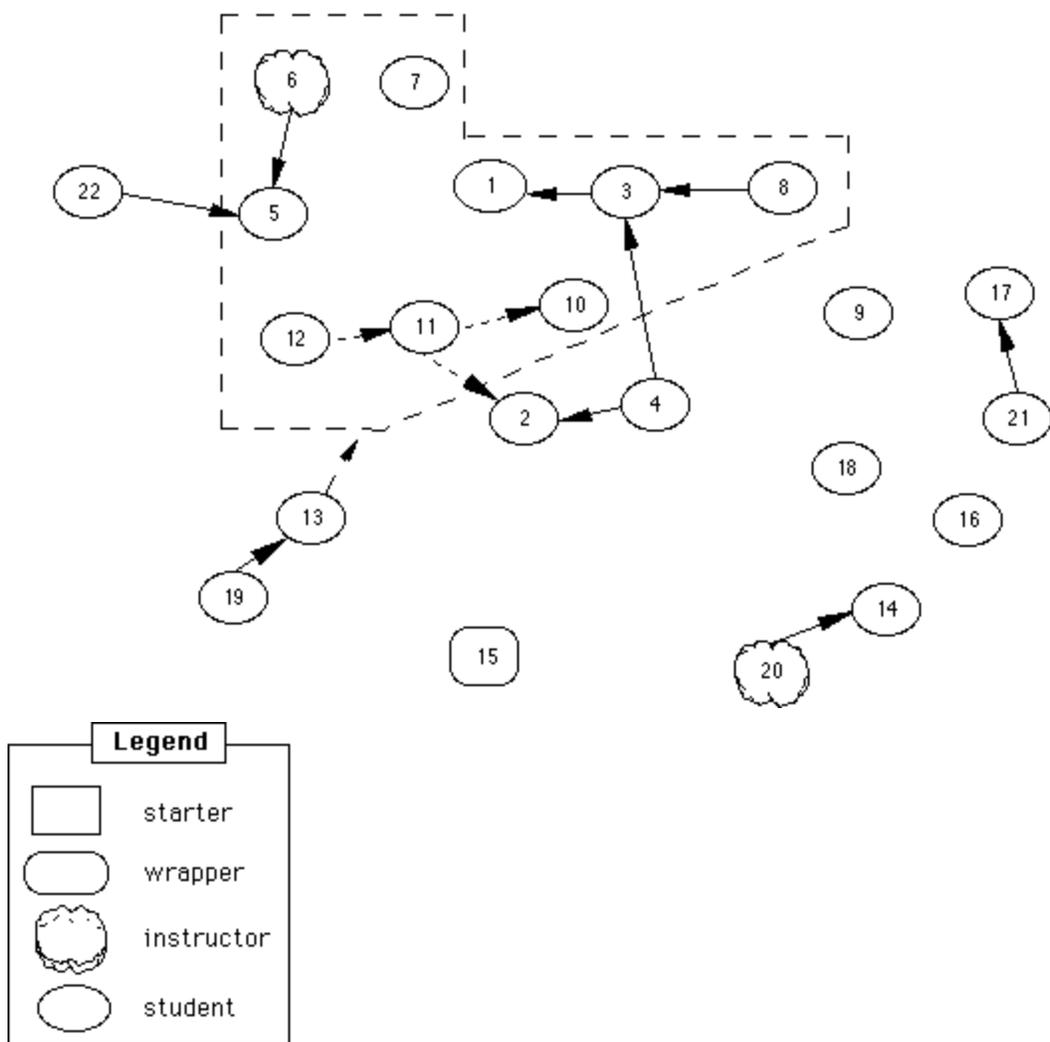


Figure 3. Conference activity graph for week 4 without links from #15 (wrapper).

As Ahern et al. (1992) alluded to, questions by the one initiating discussion—here it was the starter—are one of the main factors in understanding interactivity (see Cognitive section below for details). For example, as a result of the starter for Week 8 proposing two concrete questions, interactivity was higher that week. However, Ahern et al.'s claim that encouraging informal communication will increase students' interaction was not supported in this conference. When missing a starter in Week 4 due to someone dropping the class, students did not become more interactive or engaged with each other (See Figure 3). Such findings indicate the important role of the starter.

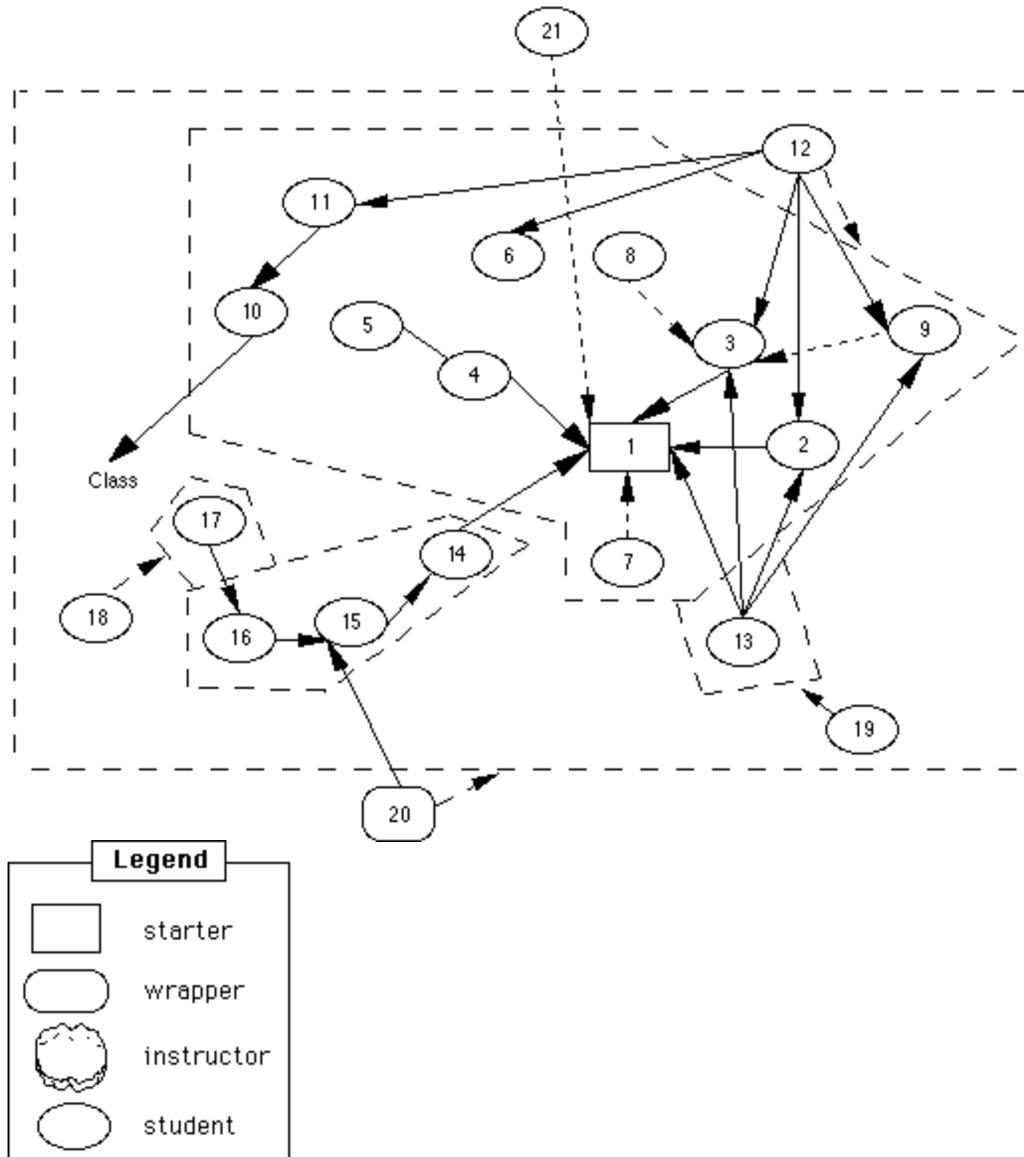


Figure 4. Conference activity graph for week 8 (Synergistic).

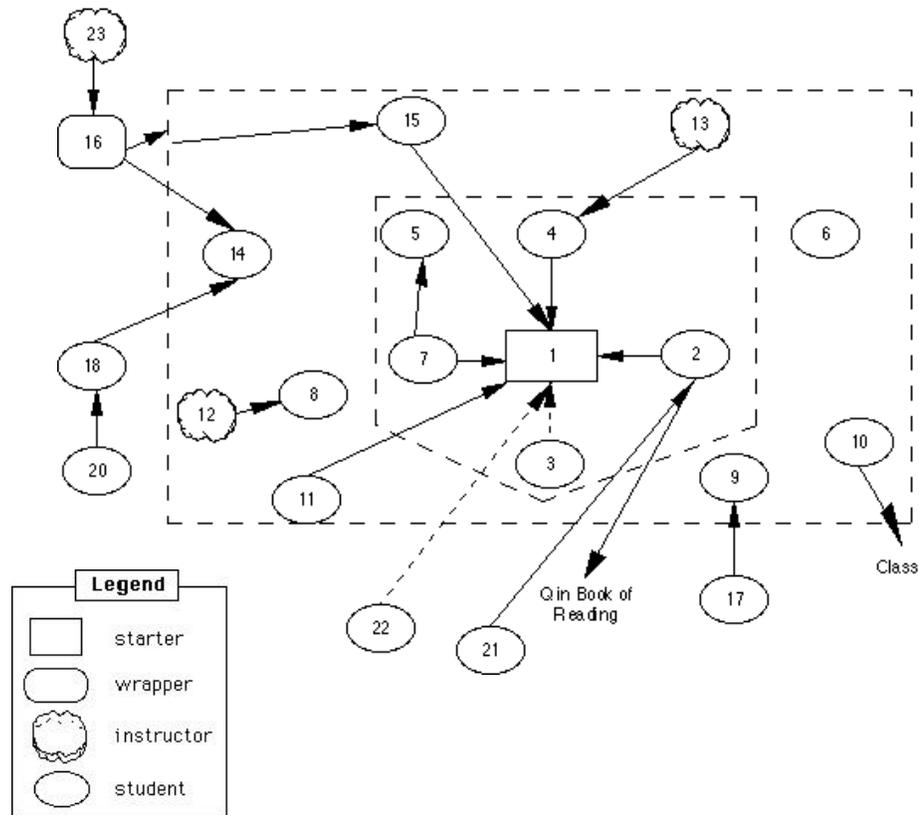


Figure 5. Conference activity graph for week 10 (Explicit).

One additional analysis was performed to determine how often students referred to the posts of each other in their *FirstClass* conferencing; an indicator of interactivity and personalization within the conference. During the first six weeks of the conference students referred there were .88 peer references per post, while in the second six weeks since jumped to 1.04 peer references per post. Clearly this is an indication both that they were reading each other's messages and that computer conferencing outside of class time was a vehicle for stimulating student interactions and mentoring. Such a finding is not to be taken lightly.

In addition to peer referencing, some messages referred to in-class discussions or a question in the reading packet assembled for the class. While this type of knowledge resource commenting has yet to be addressed in the literature, it is an indication that the social space for students to build common knowledge and intersubjectivity extends beyond the electronic conference. Moreover, it is a powerful reminder to

connect online discussion with face-to-face discussion or other resources. Along these same lines, several instructor comments in class specifically encouraged students to reply to messages posted by their classmates and to use any of their lecture notes in their postings. Such comments undoubtedly had some influence on students' behavior during the conference. Given these observations, scholars concerned with instruction in higher education might focus on ways to create more effective learning spaces that incorporate both in-class and online conferencing discussions and activities.

Social Cue Findings

According to Henri, the frequency of the social cues might be an indicator of the level of learner focus on the task. In this graduate level course, the number of social cues decreased as the semester progressed. Moreover, student messages gradually became less formal. This might be attributed to the fact that students felt more comfortable with each other as the semester continued (Kang, 1998).

	Week 2	Week 4	Week 8	Week 10	Ave.
# of social	19	18	11	12	15
# of units	55	52	59	58	56
Percentage	34.5 %	34.6 %	18.6 %	20.7%	26.7%
# of Words	293	252	335	387	317
# of Sentences	17.4	14.5	19.4	21.5	18.2

Table 4. Social Messages Exhibited in *FirstClass* Dialogue.

The relationship between cognitive processes and social cues was examined. Of the four weeks of cognitive analysis, the eighth week had the lowest number of social cues and the highest cognitive skill frequency (88.1 %), thereby indicating that during that week students engaged in intense online discussion and were highly focused on the task (see Table 4). Walther (1996) argues that the more effective CMC is, the less socioemotional communication exists. From this viewpoint, early social cues and signals are needed to help participants feel more comfortable working together and build common ground. Not surprisingly, social cues in this conference were most frequent during Week 2 when several students included self-introductions in their messages. By Week 8, students knew each other well enough from class and the conference to focus on the task at hand.

Although the number of social cues decreased after several weeks, the messages became more informal. For example, in Week 2, social cues appeared separately from content discussions and the language used by students was formalistic. Among the messages with social cues that week was the following:

Hello Folks in class,

My name is Mark...I am a student in Science Education. I have volunteered to be the starter of week discussion (actually I am the starter of the whole discussion).

I am going to start discussion of part one of the Bruning book...[student's comment within *FirstClass*]

On the other hand, the students' use of language had changed and the social cues were embedded in messages. For example, a message in Week 8 started with:

Going back to day one, and Troy's great discussion opener, I'd like to begin by noting that [a student's comment within *FirstClass*]

Cognitive Skill Findings

As stated earlier in the interaction findings, starters' questions influenced the quality of the cognitive skills displayed in the conference. Henri talks about five categories for analyzing online discussions related to the cognitive dimension. These categories include: (1) elementary clarification; (2) in-depth clarification; (3) inferencing; (4) judgment; and (5) the application of strategies.

What did the starters do to set the stage for deep cognitive discourse? In Week 2, the starter asked ten questions including five inference questions, three judgment questions, one application question, and one elementary clarification question. Table 5 shows that the cognitive skill of inferencing (i.e., drawing conclusions and forming generalizations) appeared most frequently in this week, followed by application of strategies, judgment, and elementary clarification. The starter for Week 8 asked only two questions including an elementary clarification question and a judgment question. The second question also contained the sentence that required the application of cognitive skills. In reply, more than half of student cognitive skills exhibited for that week related to personal judgments. Such findings are interesting since Week 8 contained the most synergistic type of interaction. The starter for Week 10 asked four questions including ones for judgment, elementary clarification, in-depth clarification, and application of strategies. In Week 10, student judgment was the most frequent response to these questions. Given the above results, it seems that a starter's questions provide considerable shape and direction to the types and levels of cognitive skills exhibited in online discussion.

	Elementary clarification	In-depth clarification	Inferencing	Judgment	Application of strategies	Total
week 2	3 (7.5 %)	1 (2.5 %)	16 (40%)	10 (25%)	10(25 %)	40(72.7%)
week 4	4 (8.6 %)	8 (17.4 %)	12 (26.1%)	14 (30.4%)	8 (17.4 %)	46(88.4%)
week 8	9 (17.3 %)	5 (9.6 %)	3 (5.8 %)	26 (50%)	9 (17.3 %)	52(88.1%)
week 10	10 (22.2%)	6 (13.3 %)	9 (20 %)	14 (31.1%)	8 (17.7 %)	45(77.5%)

Table 5. Type of Cognitive Skills Exhibited in *FirstClass* Dialogue.

The factors that decided the frequency of certain cognitive skills were unknown for Week 4 because this week had no starter. However, higher order cognitive skills, such as making judgments and inferences, were still prevalent during this week. Although the conference activity graph reveals the discrete nature of the discussion, individual student contributions demonstrate higher levels of cognitive skill. This may be

because the design of this conferencing activity and incoming level of student skill may have required such high level processing.

In this highly interactive conference, inferencing skills appeared more frequently in the beginning than at the end of the discussion. On the other hand, cognitive skills related to judgment appeared more frequently at the end of the discussion, especially in Week 8 which was the most interactive conference among the four. In fact, messages #14 through 19 in Week 8 contained only judgment and application skills. It seems natural that early presenters state their ideas, insights, and opinions whereas later contributors judge and contrast these comments. Therefore, the mapped sequence of cognitive skills is key indicator of interactivity within an electronic conference.

Our analyses also revealed that in this particular research project, most of the messages were fairly deep in terms of information processing. Of the four weeks of detailed analysis, 33 percent of student messages were at the surface level, 55 percent were at an in-depth level of processing, and an additional 12 percent contained aspects of both surface and deep processing. When starter, wrapper, and instructor comments were excluded from these analyses, in-depth processing jumped slightly to 58 percent and surface processing coincidentally reduced to 30 percent. In either case, when combining the messages labeled as in-depth processing with those containing both levels, it was apparent that nearly 70 percent of student electronic dialogue in this online conference was at a cognitively elaborate level.

Of course, given the length of most messages in this conference, many contained both surface and deep processing statements. A wrapper, for instance, might repeat what has been stated within his or her weekly summary (i.e., surface processing), while also pointing to future directions for the field or unresolved issues (i.e., in-depth processing). In contrast, the instructor postings, within these four weeks, were mostly surface level recognition and feedback comments to students meant to encourage their electronic processing efforts. In that way, the instructor avoided dictating the direction of the conferencing and molded a student-centered conference.

In terms of the depth of information processing, our analyses revealed that these students engaged in some fairly deep and thorough reviews and critiques of the course readings. When nearly 7 out of every 10 postings contain some in-depth commenting, it signals that there were definite benefits of the conferencing activity. Simple indices such as message length were a consistent indicator here of whether students processed the information in-depth or at the surface level. In our analyses, longer messages tended to include more supports for students' conclusions, such as personal experiences, comparisons and contrasts, and references from the readings. Clearly such message length measures provided implicit clues about student motivation and their ability of students to keep current with the readings as well as a formative evaluation of how well the students were learning the material.

Some extremely brief comments, however, also were thought provoking such as when they brought in quotes or sayings that integrated the discussion or when their comments suggested a key question or

analogous issue for the group to consider. In fact, students who responded to a few specific questions of interest raised within the conference had more probability of reaching an in-depth level of information processing than students who sequentially replied to every posted message. Some students attempted to do both by answering the starter questions first and then presenting other personally important issues and offering integrative comments.

In addition to these substance issues, it was interesting to see the wide range of length in student postings. With student postings averaging more than 300 words per week or 18 sentences, certainly some personal reflection and cognitive reprocessing of the readings was occurring. Though exact numbers were not gathered, this was vastly more than many of these students contributed in their face-to-face class meetings. Clearly, most students in this course were engaged in extensive and exhaustive weekly writing and critical reflection activities. And why not; they all had an equal chance to change the direction and focus of electronic class discussions and perhaps even aspects of the live class meeting or the course itself. It is also plausible students enjoyed their opportunity for written expression without the anxiety provoking red marks they may have experienced too often in the past.

During these online discussions, students were discovering what material was important to their peers and why. Given the above length measures and the 20 students in the course, these students were reading on average over 6,000 words each week jointly penned in an electronic conference that summarized and clarified what their peers and instructor deemed critical or controversial in the readings. Perhaps with this amount of text and idea generation, the electronic conferencing and writing activity employed here may have been a tool to restructure student cognitive representations of the information and foster student knowledge gains. Though it was not the primary focus here, future studies might assess individual cognitive gains resulting from online discussion during a semester or year.

Metacognition Findings

The overall amount and types of metacognitively-related statements varied from week-to-week (see Table 6). As indicated earlier, however, the scoring of metacognitive knowledge was extremely difficult to reliably score. Of the metacognitive skill categories, “reflection on experience” was the most dominate at 35 percent of metacognitive posts, with the other four categories ranging from 13 to 19 percent of the time. Not only do these metacognitive components of electronic discussions influence the level of information processing, but it was hoped that students would internalize the skills and strategies to which they were exposed on a social or interpsychological plane (Vygotsky, 1978). Additional research on student use of skills gained in electronic conferencing settings, therefore, seems a necessary next step.

	Evaluation	Planning	Regulation and self- questioning	Self- Awareness	Reflection on experience	Total
week 2	5 (16.1%)	3 (9.7 %)	3 (9.7%)	6 (19.4%)	14(45.2 %)	31(55%)
week 4	4 (16 %)	3 (12 %)	5 (20%)	6 (24%)	7 (28 %)	25(52%)
week 8	2 (8.3 %)	6 (25 %)	2 (8.3 %)	4 (16.7%)	11(45.9 %)	24(58%)
week 10	5 (22.7%)	5 (22.7 %)	3 (13.6%)	4 (18.2%)	5 (22.7 %)	22(59%)

Table 6. Metacognitive skills exhibited in FirstClass dialogue

Discussion of Results

It appears that by structuring electronic learning activity, students will have more time to reflect on course content and make in-depth cognitive and social contributions to a college class than would be possible in a traditional classroom setting. In addition, such conferences can ready students for in-class activities and events. Through asynchronous conferencing, each student becomes a regular contributor to the class content, at a time appropriate to him or her. From a learning environment or community standpoint, students have greater opportunities with electronic collaboration tools to solicit and share knowledge while developing common ground or intersubjectivity with their peers and teachers (Lave & Wenger, 1991; Rogoff, 1990). In this conference, such shared knowledge was apparent in informal observations in the regular classroom wherein students often commented on each others' electronically shared ideas before the beginning of class.

Not only did students share knowledge, but content analyses indicated that students were processing course information at a fairly high cognitive level. Social cues took a back seat to student judgment, inferencing, and clarification. An additional indicator of the depth of processing and interactivity within the conference, students typically referred to the electronic comments of their peers in their posts. These cognitively deep student conversations combined with the explicit peer referencing with student posts were key indicators of online conferencing success. In tapping into this discussion bank, all 20 students printed out, catalogued, and summarized their contributions for later personal reflection and use. From a more pragmatic standpoint, students discussion of articles outside of the "normal" class time allowed for other pedagogical activities to occur during the weekly live course meetings.

There were a myriad of other benefits of online discussions. For instance, as noted earlier, after reading through each message several times, the researchers were able to distinguish patterns within the discussion each week. In fact, several distinct characteristics of most students in the conference emerged, such as who was a social person as well as who displayed extensive metacognitive skill. More specifically, one student never referred to her peers in their posts, while another student's insightfulness caused him to always be cited by others. Instructors can learn from that data.

There was also a pattern noted within each weekly discussion. In contrast to other claims (Howell-Richardson and Mellar, 1996) that shorter messages would indicate a more conversational style of interaction than longer messages, the length of messages did not necessarily correspond to the formal

nature of the content here. Instead, message informality was indicated by student language usage, such as "my gut feeling," "I gotta," and "said," and use of lower case characters.

Of course, the structured nature of this conference also had some disadvantages. Most notably, most students limited their participation to the course requirement of one posting per week. Unfortunately, other than a few minor disputes, there was never a sense of real heated or seminal online discussions with students negotiating meaning, taking sides on issues, or coming to compromise. This was unfortunate. In addition, the instructor seldom used the questions and issues raised within the *FirstClass* conference in regular class lectures or discussions. There clearly is a pressing need to develop pedagogy that motivates students to electronically participate in class discussions beyond standard course requirements. Such pedagogical issues must be addressed before anyone can claim electronic learning success.

Relationship of Findings to Prior Research and Extension of the Study

Our research team has conducted over a dozen studies of electronic collaboration during the past five years. It is vital to relate this particular project to the findings of those studies to shed some light on this importance of this work. We believe that these studies may better inform the results found here. Previous work on electronic collaboration by members of our team have included comparisons of synchronous and asynchronous computer conferencing, undergraduate student asynchronous discourse on the Web about problem situations seen in schools, longitudinal studies of computer conferencing in large section college classes, the role of e-mail in extending classroom dialogue, and the design of conferencing tools for reflection and critical thinking (Bonk & King, 1998).

One of these studies revealed that asynchronous or delayed conferencing fosters more depth of discussion than synchronous student chatting (Bonk, Hansen, et al., 1998). In that study, students in the synchronous appeared to be posting to get their opinions out on an issue, but were not responsive to the postings of their peers. Here a coding scheme was used to show how undergraduate students in the asynchronous discussions took ownership over electronic discussions of case situations generated by the instructor and increasingly responded to peers over time. In both delayed and real time modes, as in this particular study, students were extremely content focused.

A later series of studies of student electronic case discussions, this time asynchronously over the Web, showed, once again, on-task focus of student electronic conferencing. However, when the cases were created by the students, student case discussions were less conceptually grounded (Bonk, Malikowski, Angeli, et al., 1998; Bonk, Malikowski, Supplee, & Angeli, 1998). Over a two year period, students generated hundreds of such cases each semester.

In learning from those findings, this particular study utilized the power of asynchronous collaboration while focusing student interaction patterns on the content of their weekly readings instead of simply relying on experience. While scripting of the weekly conferencing expectations grants students with less ownership over the discussion, it also provides a clearer framework for student discussion.

Since the time of the study reported herein, we have used the starter-wrapper technique during two other semesters with undergraduate preservice teachers. During the fall of 1997 and spring of 1998, there were 20 and 24 participants in a class taught almost completely on the World Wide Web (Bonk, 1998). Instead of *FirstClass*, however, this study utilized a shareware tool called *Conferencing on the Web* (see Bonk, Malikowski, Angeli, et al., 1998). As in the graduate study, students took on roles of starter and wrapper of the weekly readings; however, all the readings here were from a less controversial undergraduate educational psychology textbook. In addition, there were two such undergraduate discussions with their own assigned starters and wrappers—one for elementary education majors and one for secondary education majors. We did not analyze this data using Henri's scheme, but instead surveyed and interviewed some of the undergraduate students on the utility of the tool and task. The qualitative results are generally positive and reported elsewhere (see, Bonk, Daytner, Daytner, Dennen, & Malikowski, 1999). Some basic quantitative results of this research is presented below.

The results were fairly similar to the *FirstClass* conference reported here. First of all, students were extremely task focused in their discussions, using COW conference to summarize, debate, and react to the chapters. Not surprisingly, as in the present student of a graduate level class, these undergraduates typically posted just the bare minimum of one contribution per week while the instructor replied just once or twice to weekly discussion posts; typically near the end of the discussion.

As expected, however, there were vast differences in the amount and type of posting between the graduate and undergraduate students. For instance, students were slightly less responsive to their peers; there was an average of .80 peer references per post across the two undergraduate conferences as compared to the .96 peer references per post in the graduate conference. In addition, in contrast to the graduate students generation of approximately 317 words and 18.2 sentences per post, the undergraduates averaged about 231 words and 33.1 sentences per post. From a syntactic complexity standpoint, this averages to 17.4 words per sentence for the graduate students in contrast to 6.98 words per sentence for the undergraduates. Such differences are even greater when removing the starter and wrapper posts from the data, since, in the undergraduate posts, the starters and wrapper typically write more than the rest. In the graduate student conference, the length and syntactic complexity across participants were more equal.

These stark differences in quantity and complexity are another indicator of the depth of discussion in the present study. At the same time, they also allude to the fact the undergraduate students tend to rely on one person having a more informed perspective than the rest.

Recommendations

Methodological Recommendations

Our initial recommendations relate to CMC research methodology. Content analysis is crucial in understanding the dynamics of a computer conferencing system. However, there were two serious problems

revealed here. First of all, analyses of computer conferences require an inordinate amount of time to complete and fully comprehend. Furthering hampering these efforts, a solid online discussion methodology has yet to be established. While Henri (1992) claims that her model was meant, in part, to enable practitioners to identify student mental processes impacting learning in a computer conference, her model remains more of a research tool, than a teacher evaluation device. Unfortunately, since every computer conference will have its own unique attributes, researchers may have to design electronic discussion group evaluation criteria on a case by case basis. For example, using computer conferencing as a decision making tool may require different types of skills from using it as a summarization or information sharing device.

Henri argues that "research in computer conferencing content is usually restricted to the gathering of quantitative data on participation" (1992, p. 122), thereby leading to potential misinterpretation of the phenomenon. In this study, the combination of quantitative analysis, weekly conference activity graphs, and qualitative analysis was utilized to avoid such problems. Nonetheless, as Riel and Harasim (1994) and Bonk, Malikowski, Angeli, et al. (1998) point out, interviews, observations, surveys, retrospective analyses, semantic trace analysis, and task phase analysis would undoubtedly have lent additional insight into the benefits of the *FirstClass* discussions.

Throughout this study, the researchers were aware of the need to triangulate the interpretation of participant messages. In fact, interviews and retrospective reports would have been particularly helpful here. Student evaluation of their own dialogue transcripts, moreover, might have validated the researchers' interpretation of students' discourse. Such interviews and retrospective analyses are currently being performed in the undergraduate study mentioned earlier. Another key limitation was that implicit intentions of students in their electronic postings are difficult to measure robustly (Shapard, 1990). In addition to measurement dilemmas, there are a myriad of individual difference factors to consider. For instance, Smolensky, Carmody, and Halcomb (1990) found that the more extroverted the student, the greater likelihood they used CMC. It is plausible, therefore, that data for cognitive and metacognitive skills were only captured from students who were explicitly willing to show their metacognitive sensitivities.

There were several other key methodological limitations and constraints in this study. First of all, while Henri's model provides a vehicle for assessing more than just the quantitative nature of computer conferencing, it also constrains one to the categories that the model provides. In this case, the cognitive and metacognitive components were difficult to evaluate and interpret. And, as Henri points out, identifying the cognitive skills at work in student postings only provides a superficial understanding of presence and frequency of such skills in message content. While identifying the depth or surface level of processing provides additional information, it is unclear what labels to provide to mixed postings.

Secondly, we did not compare the quality of student *FirstClass* postings to emerging expertise in the course. Given that this was a graduate course without a wide range of final grades, we could not correlate grade in the course with quality or depth of posting. Clearly, the next step in understanding computer

conferencing and Web-based course delivery is to investigate not just the quality and types of electronic social interaction patterns, but also the impact on student course performance and long term retention of course material.

Thirdly, the limited postings per week also put a constraint on our analyses and interpretations of the data. For instance, if discussions were synchronous or if students had been required to post more than once per week, there might have been more interactive or “two-way” interactions. At the same time, we choose asynchronous discussions due to problems we encountered in our earlier synchronous research. Combining the interesting findings here with the above limitations, indicates that additional pedagogical experimentation is warranted.

Pedagogical Recommendations

We made a number of pedagogical observations from just this one study. As indicated earlier, the instructor remarks in class reinforced some forms of interaction in the online conference. For instance, at the start of one particular class, the instructor in this class commented, "I am glad to see some of you pointed out other's messages." Such feedback encourages students to mention other students' names in their messages. While praise is one strategy to foster electronic interaction, instructors should find additional ways to encourage student electronic social interaction and also recognize student contributions when they result in significant dialogue and negotiation of meaning. Along these same lines, presenting a template or example of starter, wrapper, and other student messages may stimulate ideas while simultaneously reducing initial student anxiety. Posting electronic legacies from previous student electronic discussions might allow students to have prototypical examples of extended and modest interactions. Model answers or sample postings from the instructor would be still another potential solution. If such legacies or model answers were electronically available, less students would write the following:

I know that this discussion has long been over, but I need to write something. The reason that I did not write anything back in January is that I felt too embarrassed at the time to write anything. This is because educational psychology was new to me, and I did not want to say anything that was ridiculous. [a late student comment within *FirstClass*]

Although such comments were extremely rare in this conference, student anxiety and shyness is a potential learning barrier in any computer conferencing situation.

Lack of time for reading all posted messages is perhaps one reason this graduate student discussion resulted in one-way, instead of two-way, interaction. In order to reduce the workload, students might be divided into smaller groups and asked to choose a discussion topic. To focus this discussion, students might be required to develop specific outcomes such as recommendations for an instructional application or reaction to a research report, thereby increasing group interaction and interdependence. Another idea relates to requiring students to participate 15-25 times during the semester, but this participation could be concentrated in those weeks of most personal interest. In contrast, the starter-wrapper format used here

generally required each student to express themselves only once each week, which caused some students who always posted messages early in a week to potentially miss out on later discussions if they failed to reenter the conference. What is certain is that educators need to develop more online conferencing tasks and strategies that enhance two-way interaction and opportunities for extended dialogue and knowledge negotiation.

As indicated, the discussion moderator or starter is a key player in determining the depth of dialogue and overall knowledge generation processes. In fact, Feenberg (1987, p. 177) argues that online leadership “is undoubtedly the crucial problem of conferencing.” Conferencing leaders must entice others to participate, express emerging consensus, call for a formal vote on open issues, send encouraging messages to people, and sense when a topic discussion has been completed. Additionally, Feenberg points out the need for meta-comments or weaving statements that attempt to summarize the present state of the discussion, identify underlying themes, and note points of disagreement. While this is difficult and time consuming, such weaving statements can refresh participant memories of earlier discussions, supply an unifying discourse theme to participant contributions, and integrate student participation (Feenberg, 1987). Interestingly, the starter role used here approximates many of the duties of Feenberg’s conference moderator role, while the wrapper role is extremely similar to his “weaver” ideas. Perhaps the starter-wrapper pedagogy is ideally suited for computer conferencing environments.

As the four activity graphs illustrated, the starter often provides the macrocontext or focus for the balance of discussion. Therefore, it is important to guide starters to ask sophisticated questions. For example, one message in Week 8 suggested that students “reflect on your experiences and make a judgment/suggestion,” while in Week 10, the starter simply stated: “reflect on your experiences.” Other messages encouraged students to “explain why” they might reinforce student in-depth processing of cognitive tasks. Since the starter or moderator’s role is important (Ahern et. al., 1992; Howell-Richardson & Mellar, 1996), there may be a need for an electronic mentoring guide or a set of electronic questions and prompts to help students learn to lead discussion. Such electronic mentoring assistance might become a highly valued area of research as online networks proliferate and instructional possibilities are better understood.

The final pedagogical recommendation is to experiment with the starter-wrapper idea at both the undergraduate and graduate levels while grounding such use in theory. Granted, the discussions were more lengthy and complex at the graduate level, but there are numerous potential benefits at the undergraduate and perhaps even at the secondary level as well. For example, using this technique, students assume the role of the teacher while reading, summarizing, and presenting the information for their peers to digest. In effect, this method is similar to reciprocal teaching wherein the student takes on the role of the instructor in order to foster greater student comprehension and metacognitive processing of information (Palincsar & Brown, 1984).

As Palincsar (1986) has pointed out, student dialogue and ownership over the learning process is key to improving reading comprehension. As in reciprocal teaching, in the starter-wrapper method, students are collaboratively discussing text read while asking questions, generating text summaries, and making predictions about where the information read is headed. Additional investigations into how to electronically scaffold student learning with various computer conferencing tools and tasks are currently being conducted (Bonk, Malikowski, Supplee, et al., 1998).

Technological Recommendations

There are some obvious improvements that can be made to the computer conferencing and collaboration tools like *FirstClass*. First of all, as in Lehrer's (1993) hypermedia study, conferencing tools should have features to cross-link messages or make hot links by using key words such as names, subjects, or article references. Second, messages posted should have graphical displays to indicate the potential links between messages, the depth of those links, and the directionality of communication patterns. Finally, students should be instructed to use the message "subject line" more effectively since peers and other future readers will be reliant on correct and informative discussion thread and comment titles. Reader efficiency and overall learning will increase when topic titles lead them into discussions that interest or are important to them. Perhaps students should be taught to metacognitively reflect longer about their titles when they compose messages. Or maybe the software should have a comment warning or cognitive skill labeling feature (i.e., this is a "hypothesis" or this is an "opinion") which students must select before posting a message; for example, see the *Asynchronous Collaboration Tool (ACT)* from Duffy, Dueber, and Hawley (1998). While the directions that the computer conferencing field can take seem endless, whatever the next generation of technology tools for learning brings, instructors must think critically about the pedagogical structuring and benefits of such tools.

Final Conclusions and Importance of this Study

This study details ways to use Henri's model for analyzing electronic discussions. It describes how computer conferencing can be employed for deep level discussions outside the classroom in a student centered environment. Analyses revealed that electronic conferencing about course readings results in extremely focused and deep discussions outside of normal class time. Such analyses also visually depicted change and growth in student interaction patterns over time. In addition, students can provide valuable peer feedback and mentoring within these electronic discussions. Computer conferencing, therefore, is a unique opportunity here for students to scaffold each other's learning. The fact that interaction patterns changed over time is evidence of why other instructors must not give up on conferencing tools after brief unsuccessful trials or temporary technology failures.

Conferencing tools can help students understand complex terminology and theories such as that learned in common educational psychology courses. Equally important, such tools are a prime example of

Hara, Bonk & Angeli: Content Analysis of Online Discussion

how to apply psychological theory to educational practice. As in traditionally taught classes, students, however, often discount this link by treating these tools as a means to complete a particular task, rather than as an opportunity to engage in rich discussion and debate with their peers and instructors.

Analyses of student electronic interactions show that, if they are designed from a pedagogical perspective, CMC tools have the potential to become rich instructional systems and powerful learning environments (Bonk & King, 1998). For this to occur, we recommend that technology designers and practitioners: (1) provide additional structure to student online discussions; (2) employ a variety of pedagogical strategies in electronic conferencing; (3) encourage student electronic interaction and debate; perhaps by adding tools for student profiles, peer commenting, cross-linking messages, comment labeling, and role play or debate; (4) thoroughly test the conferencing software and explore its limitations and possibilities prior to using it; and (5) realize that different forms of conferencing software and features serve different types of instructional purposes. In terms of the latter recommendation, synchronous chat tools might be used to apprentice students into a real world environment, handle administrative course matters, build group rapport, talk to guest experts, obtain prompt advice on a pressing issue, and get ideas on the table for later asynchronous discussions. In contrast, cognitively deeper discussions might be obtained with asynchronous tools that embed such tools as issue-based forums and debates, alternative views of argument structure, and options for comment labeling (e.g., hypothesis or fact) (Duffy et al., 1998).

CMC technology like *FirstClass* and other computer conferencing systems have unlimited potential both as an instructional device and as a research tool (Harasim, 1993; Kuehn, 1994). This study provides just one example of how computers can log online discussions for later evaluation. It also shows how instructors can use computer conferencing as a supplementary vehicle for extended class discussion. Nevertheless, since it was taught within a traditional course setting, the findings here will not necessarily generalize to courses taught entirely at a distance, courses using videoconferencing, or various nonacademic settings. Keep in mind, moreover, that it was just one college setting and one technique within that setting. We also caution those just entering this field, to consider the pedagogical outcomes, not simply the technological possibilities of CMC. If we can push ahead on both fronts, many of us will certainly enjoy interesting and cognitively rich electronic interactions in our classes, thereby extending of the boundaries of student learning and development as we enter the new millennium.

Acknowledgments:

Portions of this paper were presented in March, 1998 at the 9th International Conference of the Society for Information Technology and Teacher Education in Washington, DC.

References

- Ahern, T. C., Peck, K., & Laycock, M. (1992). The effects of teacher discourse in computer-mediated discussion. *Journal of Educational Computing Research*, 8 (3), 291 - 309.
- Alexander, P. A., Schallert, D. L., & Hare, V. C. (1991). Coming to terms: How researchers in learning and literacy talk about knowledge. *Review of Educational Research*, 61(3), 315-343.
- Barnes, S., & Greller, L. M (1994). Computer-mediated communication in the organization. *Communication Education*, 43 (4), 129 - 142.
- Berliner, D. C. (1987). But do they understand? In V. Richardson-Koehler (Ed.), *Educator's Handbook: A research perspective* (pp. 259 - 293). New York: Longman.
- Bloom, B. S. (1956). *Taxonomy of educational objectives: Handbook of cognitive domain*. New York: McKay.
- Bonk, C. J. (1998, April). *Pedagogical activities on the "Smartweb": Electronically mentoring undergraduate educational psychology students*. Paper presented at the American Educational Research Association (AERA) annual convention, San Diego, CA.
- Bonk, C. J., Daytner, K., Daytner, G., Dennen, V., & Malikowski, S. (1999). *Online mentoring of preservice teachers with Web-based cases, conversations, and collaborations*. Paper presented at the American Educational Research Association (AERA) annual convention, Montreal, Canada.
- Bonk, C. J., Malikowski, S., Angeli, C., & East, J. (1998). Case-based conferencing for preservice teacher education: Electronic discourse from the field. *Journal of Educational Computing Research*, 19(1).
- Bonk, C. J., Malikowski, S., Supplee, L., & Angeli, C. (1998, April). *Holy COW: Scaffolding case-based "Conferencing on the Web" with preservice teachers*. Paper presented at the American Educational Research Association (AERA) annual convention, San Diego, CA.
- Bonk, C. J., & Sugar, W. A. (1998). Student role play in the World Forum: Analyses of an Arctic learning apprenticeship. *Interactive Learning Environments*, 6(1-2), 1-29.
- Duffy, T. M., Dueber, B., & Hawley, C. L. (1998). Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems. In C. J. Bonk, & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 51-78) Mahwah, NJ: Erlbaum.
- Entwistle, N., Waterston, S. (1988). Approaches to studying and levels of processing in university students. *British Journal of Educational Psychology*, 58, 258-265.
- Feenberg, A. (1987). Computer conferencing and the humanities. *Instructional Sciences*, 16, 169-186.
- Grabowski, B., Suciati, & Pusch, W. (1990). Social and intellectual value of computer-mediated communications in a graduate community. *Educational and Training Technology International*, 27 (3), 276-83.
- Harasim, L. M. (1987). Teaching and learning on-line: Issues in computer-mediated graduate courses. *Canadian Journal of Educational Communication*, 16(2), 117-35.
- Harasim, L. M. (1993). *Global Networks: Computers and International Communication*. Cambridge, MA: MIT Press
- Henri, F. (1992). Computer conferencing and content analysis. In A. R. Kaye (Eds.), *Collaborative learning through computer conferencing: The Najaden papers* (pp. 115 - 136). New York: Springer.
- Hiltz, S. R. (1990). Evaluating the virtual classroom. In L. M. Harasim (Ed.), *Online education: Perspectives on a new environment* (pp. 133-183). New York: Praeger.

Hara, Bonk & Angeli: Content Analysis of Online Discussion

- Howell-Richardson, C., & Mellar, H. (1996). A methodology for the analysis of patterns of participation within computer-mediated communication courses. *Instructional Science*, 24, 47 - 69.
- Iseke-Barnes, J. M. (1996). Issues of educational uses of the Internet: Power and criticism in communications and searching. *Journal of Educational Computing Research*, 15(1), 1-23.
- Kang, I. (1998). The use of computer-mediated communication: Electronic collaboration and interactivity. In C. J. Bonk, & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 315-337). Mahwah, NJ: Erlbaum.
- King, A. (1992). Comparison of self-questioning, summarizing, and notetaking-review as strategies for learning from lectures. *American Educational Research Journal*, 29(2), 303-323.
- Kuehn, S. A. (1994). Computer-mediated communication in instructional settings: A research agenda. *Communication Education*, 43, 171 - 183.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.
- Lehrer, R. (1993). Authors of knowledge: Patterns of hypermedia design. In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools* (pp. 197-227). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Levin, J. A., Kim, H. & Riel, M. M. (1990). Analyzing instructional interactions on electronic message networks. In L. M. Harasim (Ed.), *Online education: Perspectives on a new environment* (pp. 185-214). New York, NY: Praeger.
- Mason, R. I. (1990). *Home computing evaluation: Use of CoSy on DT200, 1989*. (CITE Report No. 99). England: The Open University. (ERIC Document Reproduction Service No. ED 320 541)
- Mowrer, D. E. (1996). A content analysis of student/instructor communication via computer conferencing. *Higher Education*, 32, 217-241.
- Newman, F. W. (1992). The prospects for classroom thoughtfulness in high school social studies. In C. Collins & J. N. Mangieri (Eds.), *Teaching thinking: An agenda for the 21st century* (pp. 105 - 132). Hillsdale, NJ: Erlbaum.
- Palincsar, A. S. (1986). The role of dialogue in providing scaffolded instruction. *Educational Psychologist*, 21(1 & 2), 73-98.
- Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, 1(2), 117-175.
- Phillips, A. F., & Pease, P. S. (1987). Computer conferencing and education: complementary or contradictory concepts? *The American Journal of Distance Education*, 1(2), 44-52.
- Phillips, G. M., Santoro, G. M., & Kuehn, S. A. (1988). The use of computer mediated communication in training students in group problem-solving and decision making techniques. *The American Journal of Distance Education*, 2(1), 38-51.
- Rice, R. E. (1989). Issues and concepts in research on computer-mediated communication systems. In J. Anderson (Ed.), *Communication Yearbook*, 12 (pp. 436-476). Beverly Hills, CA: Sage Publications.
- Rice, R., & Love, G. (1987). Electronic emotion: Socioemotional content in a computer-mediated network. *Communication Research*, 14, 85-108.
- Riel, M. Cooperative learning across classrooms in electronic learning circles. *Instructional Science*, 19, 445-466.
- Riel, M., & Harasim, L. (1994). Research perspectives on network learning. *Machine-Mediated Learning*, 4(2&3), 91-113.

- Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford.
- Romiszowski, A., & Mason, R. (1996). Computer-mediated communication. In D. Jonassen (Eds.), *Handbook of research for educational communications and technology* (pp. 438 - 456). New York: Macmillan.
- Salomon, G., (1993). On the nature of pedagogic computer tools. In S. Lajoie & S. Derry (Eds.), *Computers as cognitive tools* (pp. 179-196). Hillsdale, NJ: Erlbaum.
- Schon, D. A. (1983). *The Reflective Practitioner: How professionals think in action*. New York : Basic Books.
- Schrage, M. (1990). *Shared minds: The technologies of collaboration*. New York: Random House.
- Schwandt, T. A. (1997). *Qualitative inquiry: A dictionary of terms*. Thousand Oaks, CA: Sage.
- Shapard, J. (1990). Observations on cross-cultural electronic networking: Access to Japan. *Whole Earth Review*, 69, 32 - 36.
- Smolensky, M. W., Carmody, M. A., & Halcomb, C. G. (1990). The influence of task type, group structure, and extroversion on uninhabited speech in computer-mediated communication, *Computers in Human Behavior*, 6, 261-272.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (edited by M. Cole, V. John-Steiner, S. Scribner, & E. Souberman). Cambridge, MA: Harvard University Press.
- Walther, J. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research*, 23(1), 3-43.
- Walther, J. B., & Tidwell, L. C. (1995). Nonverbal cues in computer-mediated communication, and the effect of chronemics on relational communication. *Journal of Organizational Computing*, 5(4), 355-378.
- Yagelski, R. P., & Grabill, J. T. (1998). Computer-mediated communication in the undergraduate writing classroom: A study of the relationship of online discourse and classroom discourse in two writing classes. *Computers and Composition*, 15, 11-40.
- Zhu, P. (1998). Learning and mentoring: Electronic discussion in a distance learning course. In C. J. Bonk, & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 233-259). Mahwah, NJ: Erlbaum.