Effects of Online Cognitive Facilitation on Student Learning

Rodrigo del Valle
Semiral Öncü
Nur Fatma Koksal
Nari Kim
Paul Alford
Thomas M. Duffy
Indiana University

Interest in online learning (OL) has grown rapidly and will continue to do so (Bonk, 2002; Sofres, 2001). An increasing number of universities are offering OL opportunities (Duffy & Kirkley, 2004). A number of studies have discussed and linked online collaboration through group discussions with better opportunities to promote quantity and quality of student interaction, engagement, satisfaction, and higher-order learning (Hiltz, Coppola, Rotter, & Turoff, 2000; Mikulecky, 1998; Nachmias et al., 2000). Nevertheless, it is common to see little discussion among online groups that work collaboratively. Participants tend to post without replying to other participants' contributions, and they remain in their comfort zones (Collett, Kanuka, Blanchette, & Goodale, 1999). Threaded discussions often end in trivialized conversations in which frequently several members remain as passive observers (Klemm & Snell, 1996). As Kanuka & Garrison (2004) point out "To date there have been few empirical studies on the use of asynchronous text-based Internet communication technologies and their ability and/or effectiveness to facilitate higher levels of learning" (p.31). OL might have great potential to promote critical thinking, however, to implement OL, and especially online discussions in a way that actualize this potential has proved to be a real challenge.

One of the main arguments in studies that have linked online collaboration through group discussions with better learning opportunities is that group discourse serves as a core in increasing individual critical thinking within OL environments (Angeli & Bonk, 2003; Garrison, Anderson, & Archer, 2001; Jeong, 2001). Critical thinking is defined as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning or communication, as a guide to belief and action (Paul & Elder, 2001)." Duffy, Dueber, & Hawley (1998) place inquiry at the heart of learner-centered online environments, and associate critical thinking with an inquiry process in which a learner inductively or abductively solves his puzzlement through hypothesis generation, data gathering and evaluation, considering alternatives, and resolving for a rational solution.

While critical thinking tends to be defined as an individual cognitive process, Garrison, Anderson, & Archer (2000) developed a "community of inquiry" model that provides a conceptual framework to study learning in online environments, placing critical thinking in the context of collaborative work. In this model they use the term "cognitive presence" to refer to "the extent to which learners are able to construct and confirm meaning through sustained discourse in a critical community of inquiry (Garrison et al., 2001)," focusing in this way on the sustained interactions that help individuals to develop critical thinking as a process and outcome (Archer, Garrison, Anderson, & Rourke, 2001; Garrison et al., 2000).

In addition to cognitive presence, Garrison et al. (2000) also emphasize the importance of social presence in their community on inquiry model. Social presence is the sense of relationship that can arise among people participating in online environments, because participants project their personal characteristics into the community of inquiry, thereby presenting themselves as real people (Rourke, Anderson, Garrison, & Archer, 2001). In OL social presence can be mediated using text based communication, and it appears to be relevant to promote student satisfaction and engagement (Richardson & Swan, 2003). Nonetheless, Wise, Chang, Duffy, & del Valle (2004) found that only a basic threshold of social presence is required in order to support online learners.

The role of online facilitators who cultivate learners' cognitive presence has been considered as an important factor in promoting students' critical thinking (Anderson, Rourke, Garrison, & Archer, 2001; Archer et al., 2001; Collison, Elbaum, Haavind, & Tinker, 2000; Richardson & Swan, 2003). Thus, identifying guidelines for facilitating cognitive presence in online settings is an essential issue in order to encourage learners to think critically in a collaborative environment. Collison et al. (2000) identified several facilitation strategies to promote critical thinking in online environments. These strategies suggest that facilitators should promote cognitive presence in two stages: in the first stage, the facilitator uses techniques to help learners clarify their ideas, and come to a common understanding in order to "sharpen the focus". In the second stage, the facilitator supports learners to deepen their

thoughts and dialogue by articulating more in-depth discussions on the common ground. In this context the facilitator is not acting as a content expert but as an experienced learner and mentor that promotes students critical thinking and knowledge construction, mainly by asking questions that will further push their thinking and inquiry.

The purpose of this exploratory experimental study was to examine how online cognitive facilitation that promotes cognitive presence, while keeping facilitator's social presence constant, affects student learning and satisfaction in an online community of inquiry. In this context, we explored the following questions:

1) Does online high cognitive facilitation promote collaboration and critical thinking?
2) Does online high cognitive facilitation promote student learning and improve satisfaction?

Methodology

Participants

Participants were 12 graduate students studying in the Instructional Technology Department of a large Midwestern university, with 11 of them enrolled in the distance education (DE) masters program, and one of them a residential student. Participants were equally distributed in terms of gender (50% male, 50%female). Two participants were in the age range 20-30, three in the range 31-40, five in the age range 41-50, and two of them were over 51.

The participants were randomly assigned to four 3-person groups. Three of the participants dropped from the study after the first days of discussion, which caused 3 groups to continue as 2-person groups. Additionally, two participants who were active during the discussion, for unknown reasons did not complete the online final instruments.

Task

During the study, students were involved in an 11-day online asynchronous discussion about the use of DE in K-12 environments. The whole discussion period lasted 13 days, but there was a 2-days break within that period due to the Thanksgiving holiday. To facilitate the discussion each group was asked to identify the five most important issues that should be considered in determining the role of DE in K-12 education. They were to think of their team as consulting to state departments of education on the use of DE. Participants were asked to post the issues they agreed on and the rationale for each of them by the end of the discussion. Four brief magazine articles on the K-12 DE topic were selected to serve as resources for the discussion. One of these articles was given to all members in each of the groups. The other three articles were distributed randomly among the members of each group in order to minimize the workload of the participants, and to foster the diversity of ideas in the discussion. The participants were instructed not to look for more articles on the topic, not to share articles with their teammates, and not to discuss the topic with other members of their class. They were to make at least one posting everyday, and avoid using email except in emergency or to communicate personal information to the facilitator.

Design

The independent variable was the degree of cognitive facilitation provided by the facilitator, with two groups receiving high cognitive facilitation and two groups receiving low cognitive facilitation.

There were two facilitation teams each of which consisted of three people from the research team. Each team was responsible for the facilitation of one group in the high cognitive facilitation condition, and another group in the low cognitive facilitation condition. One person from each team took the lead in generating and posting messages, and the others gave feedback before the messages were posted. Facilitators were to post a message every day.

In both high and low conditions, facilitators avoided using didactic teaching strategies, acting as content experts, and introducing new material. Both facilitators included high social presence in their postings. For the purpose of this study facilitator high social presence is defined as a style of communication that makes active use of written expressions to compensate for the lost non-verbal cues in computer mediated communication (Rice & Love, 1987). The intentional use of social presence cues (Swan, 2003; Rourke, Anderson, Garrison, & Archer, 2001; Abdullah, 1999) should allow facilitators to be perceived as friendly within the mediated communication. The cues used were humor/playful asides, expression of emotion, self-disclosure, addressing people by name, greetings/phatics, and allusions of physical presence.

In the high cognitive facilitation condition the overall goal of the facilitators was to promote critical dialogue and evidence based argumentation among team members without providing direction or points of view on the specific content. Cognitive facilitation included inquiry learning facilitation techniques such as asking for the clarification and elaboration of the presented ideas, promotion of the use of the articles, and the sorting and synthesis

of ideas. In the low cognitive facilitation condition facilitators did not use any of these strategies but rather encouraged the students to discuss and share their ideas.

Facilitators were trained in responding with high and low cognitive facilitation messages. Throughout the facilitation process they used two facilitation guides prepared by the research team; one for each condition. The high cognitive facilitation guide (Table 1) included specific strategies and detailed examples for each one. The low cognitive facilitation guide focused mainly on social and motivational presence, and instructed facilitators to avoid using any of the strategies used on the high cognitive facilitation. The strategies on the high cognitive facilitation guide (Table 1) were drawn from the model defined by Collison et al. (2000).

Table 1: *Cognitive Facilitation Strategies* (adapted from Collison et al., 2000)*

General Strategy Category	Specific Strategies
SHARPENING THE FOCUS These strategies seek to clarify ideas and find common understanding among participants. Highlight relevant ideas and key contributions, bringing coherence and pushing the dialogue forward.	IDENTIFYING DIRECTION: Selectively highlight or paraphrase relevant discussion items in order to refocus or redirect conversation, possibly weaving several discussion threads or ideas to provide a new focus. SORTING IDEAS FOR RELEVANCE: Ask students to classify or form comparisons. Alternatively, if needed you can call attention to sorting of ideas, making public the sorting mechanism, to focus on relevance and importance. Highlight 'hidden gems' in postings to bring them out of obscurity. FOCUSING ON KEY POINTS: Ask them to summarize or synthesize. If necessary eventually you can highlight key contributions, essential concepts, and connections so far. Bring to light potential gaps or tensions. Provide big picture, but do not summarize in detail or infer future directions – push participants to draw these inferences and assessments by themselves. Ask them to evaluate the strength on their ideas, seek judgments and assessments, and eventually reach consensus.
DEEPENING THE DIALOGUE Build on common ground by promoting that participants examine their own beliefs and assumptions, reflecting on perturbations to build new levels of understanding.	FULL-SPECTRUM QUESTIONING: Use a wide questioning approach (Who? What? When? Where? Why?) to push participants to examine their own personal, or collective, thoughts and beliefs. ▪ Push them to go beyond by asking "so what?" in a specific context ▪ Ask them to consider other perspectives that they may not have thought about before ▪ Ask them to clarify or elaborate of their ideas ▪ Ask them explore their assumptions and sources, and provide a rationale or examples for their ideas ▪ Ask questions to identify cause and effects/outcomes ▪ Ask the team to solve discrepancies in the ideas ▪ Ask questions considering appropriate action or inquiry especially if the discussion is stuck MAKING CONNECTIONS: Stretch the participant's imagination or conceptual frames to consider obscure but essential similarities. Moving beyond the barriers of previously held beliefs or assumptions that may block these connections across contexts or at deeper levels. HONORING MULTIPLE PERSPECTIVES: Lay out the landscape of different views present on the discussion. This is usually the last stage before the group completes their final task.

* Note: examples included on the facilitation guide are not shown on this table

Instruments

All of the instruments used in the study were administered online. They included a pre-survey, a post-survey, and two final tests.

Pre-survey. The first section of the pre-survey consisted of two demographic items: name and age. The second section included 10 five point Likert-type items where 1 "Strongly Agree" and 5 "Strongly disagree", that

were designed to assess participants' attitude towards the use of DE (three items), their interest in the topic (four items) and their attitude toward current state of K-12 education (three items). Although the internal consistency for questions on the three topics was not high enough to validate the existence of scales, individual items still provide useful information about the three indicated aspects. The last section consisted of 6 five point Likert-type items designed to assess the participants' level of trust. The trust items were drawn from Yamagishi & Yamagishi's (1994) scale of general trust, reaching in this study an internal consistency of .92.

Post-survey. The post-survey consisted of 31 five-point Likert-type items where 1 "Strongly Agree" and 5 "Strongly disagree". Six variables were measured. The first three scales were designed to assess the success of the treatment, and measured participants perceived cognitive facilitation (nine items with an internal consistency of .87), perceived facilitator social presence (seven items with an internal consistency of .89), and perceived facilitator motivational presence (three items with an internal consistency of .87). The last three scales assessed overall perceptions of participants' experience during the discussion, and measured overall satisfaction (six items with an internal consistency of .8), perceived learning (three items with an internal consistency of .79), and relevance/use of the articles (3 items with an internal consistency of .57).

Independent samples *t* tests were used to compare the results of the initial and final surveys reliable scales.

Recall Test. A recall test prompted the participants to remember as much as ideas they could from the articles they read and from their group discussion. This test was used as a basic measure of learning. Participants were instructed not to go back to the articles or the discussion forum before or during the recall task, and they were to use at most 20 minutes to complete the test and to report the time they used to complete it.

Open-ended Test. An open-ended test was used as a more elaborated measure of learning. It was a short test including four open-ended questions focusing on student's understanding of some of the basic issues included across all K-12 DE articles that were read.

Procedure

The discussion took place on the SiteScape asynchronous discussion forum (SSF). Because the participants had been using the same forum for their class discussions, they were familiar with the interface.

One day before the discussion activity began all participants were sent an email message including a link to the online pre-survey, and an attached file including the task instructions. The task instructions were also available on SSF.

Once all the pre-survey responses were received, facilitators posted their first message on SSF. Two different welcome messages were composed as the first facilitators' posting, one for the low cognitive facilitation, and one for the high cognitive facilitation condition. In addition to posting the welcome message on SSF, the same message was sent to participants by email in order to let them know that the discussion had started. After the welcome message, each facilitator made up their own messages according to the flow of the discussion, and according to the experimental condition of the groups. Due to lack of response from some participants, both facilitators did not post any message in a few occasions towards the end of the study in order not to dominate the discussion. Facilitators used email only as a reminder to those who were not actively participating. In these emails students were instructed not to reply but to post their contribution to SSF.

Two days after the discussion activity ended, all participants received an email message including a link to the post-survey, and another link to the recall and the open-ended tests.

Analysis

Content Analysis. Garrison et al.'s (2001) content analysis categories were used to assess the degree of critical thinking exhibited in the online discussion. These categories divide critical thinking in four phases: *triggering event*, *exploration*, *integration*, and *resolution*. Archer et al. (2001) define these phases as the idealized logical sequence of the process of critical inquiry. The first phase, triggering event, is an initiation phase of inquiry in which an issue or problem is raised. In the exploration phase participants' brain-storming, questioning, and exchange of information takes place. Moving beyond exploration learners come to the integration phase which is an iterative effort to construct shared meaning within the community of inquiry. The fourth phase is the resolution of brought up in the triggering event. The data that did not belong to any of these categories were put under a fifth category called *other*.

In addition to critical thinking two other variables were analyzed: *collaborativeness* of the participants during discussion and the *source of support* they used as evidence for their arguments. Collaborativeness was defined as participants' referring to the arguments of their teammates in a capacity to extend their contributions. Collaborativeness was coded into three categories depending on the reference to other participants: no reference to others, referring to one posting of a teammate, and referring to two or more postings of teammates. The source of

support was divided into two categories according to the types of evidences used in the arguments: support by referencing the readings, and support by referencing personal experience.

Two coders were responsible for the content analysis of the discussions. Sentence-level idea units for assessment of critical thinking and message-level idea units for assessment of collaborativeness and support were used for being the most appropriate in terms of usefulness and reliability. Coders worked on a small sub-set of data to develop the rules to define the analysis units and code them. After there was agreement on the definitions and rubrics of these idea unit analyses, the coders also practiced assigning data to these categories.

Since one of the coders was also a facilitator, and in order to avoid possible bias, before analyzing the discussion postings a third person removed the facilitators' messages, changed participants' names in each message to a pseudonym, and altered the order of the messages. The two trained coders broke the data into idea units individually and then compared their results. The level of agreement for this initial unitization was 96% using Holsti's Coefficient of Reliability measure. In all, the coders agreed on 852 sentence units within the 72 posted messages. After resolving discrepancies between the unitization results through discussion, coders individually coded a fifty percent sample of the messages into the critical thinking, collaborativeness, and support categories, according to the established rubrics. Results of coding were then combined and contrasted. Inter-rater reliability for content analysis was not as high as expected and therefore average scores from the two coders' results were used for analysis purposes.

Test Analysis. To assess participants' learning, the answers for the recall and the open-ended test were analyzed. The results of the recall test were scored by two different raters. Using a set of rules defined during practice sessions, raters compared the results to a predefined set of 142 possible items to recall that was extracted from all the articles used during the discussions. Raters reached a 75.5% of agreement on their scoring results. The results of the open-ended test were also scored by two different raters using a three points rubric with two criteria for each question, reaching a 78.9% of agreement. Independent samples *t* tests were used to compare the results of the final tests.

Results

Participants' Incoming Variables

Results on the initial online survey (with a 5 point Likert scale where 1="Strongly Agree" and 5="Strongly Disagree"), indicate that overall participants' (n=12) trust levels were high (M=1.61, SD=0.42), excluding one outlier (2.5 standard deviations from the sample mean) that showed low trust levels (M=3.5) according to the instrument. No significant differences were found between participants on the low and high groups on this variable. This result is relevant considering the importance of trust in student participation in online discussions (Yamagishi, 2001), and indicates that any possible effects were independent of participants' trust levels.

All participants also showed a positive attitude toward DE. When asked if they agree with the idea that "Distance education is a strategy that will provide real educational opportunities world wide," eight chose the "Strongly Agree" option and four "Agree" (M=1.3, SD= 0.5). When asked for their interest in the discussion topic, again all participants showed high levels of interest. To the statement, "The use of DE is a topic that interests me", all but one participant answered, "Strongly Agree," and the remaining answered "Agree" (M=1.1, SD=0.3). Finally, when asked about their attitude toward K-12 education, when asked to react to the following statement "We are doing all we can to provide the best education we can in the US," again participants reacted similarly, in this case disagreeing with the statement (M=4.1, SD=0.8).

Overall these results indicate that all participants were in similar conditions to participate in the discussion. They were all interested in the topic; they valued the potential of DE, and had some concerns about the current state of K-12 education. All these are indicators that they could have a live discussion on the proposed topic: the use of DE in K-12 settings.

Participants' Perception of the Treatment

The three final survey scales (Table 1) that assessed how successful the treatment was, indicate no significant differences between conditions for their perceived facilitator social and motivational presence. Nonetheless, despite of the small sample size a significant difference $t(5) = 3.17$, $p = .025$ was found for the results of the perceived cognitive facilitation scale. These results indicate that the intended manipulation was successful and perceived by the participants. They should all have the same levels of social and motivational presence but differ in the level of cognitive facilitation.

Table 1: *Treatment perceptions for high and low cognitive facilitation conditions (5 point Likert scale 1=SA and 5=SD, N=7)*

Condition		Social Presence	Motivational Presence	Cognitive Facilitation
High	Mean	1.52	2.00	2.15*
	SD	0.36	1.20	0.65
Low	Mean	1.75	2.00	3.36
	SD	0.88	1.05	0.37

* Significant at the .05 level

Discussions Analysis

In the context of an exploratory study, content analysis results serve the main purpose of revealing patterns and trends that should inform thinking for subsequent studies. Thus, rather than reporting a detailed statistical analysis we carried out the content analysis focusing on conceptual indicators.

In terms of critical thinking, several patterns emerged indicating differences between treatments. Table 2 shows combined analysis by averaging the coders' ratings and the two groups on each condition. Results indicate a considerably higher percentage of critical thinking by sentence units in the high cognitive facilitation groups.

Table 2: *Percentage of idea units by critical thinking category. Combined coders, combined groups*

Content of idea units	Low cognitive facilitation groups (n=178 units)*	High cognitive facilitation groups (n=248 units)
Other	33.99%	12.40%
Trigger	5.90%	2.72%
Exploration	35.96%	39.72%
Integration	17.42%	42.34%
Resolution	6.74%	2.82%

* n = mean number of idea units at the *sentence* level for combined treatment groups

Regarding collaborativeness, results show similar levels of collaboration between treatments (Table 3), with a slight tendency in the high condition for having in total more references to other participants' messages.

Table 3: *Number of messages by level of collaborativeness – Combined coders, combined groups.*

Number of prior messages referenced	Low cognitive facilitation groups (n=41 units)*	High cognitive facilitation groups (n=31 units)
None	62,20%	59.68%
One	28.05%	33.87%
Two or more	9.76%	6.45%

* n = mean number of idea units at the *message* level for combined treatment groups

Regarding the use of resources to support discussion postings (Table 4), there was an important difference between high and low groups, with high cognitive facilitation groups providing article based support to their postings more than twice those on the low cognitive facilitation groups.

Table 4: *Number of messages by article based support – Combined coders, combined groups.*

Support on articles data	Low cognitive facilitation groups (n=41)*	High cognitive facilitation groups (n=31)
Yes	12.20%	27.42%
No	87.80%	72.58%

* n = Mean number of idea units at the *message* level for combined treatment groups

Personal experience support was a coding decision made based on whether messages showed evidence of including examples from the participant's experience with the intention of using them to support an argument. Table 5 presents combined coder and treatment group results for personal experience support, showing very little difference between the high and low cognitive facilitation groups, both exhibiting personal experience support in nearly 30% of the messages.

Table 5: *Number of messages by personal experience support – Combined Coders, Combined Treatment Groups*

Personal Experience Support	Low cognitive facilitation groups (n=41)*	High cognitive facilitation groups (n=31)
Yes	30.49%	29.03%
No	69.51%	70.97%

* n = mean number of idea units at the message level for combined treatment groups

Final Survey Results

The three final survey outcome variables; overall satisfaction, perceived learning, and self-reported use of the articles, indicate no significant differences between conditions. Nevertheless, in all cases there is a clear tendency for participants on the high cognitive facilitation groups to have higher ratings, as shown on Table 6. They were more satisfied with the discussion, their perception of learning was higher, and their self-reported use of the articles was also higher.

Table 6: *Final survey results by facilitation conditions (5 point Likert scale 1=SA, 5=SD, n=7)*

Condition		Overall Satisfaction	Perceived Learning	Self reported use of articles
High	Mean	2.00	2.00	1.11
	SD	0.60	0.33	0.19
Low	Mean	2.42	2.42	1.67
	SD	0.52	0.63	0.38

Final Tests Results

In terms of learning outcomes (Table 7), no significant differences were found, but there is a tendency for those in the high cognitive facilitation groups to have a higher number of recalled items and a higher score on the open ended test.

Table 7: *Learning outcomes by conditions (n=7)*

Condition		Number of items recalled	Test Score(24 points scale)
High	Mean	11	20.38
	SD	7.35	2.10
Low	Mean	9.5	19.13
	SD	6.03	1.93

Discussion

The purpose of this pilot study was to explore the relationship between high cognitive facilitation, critical thinking, and learning in online collaborative environments.

According to the results of the initial survey all participants were in similar conditions to participate in the discussion. They were interested in the topic, valued the potential of distance education and had some concerns about the current state of K-12 education. In addition, all participants (with the exception of an outlier) showed high trust levels, which was relevant for the study considering the importance of trust in student participation. All these were indicators that the manipulation could work and that participants could have a live discussion on the proposed topic. Cognitive facilitation was successfully manipulated and participants in the high condition did perceive their facilitator as providing a significantly higher level of cognitive facilitation. Simultaneously, there was no difference in the perception of the facilitator as being friendly (high social presence), and providing good motivation for the discussion.

These results are relevant for future studies on cognitive facilitation, because they show that cognitive facilitation can be successfully manipulated. The results also indicate that potential differences among conditions were not due to different levels of personal interest or trust, neither to different levels of social or motivational presence on the facilitator's side.

The first research question considered if high cognitive facilitation promoted critical thinking among participants or not. Based on the results of our analysis, we do see support for a link between high cognitive facilitation and critical thinking. Although our sample size was very small, we did see evidence of more critical thinking taking place among participants in the groups receiving high cognitive facilitation than among those receiving low cognitive facilitation. While the low group had 66% of critical thinking units, the high group had 88%. Specific support to this trend comes from the higher percentage of idea units classified as integration for groups receiving high cognitive facilitation. According to Garrisons et al.'s (2003) model, integration is the most important category indicating critical thinking process. Low cognitive facilitation groups had a high number of idea units classified under other (34%), i.e. social or general postings with no direct relation to critical thinking, and concentrated their critical thinking on the two initial levels of the process (trigger and exploration 42%).

Concerning the additional categories examined, personal experience was problematic due to low inter-rater reliability. We think there was a good deal of confusion between the coders in the definition used to code this category. This disagreement may also have had an impact in the critical thinking coding as well, since personal experience was used as specific indicators in Garrison et al.'s examples (2003). We recommend that clearer definition and agreement be reached on the meaning of personal experience.

While our inter-rater reliability was lower than we would have preferred, these indicators give us hope that high cognitive facilitation may positively impact critical thinking in OL, and would therefore be a worthwhile practice to foster.

There were other relevant problems that arose in this study that need to be addressed and considered on future studies. The rating cues for critical thinking, based on the Garrison et al.'s model (2003), were not equally understood by the two raters, and better agreement could be reached by a clearer definition of the categories. In particular, the ambiguity between integration and exploration categories needs to be clarified. These categories created the most recognizable differences in coding between the coders.

One of the coders in this study was also a facilitator for two of the groups. This coder's familiarity with the discussions, and the potential of inferring context from memory, may have had an impact on the coding results, particularly his higher count for integration. It is recommended that future coding is not done by one of the study facilitators.

Context is also an important consideration. We "sanitized" the data and changed the order of the messages so the coders would not recognize the postings as being from one of the conditions. Nevertheless, the flow of an entire discussion thread could have provided clearer indication of the content categories for individual messages. If coding is done by non facilitators the original flow of the discussion could be used with no foreseen problem.

Unitization was a struggle for this study. We originally wanted to code at a "unit of meaning" level, but had much difficulty reaching agreement between coders on these units. To reduce ambiguity, we decided to code at the sentence level. This created much higher inter-rater reliability in unitization, but introduced the problems of volume of units (852 sentences), and lack of context. Garrison et al. (2003) decided to unitize at the message level. This makes logical sense as most messages are trying to accomplish one predominant task. Additionally, the model we used for analysis was developed and previously applied for coding at the message level, and did not translate ideally for applying it at the sentence level. We would recommend future studies use the message level for unitization, or develop a better rating scale more suited to the agreed upon units.

The second research question considered if high cognitive facilitation, and the consequent higher presence

of critical thinking among participants, results in higher levels of learning among participants or not. Results indicate that there were no statistically significant differences between the learning outcomes of the two conditions, or between the effects on perceived learning or satisfaction. Nevertheless, results also suggest a consistent tendency in which participants in the high condition showed higher satisfaction, higher perceived learning and higher use of the articles. In terms of learning outcomes, no significant differences were found in both the recall and the open ended tests, but again there is a tendency for those in the high cognitive facilitation groups to have, in average, a higher number of recalled items, and a higher score on the open ended test.

The fact that we had a small sample size might have prevented us from finding significant differences among conditions. Additionally, the instruments might not have measured learning in a way that would help us discriminate enough what participants learned during the discussion, and what came from their prior experience. Another factor that could have impeded appropriate discrimination was that each team member in addition to the shared article received an extra one, which made the recall test scoring complicated. Perhaps an interesting topic in which participants have none or reduced previous experience could have been selected to avoid this problem. Future studies should consider these aspects when further investigating online cognitive facilitation and student critical thinking in online environments. Nonetheless, as far as we know online cognitive facilitation has not been experimentally manipulated before, and results of this study open an interesting avenue for future research on facilitation, critical thinking, and collaboration in online learning environments.

References

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing environment. *Journal of Asynchronous Learning Networks, 5*(2).

Angeli, C., Valanides, N., & Bonk, C. J. (2003). Communication in a web-based conferencing system: the quality of computer-mediated interaction. *British Journal of Educational Technology, 34*(1), 31-43.

Archer, W., Garrison, D. R., Anderson, T., & Rourke, L. (2001). *A framework for analysing critical thinking in computer conferences.* Paper presented at the European Conference on Computer-Supported Collaborative Learning, Maastricht, The Netherlands.

Bonk, C. J. (2002). *Online training in an online world*.Bloomington, IN: CourseShare.com.

Collett, D., Kanuka, H., Blanchette, J., & Goodale, C. (1999). *Learning technologies in distance education*.Edmonton, AB: University of Alberta.

Collison, G., Elbaum, B., Haavind, S., & Tinker, R. (2000). *Facilitating online learning: Effective strategies for moderators*.Madison, WI: Atwood Publishing.

Duffy, T. M., Dueber, B., & Hawley, C. (1998). Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems. In C. Bonk & K. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse*.Mahwah, NJ: Mahwah, NJ: Lawrence Erlbaum Associates.

Duffy, T. M., & Kirkley, J. (Eds.). (2004). *Learner-centered theory and practice in distance education: Cases from higher education*.Mahwah. NJ: Lawrence Erlbaum Associates, Inc.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical thinking in a text-based environment: Computer conferencing in higher education. *Internet and Higher Education, 11*(2), 1-14.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1).

Hiltz, S. R., Coppola, N., Rotter, N., & Turoff, M. (2000). Measuring the importance of collaborative learning for the effectiveness of aln: A multi-measure, multi-method approach. *Journal of Asynchronous Learning Networks, 4*(2), 103-125.

Jeong, A. C. (2001). Supporting critical thinking with group discussion on threaded bulletin boards: An analysis of group interaction. Unpublished doctoral dissertation, University of Wisconsin, Madison.

Kanuka, H., & Garrison, D. R. (2004). Cognitive presence in online learing. *Journal of Computing in Higher Education, 15*(2), 30-48.

Klemm, W. R., & Snell, J. R. (1996). Enriching computer-mediated group learning by coupling constructivism with collaborative learning. *Journal of Instructional Science and Technology, 1*(2).

Mikulecky, L. (1998). Diversity, discussion, and participation: Comparing web-based and campus-based adolescent literature classes. *Journal of Adolescent & Adult Literacy, 42*(2), 84-97.

Nachmias, R., Mioduse, D., Oren, A., & Ram, J. (2000). Web-supported emergent-collaboration in higher education courses. *Educational Technology & Society, 3*(3), 94-104.

Paul, R., & Elder, L. (2001). *Critical thinking: Tools for talking charge of your learning and your life*.Upper Saddle River, New Jersey: Prentice Hall.

Richardson, J. C., & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction. *Journal of the Asynchronous Learning Network, 7*(1), 68-88.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education, 14*(3), 51-70.

Sofres, T. N. (2001). E-learning in usa & canada benchmark survey. Retrieved April 30, 2003, from www.smartforce.com/corp/marketing/smartforce_solutions/white_papers.htm

Wise, A., Chang, J.-y., Duffy, T. M., & del Valle, R. (2004). The effects of teacher social presence on student satisfaction, engagement, and learning. *Journal of Educational Computing Research, 31*.

Yamagishi, T. (2001). Trust as a form of social intelligence. In K. S. Cook (Ed.), *Trust in society* (pp. 121-147). New York: Russell Sage Foundation.

Yamagishi, T., & Yamagishi, M. (1994). Trust and commitment in the united states and japan. *Motivation and Emotion, 18*(2), 129-166.