The Effects of Communication Style and Message Function in Triggering Responses and Critical Discussion in Computer-Supported Collaborative Argumentation

Allan C. Jeong
Florida State University

Abstract

This study examined how differences in communication style affect how likely particular types of messages (e.g. arguments, evidence, critiques, explanations) were able to elicit critical responses during four online debates. Event sequence analysis was used to compare the response probabilities for each type of message across messages that used expository versus epistolary styles of communication observed in the four asynchronous threaded discussions. The results suggests that when a message is posted to challenge an opposing viewpoint, that message is significantly less likely to elicit a return response from the opposition when the message acknowledges individuals by name or presents a direct reference to an individual's preceding statements. A more detailed and exploratory analysis of the interactions revealed that this style of communication might have contributed to a decrease in the frequency of evidence and subsequent discussion of supporting explanations needed to defend the challenged viewpoints and arguments.

Introduction

Computer-mediated communication (CMC) provides opportunities for learner-to-learner interaction and enables learning communities to engage in more reflective critical thinking. Argumentation is one of the fundamental collaborative inquiry-based learning strategies for increasing critical thinking skills in online settings. These skills involve the processes of building arguments to support a position, and considering and weighing evidence and counter-evidence in developing supporting arguments. Innovative approaches to facilitating student participation in collaborative argumentation have been developed in computer-supported collaborative leaming (CSCL) and computer-supported collaborative argumentation (CSCA). One approach to scaffolding and facilitating collaborative argumentation is to structure the discussions such that constraints are placed on when and what types of functional moves and messages can be posted to discussions (Cho & Jonassen, 2002; Duffy et al., 1998; Jonassen & Remidez, 2001; McAlister, 2001). The other approach incorporates intelligent systems and pedagogical agents that use formalized models of argumentation to actively diagnose students' performance and suggest immediate courses of action (Eleuterio, Barthes & Bartolozzi, 2002; Jacques, Oliveira, & Vicari, 2002a; Jacques et. Al, 2002b; Karacapilidis & Papadias, 2001).

Despite these technical advances to support the functions students perform during online discussions and regardless of what technology is used to facilitate discussion, a growing body of research now suggests that student participation in online discussions can be influenced by the communication styles of its participants. When and how often a student responds to a message may depend not just on what is said in the message (in terms of function of the message), but also by how the message was delivered in terms of communication style. Significant differences in communication styles have been found between males and females. For example, men tend to assert opinions strongly as facts, place more value on presenting information using an expository style, are more likely to use crude language, violate online rules of conduct, engage in more adversarial exchanges, and terminate exchanges when there are disagreements (Fahy, 2002; Herring, 1993; Savicki et al., 1996). In contrast, females are more likely to qualify and justify their assertions, use expressions that convey more epistolary roles, make apologies, and in general, manifest a more consensus-making orientation and epistolary style. Furthermore, females are more upset by violations of politeness and are more likely to challenge participants that violate rules of conduct and (Smith, McLaughlin & Osborne, 1997). Although each gender may have a tendency towards one communication style, groups have also been found to modify their communication styles in the direction of the majority gender (Baym, 1996; Herring, 1996).

However, the impact of communication styles on when and how often messages are able to elicit responses that generate more critical and more substantive discussions has yet to be examined and empirically investigated. The lack of empirical research can be attributed to the absence of appropriate theories, methods and tools capable of operationalizing and producing precise measurements, descriptions and assessments of group interactions and processes in online discussions (Fahy, 2001 & 2002; Garrison, 2000). The main problems lie in the coding and analysis of computer conference messages (Rourke, Anderson, Garrison, Archer, 2001) and the sequential nature of messages and responses (Gunawardena, Lowe & Anderson, 1997). The difficulty in coding message content is in establishing the unit of analysis because messages often contain multiple ideas that serve multiple functions. As a result, the contents of a message must be classified into multiple codes, making it nearly impossible to map message-response sequences in terms of pre-defined message categories (Levin, Kim & Riel, 1990; Newman, Johnson, Cochrane & Webb, 1996; Gunawardena, Lowe & Anderson, 1997). These methodological problems have prevented researchers from conducting a closer and more detailed examination of the relationships between messages and responses - particularly the functional, temporal, social and semantic relationships between exchanged messages and responses (Jeong, 2004a).

One solution to this problem is to require students to pre-classify their contributions to discussions using a pre-determined set of message/response categories. This constrains each message to serve only one function at a time, and establishes a clear unit of analysis. This approach has been used in a number of computer-supported collaborative argumentation (CSCA) systems (Cho & Jonassen, 2002; Duffy et al., 1998; Jonassen & Remidez, 2001; McAlister, 2001). The ACT system (Sloffer, Dueber & Duffy, 1999), for example, is a threaded discussion board that is designed to scaffold online debates by requiring students to pre-classify each posting to one of six response categories - proposal, counter-proposal, supporting reasons, detracting reasons, supporting evidence and detracting evidence. McAlister (2003) proposed a synchronous chat tool to support collaborative argumentation by requiring students to pre-classify messages to inform, question, challenge, reason, support or maintain chat discussions. Within each of these response categories, students are able to choose a specific sentence opener (e.g. "A counter-argument is…") to channel students' thoughts by the process of completing the sentence in a way that fits with the opener.

Purpose

Using the methods described above, the purpose of this study was to determine the precise probabilities in which messages with a given function (e.g. arguments, supporting evidence, critiques and explanations) and communication style (epistolary vs. expository) are able to successfully elicit responses that contribute to discussions that critically examine claims and alternative viewpoints. The research questions that were specifically addressed in this study were the following:

1. *Level of Interaction Between Opposing Viewpoints.* When conducting discussions to critically examine alternative viewpoints, how does the use of epistolary styles of communication affect how likely students will respond back to students who challenge their claims with counter-arguments and supporting explanations?

2. *Impact on Level of Critical Discussion.* What are the implications of using versus not using these specific styles of communication on the level and depth of discussion across all presented arguments and claims?

Method

Participants

The participants (n = 17) were graduate students from a major university in the Southeast region of the U.S., consisting of 11 female and 6 male students, and ranging from 20 to 40 years in age. The students were enrolled in a 16-week online graduate introductory course to distance learning required to complete a Master's program in instructional systems with a major in distance learning. The gender of each student was determined at the beginning of the online course through personal introductions and posted biographies.

Debate procedures

Students were required to participate in a series of four highly structured debates using threaded discussion forums in Blackboard, a web-based course management system. The discussions were highly

structured given that: a) student participation in the debates and other scheduled discussions throughout the course contributed to 20% of the course grade; b) for each debate, students were required to post at least four messages to receive full credit for each debate; c) prior to each debate, students were randomly assigned to one of two teams (but balanced by gender) to either support or oppose a given position; and d) students were required to vote on the team that presented the strongest arguments after each debate.

The purpose of each debate was to critically examine design issues, concepts and principle in distance learning covered during the week of the debate. For example, students debated over the following claims: "The Dick & Carey ISD model is an effective model for designing the instructional materials for this course", "The role of the instructor should change when teaching at a distance", "Type of media does not make any significant contributions to student learning", and "Given the data and needs assessment, the fictitious country of NED should not develop a distance learning system". Students were instructed to support and refute presented claims and viewpoints with arguments, evidence, explanations, and critiques.

Online debate messages and message labels

Students were presented a list of four response categories during the debates designed to scaffold argumentation. The response categories were based loosely on Toulmin's (1958) model of argumentation. The response categories and their definitions were presented to students prior to participating in the debates. Each student was required to classify each posted message by response category by inserting the corresponding label into the subject headings of every message. Students were required to limit the content of their messages to address one and only one response category at a time. The experimenter occasionally checked the message labels to determine if students had appropriately labeled their messages according to the described procedures. No participation points were awarded for a given debate if a student failed to properly label one or more posted messages. However, students were able to return to a message at any time to correct for errors in their labels.

Symbol	Description of symbol
+	Identifies a message posted by a student assigned to the team supporting the given claim/statement
-	Identifies a message posted by a student assigned to the team opposing the given claim/statement
ARG#	Identifies a message that presents one and only one argument or reason for using or not using chats (instead of threaded discussion forums). Number each posted argument by counting the number of arguments already presented by your team. Sub-arguments need not be numbered. ARG = "argument".
EXPL	Identifies a reply/message that provides additional support, explanation, clarification, elaboration of an argument or challenge.
BUT	Identifies a reply/message that questions or challenges the merits, logic, relevancy, validity, accuracy or plausibility of a presented argument (ARG) or challenge (BUT).
EVID	Identifies a reply/message that provides proof or evidence to establish the validity of an argument or challenge.

Figure 1 – Example instructions on how to label messages during the online debates

The purpose of labeling and constraining each message to a specific function was to make the inter-relationships between students' contributions explicit and to enable students to visualize the structure of their arguments (Jeong & Juong, 2004b). The second reason for using these procedures is that they enabled the experimenter to clearly establish each message as a unit of analysis. With each message assigned to a specific response category, the types of message-response sequences observed in the debates could be clearly identified and counted to determine their relative frequencies. Previous studies on group interaction in CMC did not succeed in measuring message-response sequences (Gunawardena, Lowe, & Anderson, 1997; Newman,

Johnson, Cochrane, & Webb, 1996) because students' messages and responses often addressed multiple functions or response categories at the same time. As a result, mapping the relationships between messages and responses was a difficult if not impossible task. In this study, however, the use of student-labeled messages was found to be an adequate solution to resolving some of the previous problems by establishing a clear unit of analysis. Although these procedures appear at first sight to be artificial and perhaps intrusive, this method has been implemented in a number of computer-supported collaborative argumentation (CSCA) systems for scaffolding argumentation and problem solving (Carr & Anderson, 2001; Cho & Jonassen, 2002; McAlister, 2003; Sloffer, Dueber, & Duffy, 1999; Veerman, Andriessen, & Kanselaar, 1999).

In addition, students were also instructed to identify each message by team membership by adding an "-" for opposing or a "+" for supporting team at the end of each label (e.g. +ARG, -ARG). These tags allowed the students to easily locate the exchanges between the opposing and supporting teams within the discussion threads (e.g. +ARG→-BUT) and respond to the exchanges to advance or defend their team's position. An example discussion thread from a debate is illustrated in Figure 2.

Figure 2. Example of online debate with labeled messages

Data analysis

Inter-rater reliability. To determine the extent in which the messages were labeled correctly by students, two of the four debates were randomly selected and coded by the experimenter to determine inter-rater reliability (work in progress).

Data preparation prior to analysis. To prepare the data for analysis, computer software was written by the experimenter to download, tabulate and compile the student-labeled messages from the Blackboard discussion forums into Microsoft Excel. The experimenter reviewed all the messages to identify and tag any messages that contained expressions that reflected more conversational and epistolary exchanges. The expressions that were

found to exhibit the epistolary style were direct references to previous statements (e.g. "I agree when you say that…), and references to individual's names (e.g. "Hi Bob"). All messages that contained these expressions were tagged with an "s" (e.g. BUTs). As a result, a total of eight message categories (ARG, ARGs, BUT, BUTs, EVID, EVIDs, EXPL, EXPLs) were used to code the messages.

Event sequence analysis. Event sequence analysis (Bakeman & Gottman, 1997) was used to identify and quantify the observed interaction patterns between messages that exhibited different communication styles. Sometimes referred to as lag analysis or Markovian chain analysis, the purpose of event sequence analysis is to determine: a) the probability in which a given event is able to elicit one or more subsequent events; and b) the probabilities in which specific types of events are likely to follow a given event. Event sequence analysis has effectively used in communications research to study, for example, communication patterns in the conversations and interactions between married couples (Bakeman & Gottman, 1997 pp. 184-193; Gottman, 1979), children at play (Bakeman & Brownlee, 1982), mother and infant at play (Stern, 1974), and humans and computer-interfaces (Olson, Herbsleb, & Rueter, 1994).

A computer program (Jeong, 2003), the Discussion Analysis Tool (DAT), was developed by the experimenter to perform the event sequence analysis. DAT tallied the frequency of each message-response interaction. The response frequencies for each target message were then converted into relative frequencies, or *transitional probabilities* (Bakeman & Gottman; 1997). The transitional probabilities measured how likely a particular type of response was posted in reply to a particular type of message relative to all the other types of responses elicited by the given message.

Transitional state diagrams. The observed transitional probabilities between messages with different communication styles and function were converted into transitional state diagrams using DAT. In the diagrams, each response category was represented in a node. Directional arrows were drawn from one node to another node to represent the relative frequency of each observed message-response interaction. The density of the directional arrows connecting the nodes illustrates the strengths of the transitional probabilities between the nodes. This graphical representation of the interactions provided a means to readily identify prevalent patterns of interaction produced by messages that exhibited expository styles and epistolary style. Most of all, the diagrams provided a visual approach to identifying differences in message-response sequences between the message types.

Results

Summary statistics and overall level of interaction. Figure 3 shows the frequency matrix that summarizes the number of observed messages and responses across categories. The four debates produced a total of 323 messages. Of the 323 messages, 239 were posted in reply to a previous message and 166 of the messages did not elicit any replies. The matrix also shows how many messages of a given category were observed, and how many responses were elicited by the message within a given category. For example, the debates generated a total of 84 arguments (ARG), 65 messages (BUT) that challenged its merits with out using an epistolary style versus 20 challenging messages (BUTs) with epistolary style. In Figure 4 is the transitional probability matrix, which shows the relative frequency of each type of response elicited by each message category. For example, 50% of responses to ARG were BUT (65 of the 129 replies) versus 16% BUTs (20 of the 129 replies). This matrix also shows the overall response rates for each message category. For example, 81% of the arguments elicited a response based on the finding that only 16 of the 84 did not receive any responses at all. The overall response rate across all message categories was 67%.

Figure 3 – Matrix with message and response frequencies

	ARG	BUT	EVI	EXP	ARGs	BUTs	EVIs	EXPs	Replies	No Replies	Givens	Target%	Givens%
ARG	0	65	23	12	0	20	4	5	129	16	84	0.0%	26.0%
BUT	0	26	5	3	0	14	1	2	51	75	117	49.0%	36.2%
EVI	0	11	1	3	0	1	2	0	18	19	31	13.0%	9.6%
EXP	0	5	0	2	0	4	0	0	11	14	24	10.0%	7.4%
ARGs	0	0	0	0	0	0	0	0	0	0	0	0.0%	0.0%
BUTs	0	6	2	4	0	10	1	1	24	31	51	21.3%	15.8%
EVIs	0	1	0	0	0	1	0	0	2	7	8	3.3%	2.5%
EXPs	0	3	0	0	0	1	0	0	4	4	8	3.3%	2.5%
	0	117	31	24	0	51	8	8	239	166	323	239	323

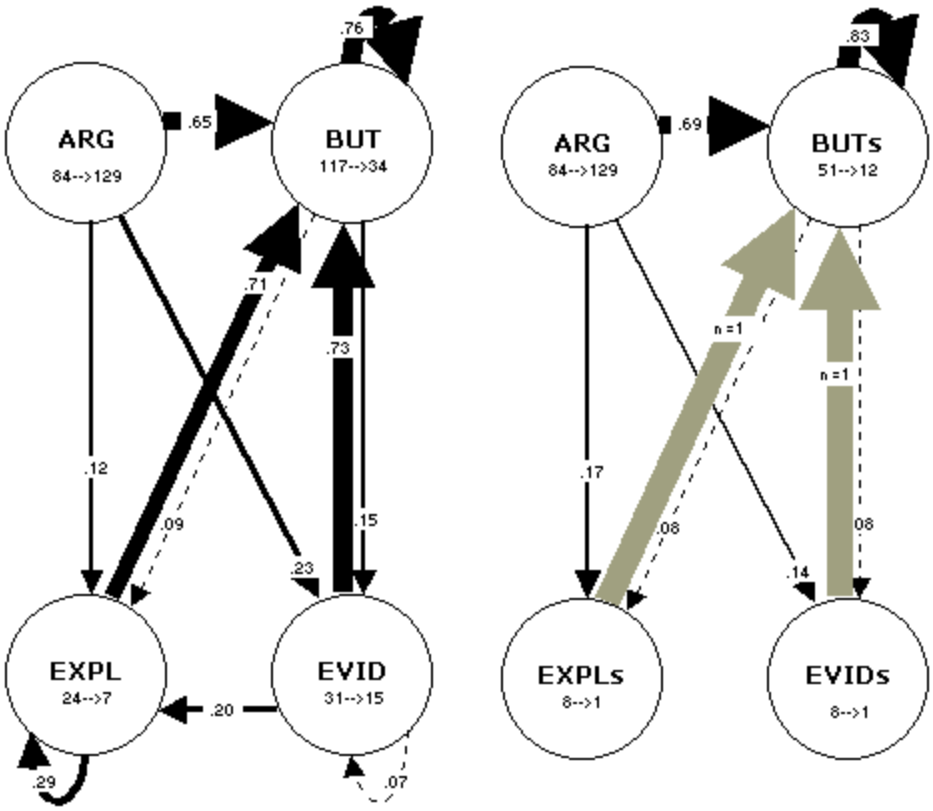
Figure 4 – Matrix with transitional probabilities between messages and responses

	ARG	BUT	EVI	EXP	ARGs	BUTs	EVIs	EXPs	Replies	No Replies	Givens	Reply Rate
ARG	.00	.50	.18	.09	.00	.16	.03	.04	129	16	84	81%
BUT	.00	.51	.10	.06	.00	.27	.02	.04	51	75	117	36%
EVI	.00	.61	.06	.17	.00	.06	.11	.00	18	19	31	39%
EXP	.00	.45	.00	.18	.00	.36	.00	.00	11	14	24	42%
ARGs	.00	.00	.00	.00	.00	.00	.00	.00	0	0	0	100%
BUTs	.00	.25	.08	.17	.00	.42	.04	.04	24	31	51	39%
EVIs	.00	.50	.00	.00	.00	.50	.00	.00	2	7	8	13%
EXPs	.00	.75	.00	.00	.00	.25	.00	.00	4	4	8	50%
n =	0	117	31	24	0	51	8	8	239	166	323	67%

Level of interaction between opposing viewpoints. By analyzing only the interactions produced by exchanges between participants on opposing teams (e.g. +ARG→-BUT, -BUT→+BUT, -BUT→+EVID, etc.), the results showed that messages presented with personal acknowledgments and direct references to an individual's previous statements (epistolary style) received significantly fewer return responses (or rebuttals) from the opposition (X = .39, STD = .60, n =67) compared to messages that were presented without using this style (X = .61, STD = .83, n = 256), t(321) = 2.08, p = .038, with the effect size of -.31.

Impact on level of critical discussion. To explore the potential impact of using the epistolary style of communication on the subsequent direction and level of critical discussion, the transitional probabilities from the upper-left and lower-right quadrants in the probability matrix (Figure 4) were examined separately to compare the types of discussion that would or could be produced if *all* messages in a discussion were presented with versus without the epistolary style. The transitional probabilities produced by messages without the epistolary style (upper right quadrant) are depicted in the left diagram in Figure 5. The diagram on the right depicts the interactions produced only by messages presented with the epistolary style.

Figure 5 – Possible patterns of interaction when discussions consist only of expository messages versus only epistolary messages.



Expository → Expository message-response exchanges

Epistolary → Epistolary message-response exchanges

A comparison of the two diagrams reveals possible differences in outcomes following interactions produced with epistolary style versus without epistolary style of communication. When the epistolary style was not used, challenges (BUT) directed at an argument (ARG→BUT) were more likely to elicit responses with evidence in defense of the challenged argument. In other words, the sequence of events produced without the epistolary style (ARG→BUT→EVID) was more likely to occur (in 15% of replies to BUT) when the epistolary style was not used to challenge an argument. When the epistolary style was used to present a challenge (ARG→BUTs), this interaction was less likely to lead to the production of evidence (in only 8% of replies to BUTs). The left diagram in Figure 5 also suggests that once evidence was elicited by a challenge (without the epistolary style), students were more likely to sustain and develop the discussion with explanations (ARG → BUT → EVID → EXPL → EXPL). These differences suggest that the use of expository style produced discussions that exhibited more reflection and critical examination of arguments during the online debates. However, these observations must be considered with caution because these observations are based on low frequencies of messages presented with the epistolary style.

Discussion

The findings of this study show that the epistolary style of communication – namely the direct reference to individuals by name and direct reference to previous statements - inhibited the critical discussion and examination of arguments, and that critical discussion is more likely to occur when students adopt and implement a more expository rather than epistolary style of discourse during computer-supported collaborative argumentation. This finding may appear to contradict the prediction that a more epistolary or conversational style of communication encourages individual participants (particularly female participants) to reciprocate responses and extend a conversation by helping to build rapport between participants (Fahy, 2002). However,

the findings in this study showed that the epistolary style inhibited rather than supported student responses to challenges. One possible explanation for this unexpected finding is that the confrontational nature of collaborative argumentation may have been intensified or even personalized when students made direct reference to individual names and previous statements. Engaging in discussion without this epistolary style would seem to have helped the students maintain focus on the ideas and not the personalities involved in the discussions, thereby reducing the sense of contentiousness inherent in the debate activity.

The findings from the exploratory analysis also suggest that the use of the epistolary style could have a potentially negative effect on the level of reflection, critical analysis and discussion. The analysis of the state diagrams revealed patterns to suggest that the epistolary style can reduce the frequency of evidence and explanations presented in defense of arguments following challenges to the arguments. To thoroughly test the effects of discourse styles on students' interaction patterns and the outcomes produced by the interactions, future studies will (a) need to collect a larger corpus of data to gather sufficient number of messages with contrasting styles, or (b) conduct a controlled experiment in which students in multiple groups are instructed to implement different styles of discourse as they participate in online collaborative activities such as debates, problem-solving, and case-studies.

In conclusion, this study was successful in making a first attempt at determining the effects of discourse styles on student performance in CMC when no previous studies have succeeded or attempted to determine its actual impact. The findings in this study serve to demonstrate the efficacy of using event sequence analysis, combined with the use of response constraints to label messages by function, to precisely measure and study the effects of epistolary versus expository styles in computer-mediated communication. Ultimately, this study will also serve as a model for investigating the effects of other styles and protocols commonly observed in online communication, which include the use of emoticons, qualifiers, humor, rhetorical questions, and the explicit versus discrete expression of disagreements. Measuring the precise effects of these communication styles and protocols will enable researchers and instructors to develop more refined strategies and computational models for supporting and optimizing student performance in computer-supported collaborative learning.

References

Bakeman, R. & Brownlee, J. (1982). Social rules governing object conflicts in toddlers and preschoolers. In K. H. Rubin & H. S. Ross (Eds.), *Peer relationships and social skills in childhood* (pp. 99-111). New York: Springer-Verlag.

Bakeman, R., & Gottman, J. (1997). *Observing Interaction: An introduction to sequential analysis*, Cambridge, University Press.

Baym, N. (1996). Agreements and disagreements in a computer-mediated discussion. *Research on Language and Social interaction, 29*(4), 315-345.

Carr, C., & Anderson, A. (2001). Computer-supported collaborative argumentation: Supporting problem-based learning in legal education. Paper presented at the *Computer Support for Collaborative Learning (CSCL) 2001 Conference*. Retrieved October 30, 2003: http://www.mmi.unimaas.nl/euro-cscl/Papers/25.pdf.

Cho, K., & Jonassen, D. (2002). The effects of argumentation scaffolds on argumentation and problem solving. *Educational Technology Research and Development, 50* (3), 5-22. Retrieved from http://tiger.coe.missouri.edu/~jonassen/Argumentation.pdf on March 3, 2004.

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.

Eleuterio, M., Barthes, J. & Bartolozzi, F. (2002). Mediating collective discussions using an intelligent argumentation-based framework. In Proceedings of the Computer Support for Collaborative Learning (CSCL) 2002 Conference.

Fahy, P. (2002a). Epistolary and expository interaction patterns in a computer conference transcript. *Journal of Distance Education*, 17(1), 20-35.

Fahy, P. (2002b). Use of linguistic qualifiers and intensifiers in computer conference. *The American Journal of Distance Education, 16*(1), 5-22.

Fahy, P. (2003). Indicators of support in online interaction. *International Review of Research in Open and Distance Learning*, 4(1). Retrieved April 21, 2004 from: http://www.irrodl.org/content/v4.1/fahy.html.

Garrison, R. (2000). Theoretical challenges for distance education in the 21st century: A shift from structural to transactional issues. *International Review of Research in Open and Distance Learning, 1*(1), 1-17.

Gottman, J. M. (1979). *Marital interaction: Experimental investigations*. New York, Academic Press.
Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of global on-line debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*, 397-431.
Herring, S. (1993). Gender and democracy in computer-mediated communication. *Electronic Journal of Communication, 3*(2). Retrieved August 22, 2001 from: http://www.cios.org/www/ejc/v3n293.htm.
Herring, S. (1996). Two variants of an electronic message schema. In S. Herring (Ed.), *Computer-mediated communication: Linguistic, social and cross-cultural perspectives*, (pp. 81-106). Amsterdam: John Benjamins
Jacques, P., Oliveira, F. & Vicari, R. (2002a). An experiment using software agents for Dialogue analysis in collaborative distance learning. In Proceedings of the Computer Support for Collaborative Learning (CSCL) 2002 Conference.
Jacques, P., Andrade, A., Jung, J., Bordini, R. & Vicari, R. (2002b). Using pedagogical agents to support collaborative distance learning. In Proceedings of the Computer Support for Collaborative Learning (CSCL) 2002 Conference.
Jeong, A. (2003). The sequential analysis of group interaction and critical thinking in on-line threaded discussions. *The American Journal of Distance Education, 17*(1), 25-43.
Jeong, A. (2004a). Methods and Tools for the Computational Analysis of Group Interaction and Argumentation in Asynchronous Online Group Discussions. Paper submitted to the Annual meeting of the American Educational Research Association, Montreal, Canada, April 2005.
Jeong, A. & Juong, S. (2004b). The effects of response constraints and message labels on group interaction and argumentation in online discussions. Paper presented at the American Educational Research Association conference, San Diego CA.
Jonassen, D., & Remidez, H. (2002). Mapping alternative discourse structures onto computer conference. Paper presented at the *Paper presented at Computer Support for Collaborative Learning 2002 Conference: Foundations for a CSCL Community*, Boulder, CO.
Karacapilidis, N. & Papadias, D. (2001). Computer supported argumentation and collaborative decision making: The Hermes system. In *Proceedings of the Computer Support for Collaborative Learning (CSCL) 2001 Conference*.
Levin, J., Kim, H. & Riel, M. (1990). Analyzing instructional interactions on electronic message networks, *Online Education*, L. Harasim (ed.), Praeger, New York, pp. 185-213.
McAlister, S. (2003). *Assessing good argumentation*. Retrieved April, 10, 2004, from the World Wide Web: http://iet.open.ac.uk/pp/s.r.mcalister/personal/AssessingGEA.htm
Newman, D., Johnson, C., Cochrane, C., & Webb, B. (1996). An experiment in group learning technology: Evaluating critical thinking in face-to-face and computer supported seminars. *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 4*(1), 57-74.
Olson, G., Herbsleb, J., & Rueter, H. (1994). Characterizing the sequential structure of interactive behaviors through statistical and grammatical techniques. *Human-Computer Interaction, 9*(3/4), 427-472.
Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education, 12*, 8-22.
Savicki, V., Kelley, M., & Ammon, B. (2002). Effects of training on computer-mediated communication in single or mixed gender small task groups. *Computers in Human Behavior, 18*, 257-269.
Sloffer, S., Dueber, B., & Duffy, T. (1999). Using asynchronous conferencing to promote critical thinking: Two implementations in higher education. Retrieved on October 30, 2003 at http://crlt.indiana.edu/publications/crlt99-8.pdf
Smith, C., McLaughlin, M. & Osborne, K. (1997). Conduct controls on Usenet. *Journal of Computer-Mediated Communication, 2*(4). Retrieved March 3, 2004 from http://www.ascusc.org/jcmc/vol2/issue4/smith.html
Stern, D. N. (1974). Mother and infant at play: The dyadic interaction involving facial, vocal, and gaze behaviors. In M. Lewis & L. A. Rosenblum (Eds.), *The effect of the infant on its caregiver* (pp. 187-213). New York: Wiley.
Toulmin, S.E. (1958). *The uses of argument*. Cambridge: University Press.
Veerman, A., Andriessen, J & Kanselaar, G. (1999). Collaborative learning through computer-mediated argumentation. In C. M. Hoadley and J. Roschelle (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference* (pp. 640-650). Palo Alto, CA: Stanford University

[Available from Lawrence Erlbaum Associates, Mahwah, NJ].