The Effects of Task Characteristics on Online Discussion

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Abstract: A key guidance factor of computer supported collaborative learning (CSCL) is the specification of a discussion task. Aspects of the discussion task may affect the quality of group discussion for higher-order learning. This experiment investigated the effects of two aspects of discussion task on asynchronous text discussion of an online higher-education course. Groups completed discussion assignments that varied in degree of task context and outcome specification. Content analysis was used to assess conceptual conflict and level of information processing of online messages. Results indicate that conceptual conflict is associated with higher-order discussion, but differences in task context and product do not have large effects on the quantity or quality of online discussion.

Introduction and Research Overview

Wiley and Bailey (2006) describe *process loss* as the less effective performance of groups in completing some tasks. A significant body of research, however, has shown that collaborative learning groups, including online groups, can foster shared understanding, retention of learned material, and deeper processing compared to non-cooperative learning activities (Johnson & Johnson, 1994; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Slavin, 1987, 1992; Yeager, Johnson & Johnson, 1985). Other research supports the assertion that collaborative learning can promote higher-order learning such as critical thinking (e.g., Anderson, Howe, Soden, Halliday & Lowe, 2001; Gokhale, 1995; Meyer, 2003). Such research suggests that collaborative learning groups have characteristics that result in *process gain* in comparison to other group efforts. A major focus of collaborative learning research is to identify what characteristics result in process gain and how learning can be designed to maximize such gain in addition to meeting learning goals.

Computer supported collaborative learning (CSCL) often relies on peer-to-peer discussion as the key activity supporting achievement of higher-order learning objectives. Hammond's (2005) survey of online discussion studies lists several that cite evidence of higher-order knowledge construction and learning advantages of group discussion. Efforts to improve process gain of learning by discussion include efforts to understand how aspects of discussion *task* may affect the quality of peer discussion. This study investigated how two aspects of discussion task affect asynchronous online discussion (AOD) associated with higher-order learning.

Characteristics of High-Quality Discussion for Higher-Order Learning

Models of learning by discussion, such as the Process of Controversy model of Johnson and Johnson (1979) or the Collaborative Knowledge Building model of Stahl (2000), indicate that for higher-order learning to occur, information expressed in discussion must vary (diverge) sufficiently to achieve *conceptual conflict* among students. Conceptual conflict occurs when students encounter ideas and information that do not fit with what they believe to be true (Johnson & Johnson, 1979). These models assert that collaborative learning occurs when students encounter cognitive conflicts and then engage in group processing of information to identify or produce a shared interpretation that completes the discussion task. Discussions in which ideas and assertions diverge and conflict tend to promote learning, especially higher-order learning.

In completing a group learning task, group members process shared information to identify or generate information that members agree resolves the task (i.e., information *converges* to a task solution). A group can process information by negotiation, questioning, and argumentation (Andriessen, 2006, Andriessen, Baker & Suthers, 2003; Spatariu, Hartley & Bedixen, 2004), but CSCL discussions often do not converge. Andriessen (2006) found that online discussion messages tend to be both unconnected (do not reference each other) and non-argumentative. Hewlitt (2005) found that students tend to focus only on the most recently posted messages, while older messages tend not to be reexamined or referenced. Lobry de Bruyn (2004) found low levels of analysis, synthesis, and summarizing ("convergent processes") displayed in discussion messages. Online discussions often fail to integrate diverse ideas, opinions, and suggestions into new group knowledge that indicates higher-order learning.

Peer discussion may fail to support higher-order learning because information does not sufficiently diverge to create conceptual conflict. When peer discussion does diverge sufficiently, students often do not connect the different ideas expressed and do not return to explain, summarize, or reach conclusions about issues.

Measuring Discussion Quality

Discussion divergence is beneficial if it stimulates conceptual conflict within group members (Spatariu et al., 2004), so one measure of quality of discussion for learning is the amount of conceptual conflict evident in the discussion. Such conflict, however, is insufficient for collaborative learning. Group members must also process information to identify or generate information that the group agrees resolves the discussion task. Information convergence is difficult to measure, but researchers can measure the type of information processing present in a discussion. Such processing, displayed in online text-only discussion messages, suggests whether information is diverging and converging. The type of information processing displayed in discussion messages also indicates whether higher-order learning is occurring. This study measured discussion conflict and level of information processing observed in online messages and indicators of discussion quality for learning.

Measuring Collaborative Information Processing

Several studies use content analysis to analyze the quality of online discussions or to access more detail about the collaborative learning process (De Wever, Schellens, Valcke & Van Keer, 2006; Rourke, Anderson, Garrison & Archer, 2001). Veerman, Andriessen, and Kanselaar (1999) classify "constructive activities" in messages into three categories: 1) added, explained, or evaluated; 2) summarized; 3) transformed. This scheme can be seen as an information processing approach in that constructive activities can be viewed as levels of information processing. Comparison of content analysis instruments used in CSCL studies reveals that several instruments tend to agree on only two basic classifications that are similar to the added and transformed categores of the Veeman et al. (1999) classification scheme (Jorczak, 2008).

The measurement approach adopted for this study, therefore, used two categories of information processing displayed in messages: 1) *adding/clarifying* diverse information to the discussion from knowledge sources; and 2) *generating* (creating) information new to the group (and not obtained from a source) that resolves conceptual conflict and achieves group goals. The adding/clarifying category involves processing to obtain information including judging it relevant to the discussion task and clarifying or stating the information in a way that is meaningful to all group members. The generating category requires group or individual cognitive processing involving inferring or elaborating, resulting in relevant new information that comes from neither a source outside the discussion nor any member's prior knowledge.

Following this approach, this study created a content analysis instrument by which discussion messages were placed into one of three levels of information processing: repetitive (no additional information added to the discussion), additive, and generative. The differences in additive and generative levels are consistent with the distinction between lower- and higher-order learning adopted for this study.

Measuring Conceptual Conflict

Andriessen (2006) coded messages into six categories of "dialog moves" including statements, checks, challenges, counters, acceptances, and conclusions. Three of these categories (check, challenges, and counters) display disagreement (Andriessen, 2006; Veerman et al., 1999). The amount of disagreement expressed in a discussion is related to the amount of conceptual conflict present in the discussion. Agreement and disagreement are often explicitly expressed in discussion messages. Implicit disagreement can be identified by messages that check, challenge, and counter statements of other students (Veerman et al., 1999). Only two categories of messages are defined for measuring discussion conflict in this study: 1) neutral/agreeing and 2) disagreeing.

Variables that Affect Discussion Quality

Several variables have been suggested and investigated as affecting the quality of online discussion. For example, Wiley and Bailey (2006) suggest that task coordination, group interdependence, and amount of argumentation are factors that determine if collaborative learning displays process loss or gain. Lobry de Bruyn, (2004) found that instructional interventions can improve discussion convergence. Hewitt (2005) agrees that instructor interventions can shape electronic discourse, and he lists course design, software interface design, and individual student differences as factors that affect learning by discussion. Similarly, Veerman and Veldhuis-Diermanse, (2006) suggest four categories of such factors: instructors, communication medium, students, and learning task.

Instructional *guidance* has been identified as a necessary component of any instructional design (Kirschner, Sweller & Clark, 2006), and it is rare to observe effective interaction in spontaneous unguided student discussions (King, 2007; Weinberger, Stegmann, Fischer & Mandl, 2007). Discussion tasks are a key means for instructional designers to guide discussion toward more divergence and convergence of information. To date, lacking direction from research, task specification for productive online discussion has often been inadequate. Kirschner, Beers, Boshuizen, & Gijselaers (2008) opine:

> With respect to tasks, it is too often the case that the learning tasks are not suited to collaboration….They are often too closed (i.e., there is little room in the problem space to discuss), too easy (i.e., it can more efficiently be carried out by one person than by a team), or too controlled (i.e., there is little room for learner initiative)…. (p. 404)

CSCL researchers have suggested several task characteristics that may affect discussion quality, including task *scripting*, *function,* and *goal*. Scripting can improve discussion (King, 2007). Scripting involves detailed instructions that guide student discussion and may include a template of expected student responses, such as the labeling or diagramming of the discussion (e.g., Fischer & Mandl, 2005; Suthers, 2003). Tasks can be scripted to scaffold students to adopt specific modes of interaction (e.g., argumentative). Highly-structured tasks lessen the management burden on students and let them spend more time on the task (Veerman & Veldhuis-Diermanse, 2006; De Wever, 2003). Veerman and Veldhuis-Diermanse (2006) suggest a positive correlation of task structure with knowledge construction and also found that tasks with designated student roles or perspectives (a type of structuring) resulted in more discussion.

Differences in task function are also thought to affect discussion. For example, the type of discussion task can directly affect the amount and quality of question asking and argumentation in discussion (e.g., Rose & Flowers, 2003; Wiley & Bailey, 2006). Controversial tasks can stimulate argumentation. Nussbaum (2005) found that tasks that specify different discussion goals substantially affect characteristics of student discussion. The goals "to persuade" and "to generate reasons" had the strongest effect on argumentation. The persuasion goal resulted in more conflict and debate. The goal "to explore" increased discussion divergence and resulted in more connected messages (Nussbaum, 2005).

Task Context

Naidu and Oliver (1999) are among the researchers who stress the importance of operating within a context during instruction. From a cognitive perspective, highly contextualized tasks (those providing specific and realistic details) promote the recall and sharing of student ideas and experiences, because the additional details of context stimulate students' episodic memories of events within the proposed or similar contexts. Providing details of context should serve to activate schema in long-term memory and therefore enable students to provide more information about the discussion topic. Highly-situated tasks may increase the amount and quality of discussion by increasing the introduction of new and diverse information, thereby increasing opportunities for conceptual conflict and knowledge negotiation.

Increased context of discussion tasks should make discussions more realistic which would, according to some proponents of situated learning, improve learning (e.g., Greeno, More & Smith, 1993). Theoretical models, such as social constructivism, suggest that detailed, or at least more realistic, contexts can be expected to promote learning. Social constructivist theory posits that "authentic" activities (those similar to activities encountered outside the classroom) have learning benefits such as the more realistic use of social resources and increased meaningful connections (Ormrod, 2008, p. 343). Online discussion tasks provide an opportunity to test whether increased detail of task context affects aspects of discussion associated with learning.

Task Product

One approach to the lack of discussion convergence is to specify tasks that require the creation of a final product or statement of group consensus. Wiley & Bailey (2006) point out that successful collaboration occurs when students must cooperate to achieve a goal (i.e., accomplish an interdependent task). It is likely that a specific end product or goal stimulates students to share information and to discuss and learn from the knowledge, experiences, beliefs and values of other students (Veerman & Veldhuis-Diermanse, 2006). Andriessen (2006) suggests that effective argumentative discussion requires that students share and maintain a focus on the themes and problems of the discussion task. Specification of a group product (e.g., a written statement of consensus, or creation of a product such as a slide presentation) may act to strengthen group focus on a topic. A specific task outcome may promote a merging of effort with clarity of goal that promotes the cognitive learning processes of knowledge negotiation and synthesis.

Research Questions

Theory and research about online collaborative discussion for learning lead to these assertions: 1) Of the many variables that may affect online discussion for learning, discussion task characteristics are key variables of instructional guidance affecting the level of both cooperation and conceptual conflict in online discussions. 2) Productive discussions for learning tend to first display divergence of information (stimulating conflict), and then convergence on a task resolution that may include generated (i.e., higher-order) information. A research question of interest would investigate the relationship of task variables to discussion characteristics such as conceptual conflict (a type of divergence) and type of information processing (indicative of both divergence and convergence).

This study investigated the effect of task *context* (authentic details) and *product* outcomes (written task products) on the amount of conceptual conflict and information processing present in asynchronous online discussions for learning. This study also sought to assess the relationship between conflict and the level of information processing in asynchronous online text discussions. The following hypotheses were investigated:

H_1: Discussions displaying increased conflict result in higher levels of information processing.

H_{2a} H_{2b}: Higher specification of task context (2a) or product (2b) will increase the number of messages in a discussion.

H_{3a} H_{3b}: The degree of context specification in a discussion task presented to a small online collaborative learning group will affect the amount of conceptual conflict (3a) and information processing (3b) observed in discussions.

H_{4a} H_{4b}: The degree of specification of task product presented to a collaborative learning group will affect the amount of (4a) conceptual conflict and (4b) information processing observed in discussions.

Methodology

Environment and Participants

Participants were graduate and undergraduate college students in an online semester-long survey course about educational psychology theory. The class included 30 students; female graduate students predominated, but the class included some males and undergraduates. Students were randomly assigned to one of eight discussion groups of 3-5 members. Assignments included six asynchronous text-only discussions; four were part of the experiment. Scores for online discussion were assigned to individuals based on a grading rubric designed to encourage participation. Small group discussions accounted for 30 percent of each student's final grade.

Research Procedures

Manipulated Variables

The experiment manipulated two aspects of the written description of a discussion assignment: *task context* and *task product (outcome).* Task context is the amount of detail (low/high) provided in the task description that places the task in a realistic context. Task product is the degree (low/high) to which a task outcome is specified; the high outcome condition specifies a written product.

For example, a low context and low product task specification asks: "In your group, discuss and list the basic differences and similarities between behavioral and cognitive perspectives of learning. There is no need to post anything in the whole class discussion." The high context and product condition is represented with this text:

> Imagine your group is selected to deliver an in-service teacher workshop at the beginning of the school year. The topic is 'basic differences and similarities between behavioral and cognitive perspectives on learning.' Because of the busy in-service schedule, you have been allocated 15 minutes. You should specify the context of the in-service workshop (e.g., grade level) and present information appropriate to that context. Discuss what you would include in this presentation with your small group. After group discussion, create a brief slide show of your presentation and attach it to a message in the whole class discussion.

The last sentence of this high context specification sets a *high product* condition in which a specific written product is required (a slide presentation) that must be posted online. The high and low levels of context and product resulted in four experimental conditions for this single discussion assignment.

Experimental Design

A completely randomized 2x2 factorial experimental design was implemented. The eight discussion groups were randomly placed into the four experimental conditions (two groups per condition). Each set of two groups was given an alternate version of a discussion assignment that varied the two variables of task specification. Each discussion assignment, therefore, required four variations to implement the four experimental conditions. The arrangement of two groups per condition was repeated for three additional discussion assignments and each set of two groups was rotated through all of the experimental conditions (but for different assignments addressed at different times during the semester). All groups, therefore, received all experimental conditions, but not for the same assignments or at the same time.

Coding Procedure and Data

A content analysis of message text was conducted, with a message as the unit of analysis. Three trained coders categorized each message into a general content category and then further coded on-topic messages into categories of the two dependent variables (conceptual conflict and level of information processing) using the instruments explained below.

Messages were coded into a general content category: on-topic, procedural, social, instructor, or unclassified. *On-topic* messages are defined as those in which all or part of the message was devoted to discussing the topic or issue of the assignment. Off-topic messages include *procedural* messages about how to accomplish the discussion assignment and *social* messages that exchange expressions of greeting, gratitude, or concern; or other personal information. *Instructor* messages were posted by the class instructor or teaching assistant. *Unclassified* messages were not on topic, but did not fit into any of the other categories.

One coder coded the messages of four groups, one coded three groups, and one coded one group. To assess coder reliability, all three coded the same set of 21 messages. Percent agreement among the three coders for general content was 95.2 percent. Coders placed on-topic discussion messages into additional categories based on two constructs operationalized by the two content analysis instruments that assessed the two dependent variables: type of information processing and conceptual conflict. Conceptual conflict was measured as a proportion of disagreement present in a discussion. Agreement was 84.2 percent for instrument 1 and 84.6 percent for instrument 2.

Instrument 1 specified three levels of information processing represented in a message: none, additive, and generative. The *none* classification was applied when no relevant new information was added to the discussion (information was repeated). *Additive* indicated that the message contained additional information relevant to the discussion task. Additive information often was obtained from a source, such as the class textbook or from personal sources such as student experiences. The *generative* level of information processing was assigned to messages in which information added previously was further cognitively processed by the group. Such processing resulted in new information that did not come from an external source or from prior knowledge of group members. Messages in this category are the result of processes that transform information (such as synthesizing or inferring) and are indicative of higher-order processing.

Instrument 2 specified two major categories of dialog action: neutral/agreeing and disagreeing. Dialog actions are based on the "dialog moves" of Andriessen (2006). The Andriessen (2006) instrument specifies subcategories of the neutral/agreement category (statements, acceptances, conclusions), and the disagreement category (checks, challenges, and counters). The latter three subcategories are considered argumentative and indicate disagreement, which was interpreted as an indicator of conceptual conflict.

Results

General Message Content

A total of 914 discussion messages were coded, 830 of which were posted by students. The number of student messages coded "on topic" was 539 (64.9%). About 28 percent of the student messages were coded procedural, about 5 percent social, and less than 2 percent unclassified (see bottom row of Table 1).

The high product conditions have much higher percentages of procedural messages (over 40%) than the low product conditions (under 15%), logically indicating that requiring a written product increases the need to discuss the product (see Table 1). The high product conditions also result in fewer total on-topic posts (see Figure 1) despite the higher message counts for the high product conditions (right column of Table 1).

Table 1: Percent of messages in general categories by assignment condition.

Condition	On Topic	Procedural	Social	Unclassified	Count
High Context-High Product	47.5	40.8	8.8	2.9	238
High Context-Low Product	89.6	4.3	1.8	4.3	163
Low Context-High Product	53.1	42.7	4.1	0	241
Low Context-Low Product	80.9	13.3	5.3	0	188
% of total student messages	64.9	27.9	5.3	1.7	

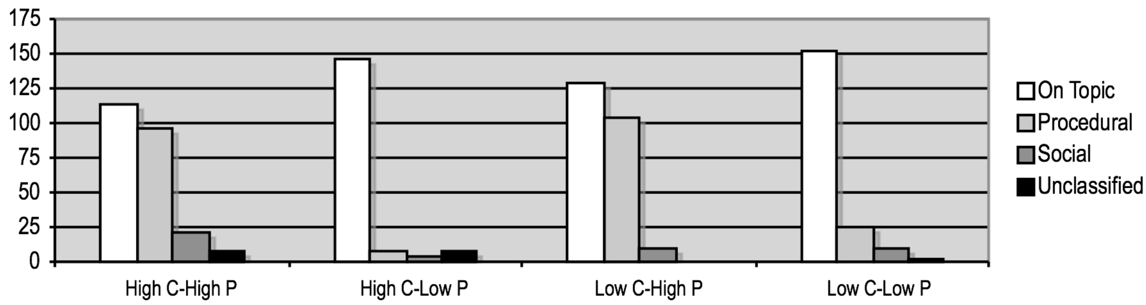

Figure 1. General category message counts for each condition.

On-Topic Messages

The eight groups posted from 42 to 99 (μ = *67.4,* σ = *20.5, N = 539*) messages on topic for the four assignments. Figure 2 shows the percentages of on-topic messages for the two levels of the manipulated task variables. Differences in percentages under each condition are small, but the percentage difference of product specification is slightly greater (10.6%) than the difference in context conditions (3.8%).

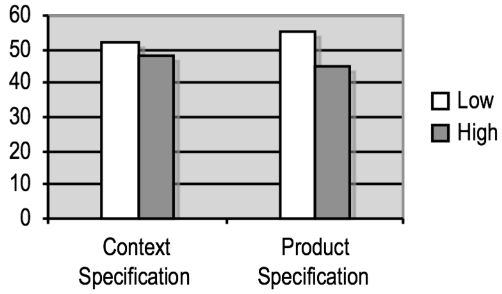

Figure 2. Percent of on-topic messages per level of task context and product specification.

Percentage of on-topic messages for each of the four experimental conditions are roughly equivalent within a narrow range of 21.0 – 28.2% (Figure 3). While the percentages are lower for the high product conditions, these data generally suggest that the degree of task context and product specification does not affect the number of on-topic messages in a discussion.

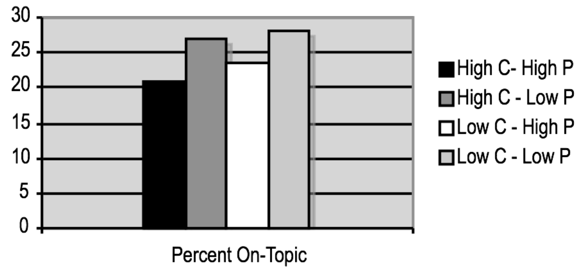

Figure 3. Percent on-task messages for experimental conditions.

Effects on Information Processing

Looking beyond mere amount of discussion, Table 2 shows the percentages of on-topic messages coded at the three levels of information processing for each experimental condition. The percentage of generative messages in the high-context, low-product condition (9.6%) is marginally higher than the narrow 7.1 to 7.8 percent range of the other conditions. Overall, this table shows little difference in the distribution of the level of processing in any of the experimental conditions and an overall generative processing percentage of only 8 percent.

Table 2: Percent information processing category for experimental conditions.

	% Information Processing Level		
Condition	Repetitive	Additive	Generative
High Context - High Product	18.6	74.3	7.1
High Context - Low Product	17.8	72.6	9.6
Low Context - High Product	7.0	85.2	7.8
Low Context - Low Product	14.5	78.3	7.2
All Messages	14.5	77.5	8.0

Table 3 displays the distribution of message processing for high and low task *context*. Each cell shows the percentage of messages coded at a level of information processing for the two levels of task context. Note that the percentages in the inner cells are based on the total number of messages coded under the low or high context conditions (280 and 259 respectively).

Table 3: Message percentages for context versus level of processing.

Context	Processing Level			% of Total
	Repetitive	Additive	Generative	
Low context	11.1	81.4	7.5	51.9
High context	18.1	73.4	8.5	48.1

A Pearson's chi-square test of the data in Table 3 ($\chi^2 = 5.951$, $df = 2$, $p = .051$) shows that differences in the distributions of processing level of messages due to context just miss statistical significance at the .05 level. Inspection of the percentages indicates that most of the difference in the distributions is between repetitive and additive messages, as the high context condition resulted in only one percent more generative messages. Cramer's V, which tests the strength of association, is 0.105, indicating a very weak association of context to processing. Although these results are not sufficient to draw conclusions about the effect of task context on information processing in discussions, the data do suggest little or no relationship of task context to level of processing.

A similar test of the information processing distributions of low and high *product* ($\chi^2 = 1.735$, $df = 2$, $p = 0.42$) are insufficient to reject the null hypothesis that the two levels of product specification result in the same distribution of information processing.

Effects on Conflict

Table 4 shows the percentages of neutral/agreeing versus disagreeing messages in each experimental condition. The low context conditions tend to have slightly higher percentages of messages displaying disagreement. Overall, the percentage of messages displaying disagreement was low (11.7%).

Table 4: Discussion conflict per condition.

Condition	Neutral/Agree	Disagree
High Context - High Product	90.3	9.7
High Context - Low Product	91.1	8.9
Low Context - High Product	85.2	14.8
Low Context - Low Product	86.8	13.2
All Messages	88.4	11.7

Table 5 is a cross tabulation of the percentage of disagreeing messages under different levels of task *context*. A Pearson's chi-square test of the distribution of conflict for the high/low levels of task context does not establish a different effect of context on conflict ($\chi^2 = 2.833$, $df = 1$, $p = .092$). The results indicate that lower context results in higher conflict, which is the opposite of expectations. Cramer's V is a very low .073. A Pearson's chi-square test of the distribution of conflict for high/low levels of task *product* (data not shown) does not establish a different effect of task product on conflict ($\chi^2 = 0.244$, $df = 1$, $p = .621$).

Table 5: Cross tabulation of message conflict for conditions of task context.

Context	Neutral/Agree	Disagree	Proportion of Total
Low	86.1	13.9	51.9
High	90.7	9.3	48.1

Relationship of Conflict to Processing Level

Table 6 compares the percentages of conflict to generative processing for the four experimental conditions. No pattern of conflict and generative processing is apparent by this comparison. The slight increase in conflict of the low context conditions is not reflected in a change in the percentage of generative information processing.

Table 6: Comparison of percentage of conflictive to generative messages.

Condition	Disagree	Generative
High Context - High Product	9.7	7.1
High Context - Low Product	8.9	9.6
Low Context - High Product	14.8	7.8
Low Context - Low Product	13.2	7.2

Table 7 displays the number and percentage of messages coded at the three levels of processing for the two levels of conflict. The bottom row is the percentage of disagree messages for each level of processing. Generative messages display higher levels of conceptual conflict (25.6 %) than repetitive (11.5%) and additive (10.2%) messages (Figure 4). The percentages in parentheses are for the total number of messages of the row. A Pearson's chi-square test of Table 7 data indicates that the row distributions are statistically different (χ^2 = 8.838, df = 2 p = .012). Inspection of the table shows that the difference in the distributions is due almost entirely to differences between the additive and generative categories. These data are evidence that generative messages tend to display more disagreement than messages at other levels of processing.

Table 7: Cross tabulation of the number (and percentage) of messages' processing to conflict.

	Processing			
Conflict	Repetitive	Additive	Generative	Total Messages
Neutral or agree	69 (14.8)	375 (78.8)	32 (6.7)	476
Disagree	9 (14.3)	43 (68.3)	11 (17.5)	63
Percent Conflict	11.5%	10.2%	25.6%	539

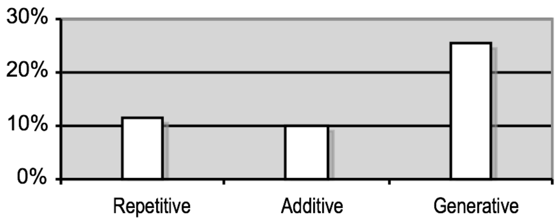

Figure 4. Percentage of disagreeing messages for three levels of information processing.

Conclusions and Discussion

Perhaps the most significant finding of this study is that both conceptual conflict and generative information processing occurred very infrequently in these discussions. Only 8.0 percent of all on-topic messages were coded generative, indicating a low level of higher-order processing in discussions of an online university class of advanced undergraduate and graduate students. This low level of higher information processing is similar to results of other studies. For example, Meyer (2003) and Garrison, Anderson, and Archer (2001) found 2.9 and 13.7 percent of messages, respectively, at the integration level of critical inquiry. The results of this study add to the growing evidence that students in online classes using collaborative discussion groups are not sufficiently engaging in higher-order thinking. Online text discussion mostly involves the acquisition of information from sources and reinforcement of existing beliefs as opposed to generation of information that is new to the group.

Significantly, disagreement is also very low (11.7%) in these online discussions. Examination of the different distributions of messages in the generative category of group information processing for different levels of conflict provides evidence that generative processing is associated with increased disagreement (Table 7). H_1 was not directly tested, but these data statistically suggest a relationship between conflict and level of information processing. If conceptual conflict is a necessary aspect of higher-order group learning, then 12 percent disagreement is disappointingly low and perhaps explains the low level of generative processing.

The results of this study do not support hypotheses H_{2a} and H_{2b}. Very little difference was observed in the number of messages posted for high and low levels of task context and product. Moreover, the number of messages posted is higher for the low conditions. The number of messages posted is a rough indicator of discussion quality, but more messages do not guarantee that discussion is qualitatively better for learning or higher-order learning. Quantity measures also do not indicate what is occurring in the discussion with respect to variables such as divergence, convergence, and conceptual conflict.

Testing hypotheses H_{3a} and H_{3b} via Pearson's chi-square test does not allow rejection of the null hypotheses that the different degrees of context specification result in no difference in conceptual conflict and information processing. However, the results from manipulation of task context had low probabilities (p = 0.51 and p = .092, respectively) suggesting that the low effect sizes (Cramer's V = .105 and .073) may be valid. These data are insufficient to establish or reject a relationship between task context and discussion conflict or processing, but suggest that more detailed task context has no large effect on conflict or processing in asynchronous text discussions.

Tests of the H_{4a} and H_{4b} hypotheses are inconclusive. The very small differences in the distribution of messages coded for the experimental conditions, however, suggest that specifying a written product has little effect on the amount of conflict or level of processing observed in discussions. Specification of a written product does seem to reduce the number of on-topic messages, as students spend more time and effort discussing how to produce the task product. Such student attention on a product may not be beneficial to the goal of increased generative information processing in collaborative discussion.

To improve CSCL discussion, researchers need to find learning environment variables that increase discussion divergence and convergence. This study did not find evidence that different levels of task context or product do affect divergence as measured by disagreement, nor were these task variables found to affect the amount and level of information processing. Instructional designers and instructors should not rely on increased task context or specification of a written group process to promote high-quality discussion for learning. This experiment did find support for the assertion that discussion conflict is related to higher-order information processing, suggesting that tasks which increase conceptual conflict are a promising means to improve the quality of CSCL discussions.

References

Anderson, T., Howe, C., Soden, R, Halliday, J. & Low, J. (2001). Peer interaction and the learning of critical thinking skills in further education students. *Instructional Science, 29*, 1-32.

Andriessen, J. (2006). Collaboration in computer conferencing. In A. M. O'Donnell, C. E. Hmelo-Silver, & G. Erkens, (Eds.), *Collaborative Learning, Reasoning, and Technology*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Andriessen, J., Baker, M. J., & Suthers, D. (2003). Argumentation, computer support, and the educational context of confronting cognitions. In J. Andriessen, M. J. Baker & D. Suthers, (Eds.), *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning environments* (pp.1-25). Dordrecht, The Netherlands: Kluwer Academic Publishers.

De Wever, B. (2003). Theoretical and empirical foundations of asynchronous discussion groups as a tool for computer-supported collaborative learning environments in higher education. CSCL 2003 Conference Doctoral Consortium. Retrieved January 27, 2008 from http://www.intermedia.uib.no/cscl/doc/files/deWever.pdf

De Wever, B., Schellens T., Valcke, M., & Van Keer H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers and Education, 46*, 6-28.

Fischer, F. & Mandl, H. (2005). Knowledge convergence in computer-supported collaborative learning: The role of external representation tools. *The Journal of the Learning Sciences*, 14(3) 405-441.

Garrison, D. R., Anderson, T. & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, 15, 7–23.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, 7(1).

Greeno, J. G., More, J. L., & Smith, D. R. (1993). Transfer of situated learning. In D. K. Detterman & R. J. Sternberg (Eds.), Transfer on trial: Intelligence, cognition, and instruction. Norwood, NJ: Ablex

Hammond, M. (2005). A review of recent papers on online discussion in teaching and learning in higher education. *Journal of Asynchronous Learning Networks*, 9(3).

Hewitt, J. (2005). Toward an understanding of why threads die in asynchronous computer conferences. *The Journal of Learning Sciences*, 14(4), 567-589.

Johnson, D. W. & Johnson, R. T. (1979). Conflict in the Classroom: Controversy And Learning. *Review of Educational Research*; 49(1), 51-69.

Johnson, D. W. & Johnson, R. T. (1994). An overview of cooperative learning. In J. Thousand, A. Villa and A. Nevin (Eds), *Creativity and Collaborative Learning*; Brookes Press, Baltimore, 1994.

Johnson, D. W., Maruyama, G., Johnson, R., Nelson, D. & Skon, L. (1981). Effects of cooperative, competitive, and individual goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89, 47-62*.

Jorczak, R. L. (2008). *The effects of task characteristics on higher-order learning in online collaborative learning.* Unpublished doctoral dissertation, University of Minnesota, Minneapolis, MN.

King, A. (2007). Scripting collaborative learning processes: A cognitive perspective. In F. Fischer, I. Kollar. H. Mandl, and J. M. Haake (Eds.), *Scripting Computer-Supported Collaborative Learning* (pp. 13-38). New York: Springer Science + Business Media.

Kirschner, P. A., Sweller, J., & Clark, R. E., (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. *Educational Psychologist,* 41(2), 75-86.

Kirschner, P. A., Beers, P. J., Boshuizen H. P. A, Gijselaers, W. H., (2008). Coercing shared knowledge in collaborative learning environments, *Computers in Human Behavior* 24, 403–420.

Lobry de Bruyn, L. (2004). Monitoring online communication: Can the development of convergence and social presence indicate and interactive learning environment? Distance Education, 25(1), 67-81.

Meyer, K. A. (2003). Face-to-face versus threaded discussions: The role of time and higher-order thinking. *Journal of Asynchronous Learning Networks*, 7(3).

Naidu, S. & Oliver, M. (1999). Critical incident-based computer supported collaborative learning. *Instructional Science*, 27**,** 329–354.

Nussbaum, E. M. (2005). The effect of goal instructions and need for cognition on interactive argumentation. *Contemporary Educational Psychology,* 30, 286-313.

Ormrod, J. E., 2008. *Human Learning (5th edition)*, Upper Saddle River, NJ: Merrill Prentice Hall.

Rose, M. A. & Flowers, J. (2003). Assigning learning roles to promote critical discussions during problem-based learning. Paper presented at the 19th Annual Conference on Distance Teaching and Learning, Madison, WI. Retrieved on September, 3, 2007 from http://www.uwex.edu/disted/conference/Resource_library/resource_library.htm.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of AI in Education*, 12, 8–22.

Slavin, R. E. (1987). Developmental and motivation perspectives on cooperative learning: A reconciliation. *Child Development,* 58, 1161-1167.

Slavin, R. E. (1992). When and Why Does Cooperative Learning Increase Achievement? Theoretical and Empirical Perspectives. In R. Hertz-Lazarowitz & N. Miller (Eds.) *Interaction in Cooperative Groups* (pp 145-173). New York: Cambridge University Press.

Spatariu, A., Hartley, K., & Bendixen, L. D. (2004). Defining and measuring quality in online discussions. *Journal of Interactive Online Learning* 2(4).

Stahl, G. (2000). A model of collaborative knowledge building, in: Proceedings of the Fourth International Conference of the Learning Sciences (ICLS 2000), (pp. 70-77). Ann Arbor, MI. Retrieved on March 5, 2007 from http://cis.drexel.edu/faculty/gerry/publications/conferences/2000/icls/icls.pdf.

Suthers, D. (2003). Representational guidance for collaborative inquiry. In J. Andriessen, M. J. Baker & D. Suthers, (Eds.), *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning environments* (pp. 27-46), Dordrecht, The Netherlands: Kluwer Academic Publishers.

Wiley, J. & Bailey, J. (2006). Effects of collaboration and argumentation on learning from web pages. In A. M. O'Donnel, C. E. Hmelo-Silver, and G. Erkens, (Eds.), *Collaborative Learning, Reasoning, and Technology*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Veerman, A. L., Andriessen, J. E. B. & Kanselaar, G. (1999). Collaborative learning through computer-mediated argumentation. In C. Hoadly & J. Roschelle (Eds.), *Proceedings of the third conference on CSCL* (pp. 640 - 650). Palo Alto, California: Stanford University.

Veerman, A. & Veldhuis-Diermanse, E. (2006). Collaborative learning through electronic knowledge construction. In A. M. O'Donnel, C. E. Hmelo-Silver, and G. Erkens, (Eds.), *Collaborative Learning, Reasoning, and Technology*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Weinberger, A., Stegmann, K., Fischer, F. & Mandl, H. (2007). Scripting argumentative knowledge construction in computer-supported learning environments. In F. Fischer, I. Kollar. H. Mandl, and J. M. Haake (Eds.), *Scripting CSCL* (pp.13-38). New York: Springer Science + Business Media.

Yeager, S., Johnson, D. W., & Johnson, R. T. (1985). Oral discussion, group-to-individual transfer, and achievement in cooperative learning groups. *Journal of Educational* Psychology 77(1), 60-66.