Knowledge Construction through Social Interaction in Computer Conferencing Systems

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Introduction

Computer-mediated communication (CMC), specifically computer conferencing, has captured the interest of educators and psychologists especially in developing collaborative and participatory learning communities to promote higher-order conceptual learning and analytical thinking skills, and to support social construction of knowledge (Curtis & Lawson, 2001; Harasim, 2000; Kanuka & Anderson, 1998). Computer conferencing has the capability of creating flexible communication patterns (Berge & Collins, 1996), removing time and space restrictions, promoting self-reflective dialogues (Harasim, 1993), and creating a (discussion) forum for the construction of knowledge in the teaching and learning process (Heller & Kearsley, 1996; Henri, 1992).

Computer conferencing can provide intellectual on-going discussion focusing on a topic or relevant concepts within the course. In addition, it allows the learner to participate in-depth discussions by checking references, referring back to preceding topics and taking any amount of time to prepare a detailed comment or argument. Furthermore, computer conferencing can be used to facilitate group project work and encourage interactive participation and interpersonal collaboration between instructor and learners and among learners.

Computer-mediated conferencing, in particular asynchronous online discussion, is becoming increasingly a common instructional strategy in higher education because of its potential to support social interaction, collaborative learning, knowledge building, and critical thinking. Despite its popularity, there are few theories and limited amount of empirical evidence for the claims made about the potential benefits of this medium (Henri, 1992; Mason, 1992; Gunawardena et al., 1997; Garrison et al., 2001). There is still a lack of clarity of the dynamics of online discussion and how it may be utilized to foster students’ cognitive development (Hara et al., 1998). There are few theories and little empirical research on what online collaboration or social interaction is and should be; how online discussions promote learning experience, in particular, higher-order thinking and knowledge construction. Thus, in support of research, this study was undertaken to scrutinize the patterns of student interaction taking place in online discussions and to examine the co-construction of knowledge among them. In addition, the study was aimed at guiding researchers and educators in the design and utilization of the efficiency of CMC that could increase collaboration and support learning.

Research Objectives

The adoption of computer conferencing for learning is still relatively under-researched. In spite of considerable research interest in this area, there still remains a need for examining the best use of the richness and efficiency of exchange provided by CMC content. It is important to have a better understanding of the potentials of CMC in learning experience. The primary objective of this study was to analyze the value and quality of the asynchronous online discussion for learning experience and knowledge construction through social interaction. Specifically, the aim was to investigate:

- the social participation and interactive patterns in asynchronous online computer conferences characterized by explicit, implicit, or independent interaction
- whether the interactive nature of CMC exchange support and encourage the development of knowledge and practice of higher-order thinking skills through collaborative learning process
- pedagogical factors that may have influence on the level of knowledge building and the type of collaborative learning discourse

Theoretical Framework

The important assumption of constructivism is that knowledge is actively constructed based upon unique set of experiences and beliefs. In constructivism, knowledge is always under construction as a cumulative history of interactions in authentic and meaningful contexts. Radical constructivism, a form of constructivist theories, claims
that knowledge is the individual cognitive process of the human mind, or the function of cognition that serves the organization of the experiential world. The world is constructed in minds through the construction of personal realities or experiences. The other prevalent position in constructivist learning theories—social constructivism—claims that learners obtain knowledge and make sense of their experiences through communication, or language, as they explore new perspectives and communicate their understanding with others (Jonassen, et al., 1995; Hein, 1991; McGuire, 1996; Warschauer, 1997). From a social constructivist viewpoint, learner is actively acquiring the knowledge through language in social experiences. Vygotsky (1978), most often associated with social constructivism, emphasized the effect of social experiences that occur over time in a contextual and situated synthesis on knowledge construction. In other words, knowledge is constructed through social interaction and interpersonal communication based upon interpretation of information and learning experience within a context.

Computer conferencing or online discussions can be used to encourage interactive participation and interpersonal collaboration between instructor and learners and among learners. Collaboration among learners enhances the quality of learning and formulates a deeper understanding of the content. Jonassen et al. (1995) notes that “learning is necessarily a social dialogical process in which communities of practitioners socially negotiate the meaning of phenomena” (p.9). However, designing and maintaining a learning environment (e.g., asynchronous online discussions) in which knowledge is constructed through social negotiations is challenging. It is essential to understand the way interactive discussions through computer mediated communication support the co-construction of knowledge.

Gunawardena, Lowe, & Anderson (1997) developed an Interaction Analysis Model - serves as the theoretical framework for this study- to specifically examine “the negotiation of meaning and co-construction of knowledge in collaborative learning environments facilitated by computer conferencing” (Gunawardena et al., 1997, p. 397). Interaction Analysis Model is based on constructivistic conceptions of learning. Gunawardena et al. (1997) addresses two kinds of knowledge creation that take place in any shared learning experience, the “individual” and the “social.” They recognize the interdependence of both the individual and social construction of knowledge in their model. They developed this model from a constructivist perspective by using the metaphor of a patchwork quilt block to describe the significance of interaction. Within this model, the notion of interaction in a computer-mediated conference is defined as the production of new knowledge and/or the understanding of new meaning. The model proposes a five phase evolution of knowledge construction: Phase I) sharing/comparing of information; Phase II) discovery and exploration of dissonance or inconsistency among ideas, concepts or statements; Phase III) negotiation of meaning/co-construction of knowledge; Phase IV) testing and modification of proposed synthesis or co-construction; Phase V) agreement statement(s) /applications of newly-constructed meaning.

Methodology

Context

The data for this study were collected over a 14-week semester from an online master’s course offered by the college of education at a large Midwestern U.S. university, designed for K-12 teachers and other educational practitioners. The course management tool, WebCT, was the main course component and primary communication medium among students. Discussion board of WebCT was utilized for the majority of class work and learning experience of students. Participation to weekly discussions at least three times was required. The conference transcripts of three main discussion topics were selected for this study to analyze the shared learning experience through online discussions of WebCT.

Subjects

There were 15 students enrolled in the course. Two were undergraduate students, eleven of them were masters, and two of them were doctoral students. 60% of the students were working full time, 33.3% were working part-time and 6.7% were not working. The majority of students were adult learners with an average age of 29 and 73% of them working as a teacher or an educator in different fields such as elementary school computer teacher, secondary school English teacher, social studies teacher, community college instructor, and higher education dean at a community college. 36% of the students had never taken a distance education whereas 43% of them took more than one distance course. Therefore, the majority of students were experienced in learning at a distance.
Data Collection & Analysis

In this study, quantitative and qualitative research methodologies were conducted. For quantitative modes of inquiry, survey was conducted to collect demographic and descriptive data. The survey was completed by 14 of 15 students giving a return rate of 93.3%. Additionally, for the first research objective on social participation in computer conferencing, descriptive statistics such as the number and length of student postings contributed each discussion topic were calculated. Moreover, in order to understand the underlying patterns of interaction in the structure of the course, Howell-Richardson and Mellar’s (1996) interaction maps that provide visual representations of electronic conferencing, and Henri’s (1992) criteria related to message interactivity (i.e., explicit, implicit, or independent statements) were combined to create conference activity graphs to illustrate the flow of the discussions and the direction of the postings. The unit of analysis for those was selected as the “unit of message”.

For qualitative part, interview and content analysis methodologies were conducted. The course instructor was interviewed to obtain background information about the course (i.e., learning objectives, design strategy, and assessment) and her perceptions on student learning experience. Content analysis was chosen as the main methodology of this study to analyze the computer conference transcripts to examine the co-construction of knowledge in computer conferencing. All participant names were replaced with pseudonyms in conference transcripts to assure the confidentiality. To answer the second research question, the content of the messages of three discussion topics was coded based on Gunawardena et al.’s (1997) interaction analysis model using computer assisted qualitative data analysis package, Atlas.ti.

According to Gunawardena et al. (1997), a message as a whole embodies a student’s cognitive activity and contribution to the construction of knowledge. Thus, they used the complete messages in discussion forum as the unit of analysis. However, the unit of message did not fit in this study because some messages contained very little information; others contained three or more distinct ideas, comments, complex arguments or hypotheses addressing different concepts or questions raised during the discussions. Therefore, the unit of analysis was selected as the unit of thematic (meaning). Henri (1992) justifies this type of unit of analysis by arguing that “it is absolutely useless to wonder if it is the word, the proposition, the sentence or the paragraph which is the proper unit of meaning, for the unit of meaning is lodged in meaning” (p. 134).

Gunawardena et al.’s framework was slightly modified to make it more relevant and apparent for coders. It was also modified because of the differences between thematic unit of analysis and complete message unit of analysis used by Gunawardena et al. (1997). The primary coder analyzed the data according to this framework on three separate occasions to validate the coding procedures of the modified model. Descriptive rules along with examples for the coding process were explained to two other coders in a training session. Then, two coders analyzed a portion of the data (10% of total) independently. The final inter-coder agreement was 85%.

Findings & Discussions

Participation Results

Overall participation results in the course are as follows: Students posted a message on the discussion forum per week approximately 2 times. In order to post a message, they spent 25 minutes on average. In addition, students replied to 2 messages on average in a week.

Table 1 below provides an overview of participation levels for each discussion topic area. In term of the discussion topic, Online Educator, 7 out of the 15 students contributed to the discussion in about one-month period. The average number of posts per student was 2. For Attitude, 8 out of 15 students in the class participated in the discussion in about three-month period with an average number of 2.4 posts per student. 7 out of 15 students contributed to the discussion topic, Assessment, in 40-day period. The average number of messages per student was 2.6.
<table>
<thead>
<tr>
<th>Discussion Topic</th>
<th>Discussion Period</th>
<th>Total # of students participated out of total # enrolled</th>
<th>Total # of messages</th>
<th>Total # of instructor messages</th>
<th>Average # of posting per student</th>
<th>Total # of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Educator</td>
<td>September 20-October 19</td>
<td>7 of 15</td>
<td>14</td>
<td>0</td>
<td>2</td>
<td>2266</td>
</tr>
<tr>
<td>Attitude</td>
<td>September 18-December 6</td>
<td>8 of 15</td>
<td>19</td>
<td>0</td>
<td>2.4</td>
<td>1941</td>
</tr>
<tr>
<td>Assessment</td>
<td>November 2-December 10</td>
<td>7 of 15</td>
<td>18</td>
<td>4</td>
<td>2.6</td>
<td>2441</td>
</tr>
<tr>
<td><strong>Total/Average</strong></td>
<td></td>
<td><strong>22/7.3</strong></td>
<td><strong>51/17</strong></td>
<td><strong>4/1.3</strong></td>
<td><strong>2.3</strong></td>
<td><strong>6648/2216</strong></td>
</tr>
</tbody>
</table>

Findings revealed that the level of overall participation in the course and the participation to three discussion topics was low. The statement made by a student to an open ended survey question described clearly the learning environment in terms interaction and participation: “I need people to respond to questions/comments.” However, it is found that students were in control of the flow of discussions, in other words, they dominated the discussions, not the instructor. This is most likely because of one of the course goals: to create a constructivist and flexible online learning environment for students to develop cognitively demanding knowledge by interacting with their peers. The instructor was purposefully providing a learner-centered context in which students were in charge of their own learning by responding to others critically and thoughtfully. It is also found that instructor’s contribution to discussions made no such difference in terms of the participation level of students.

Interaction Patterns

In discussion topic- Online Education, the discussion was quite straightforward, every student responded to the previous comment. It was found that student postings were more explicit and directly referred to others in their content when there was a starter and facilitator in online discussion. In discussion topic - Attitude, every message was connected either explicitly or implicitly. Unlike in Online Educator, some postings were referenced by more than one student. It was also found that students began to pay attention to multiple threads as the discussion progressed and the discussion became more continuous and engaging especially in the later stages. In comparison to Online Educator, there was a synergistic interaction among students in Attitude.

The Assessment was the only topic of the three, which had a teacher presence (see Figure 1). Instructor posted a prompt to start the discussion and contributed with three other messages during discussion: her second message was another prompt that was just posted after the first one supporting the previous one with explanations, examples and resources where students can find information. The other postings of instructor were initiating prompts such as “Now it is another person's turn to answer a question” or “Also think about informal assessment for your ILO Orientation, what and how?” All posts of the instructor were coded as Phase I (sharing/comparing of information). Overall, her role can be described as a triggering role because of providing background information that culminates a question.

Discussions in the Assessment topic mainly followed the questions or comments posed by key participants. In this discussion, the key participants were the instructor and Barbara (see Figure 1). Especially, Barbara played a role of a facilitator by providing arguments, resources, examples, and responds to others. She also acted as if a summarizer of the messages which gave more structure to the discussion and made it more engaging. For instance, Barbara (#11) not only implicitly responds to others who made comments about her previous posts but also explicitly responds to a peer by making statement of agreement, sharing more information, and finally asking more initiating questions to carry on the discussion.
Knowledge Construction Phases

The analysis of data gathered for the content analysis showed that the predominance of messages fell into the first phase of co-construction of knowledge: sharing and/or comparing of information (see Table 2). For instance, the message below, which was coded at Phase I, exemplified two types of statements. Maria, in her message, provides background information citing a resource along with her personal opinion, observation and
reflection. Later, message concludes by asking questions to trigger a discussion in order to obtain group consensus on the new information. This is an example for the early process of social negotiation of knowledge construction.

As I was reading chapter 3 it struck me that probably the most important thing in a distance program, according to McVay is, "the student's ability to obtain information and research materials." (McVay, 54) [PHI/A] She discusses a scenario where 3 students are taking a distance course: 1 in a rural area, 1 in the Australian Outback, and one at a University campus. [PHI/A] Our situations do not mirror McVay's theoretical situation, [PHI/A] but we are all spread out; [PHI/A] some of us at ISU and some of us in rural areas--while some of us are just so busy that it's as if we're in the Outback. [PHI/A]

From the Library Support for Distance Education, one of the important principles they believe should be incorporated into DE is, "Empowerment of students to access information and to perform their own research on a self-service basis." [PHI/A]

The reason why I bring this point about empowerment up is because in my opinion it is vital that students participating in DE already have good research skills and then they also need access. [PHI/A] So, who is responsible #1 to make sure that students (of all ages) have the research skills,[PHI/D] and #2 who will make sure that students have access (not as a product of students shelling out lots of cash)? [PHI/D]

There is so much research on equity in access that I'm sure some of our professors have had a hand in researching. [PHI/A]What are everyone's thoughts? [PHI/D]

<table>
<thead>
<tr>
<th>Topic</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Phase IV</th>
<th>Phase V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Online Educator</td>
<td>106</td>
<td>72</td>
<td>12</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Attitude</td>
<td>46</td>
<td>40</td>
<td>23</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Assessment</td>
<td>123</td>
<td>82</td>
<td>2</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Total/Average</td>
<td>275</td>
<td>66</td>
<td>37</td>
<td>9</td>
<td>68</td>
</tr>
</tbody>
</table>

On the other hand, several exchanges showed evidence of movement from Phase I to higher phases. Of the three discussion topics, Attitude had the highest percentage of Phase II (20%), Phase III (26%), and Phase IV (13%). The evidence of higher phases was observed, in particular, when the discussion became more engaged and interactive as it progressed. For instance:

Leslie (#13): The mentor is also the person that could give the DE student that social benefit. [PHIII/A] If the mentor acts as an advocate for the student, perhaps gets to know them more on a personal level, then the DE student might be more apt to have a good attitude about the class, even when the class work get rough. [PHIII/D]

But, even the students with the best attitudes can lose motivation and start feeling insecure. [PHII/A] If there are good people supporting the program (teacher, mentor, counselor, parent community), the students will have a much better chance of a successful learning experience. [PHII/D] So, in many ways the DE program is only as good as the people that support it. [PHII/E]

Barbara (#15): Tying in attitude and the cultural differences we have been discussing I am wondering if some cultures would do better with attitude. [PHIV/A, B] I am thinking specifically of Asian countries where the martial arts are taught. I am currently taking Taekwondo and positive attitude and perseverance are two of the tenants that are taught. [PHIV/C]

In the example above, we see how a discussion develops from Phase III (sometimes iteratively, from Phase III back to Phase II) when Leslie integrates and synthesizes the information through co-construction of knowledge to
Phase IV when Barbara tests the proposed synthesis against both received fact as shared by others and her existing cognitive schema as well as her experience.

It was interesting to find out that although there was no teacher presence, discussions moved from early phases to later phases. Therefore, it is possible that meaningful, critical, and reflective discussions can occur without the presence of an instructor. This indicates that computer-mediated conferences can promote social construction of knowledge and collaborative learning in a constructivist learning context.

Overall, the findings showed that knowledge construction took place in early phases of interaction analysis model by Gunawardena et al. (1997). Higher cognitive skills and analytical thinking abilities such as metacognitive activities were observed little in the discussions. There are number of reasons for little presence of higher phases of knowledge construction. One reason is that although the primary medium for the course is discussion forum, no guidance or structure was established for discussions. This might have prevented students to concentrate on a topic in order to make critical reflections and provide thoughtful comments in a timely manner. The recommendation is for instructors to structure discussions in a way that students will have a common set of rules for discussions including participation requirements, certain dates for initial posts, certain discussion topics, and description of the length and the quality of messages.

Another possible reason for the little presence of higher phases of knowledge co-creation is because of the lack of a facilitator or a moderator. Findings revealed that students developed knowledge and critical thinking skills at higher levels when there was strong model of a facilitator. In addition, it was also observed from interaction maps that the meaningful remarks made by a facilitator promoted the quality and quantity of interaction among students. The second recommended instructional strategy for instructors is to be an active member in discussion and play a role in guiding students toward higher levels of learning. According to Hara et al. (1998), the discussion moderator “is a key player in determining the depth of dialogue and overall knowledge generation processes.” (p. 28). Gunawardena et al. (1997) also point out that the moderator “is open to conceptualizing the learning process as joint construction of knowledge and negotiation of meaning.” (p. 428).

Conclusion

Understanding the experience of learning and the overall pattern of knowledge construction that emerges from computer-mediated conferencing assists educators to acquire intended and worthwhile learning outcomes. This study explored the dynamics of learning community at a graduate level course facilitated by computer-mediated conference in terms of two main concern areas: interaction patterns and knowledge construction through social negotiation among students. Using Gunawardena et al. model (1997), co-construction of knowledge was found primarily at the first phase as a result of students’ conversation. On the other hand, several exchanges showed evidence of movement from Phase I to higher phases. The findings show that a lack of structured, organized discussion and the absence of a moderator may have contributed to these results.

The analysis of data revealed that knowledge construction through social interaction took place. Students built on others’ contributions to co-create knowledge. However, this learning experience could be optimized to increase the participation level and obtain high phases of Interaction Analysis Model (Gunawardena et al., 1997). One of the students expressed a need for participation in discussion forum as quoted below,

I think it's important to establish a comfortable forum for student discussion. For me to participate, it's important that I feel that: a) I have something meaningful to contribute, b) I can post those reflections in a non-threatening environment, and c) my reflections serve a meaningful purpose (i.e. they contribute to my learning and the learning of others in the class and are not simply posts for the sake of having us post to the discussion board).

Rich instructional systems and learning experiences can be designed by understanding how knowledge is constructed and distributed in CMC environment. Further research is needed in understanding how students develop cognitively demanding knowledge through computer conferences. What are the factors and pedagogical strategies that affect higher-order thinking skills and knowledge construction in a collaborative online learning environment? Does online discussion as a component of a blended learning environment promote social construction of knowledge? There remain many questions and areas to be further investigated. These studies will help us understand the richness and potential of computer conferencing in learning experience.
References


