

Researching “Collaborative Knowledge Building” in Formal Distance Learning Environments

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Abstract. Distance learning environments provide a rich opportunity for collaborative knowledge building, particularly through peer-to-peer dialogue. Much of the discussion in distance learning environments occurs in asynchronous forums, and it is content analysis of these discussions that constitutes the majority of research in online learning. However few studies in this area provide enough information about the context to know what works and what doesn't. Most studies do not go beyond downloading and analyzing the transcripts after the course is completed. Studies also lack a solid epistemological stance, attempting to capture evidence of individual learning of knowledge rather than examining the process of group learning through knowledge construction. An ongoing lack of attention to a coherent theoretical foundation, examining transcripts without attending to their situated contexts, and relying primarily on reductionist content analysis methods, will continue to limit our understanding of the potentiality and actuality of online collaborative learning environments. In this paper we explore how Stahl's social theory of CSCL can be applied to formal online learning environments to address these limitations.

Keywords: Online discourse, collaborative knowledge building, discourse analysis methods

INTRODUCTION

Internet-based distance education is one avenue for computer-supported collaborative learning. However, distance education contexts vary as widely as any CSCL context in terms of learner populations, technology, learning goals and learning tasks. Research in distance learning environments have tended to be exploratory case studies in which discussion transcripts are downloaded and analyzed after the course is completed, either by the instructor of the course or an outside researcher. The full context of the case study is often not described as recommended by case study methodology (Stake, 1995; Yin, 1984). Analysis has relied mainly on frequency counts of participant posts and/or coding and counting phenomena through content analysis (Hara, Bonk & Angeli, 2000; Henri, 1992). The primary purpose of these studies seem to be to account for individual learning through the discussion process, but as pointed out by Rourke and Anderson (2004), there is often no clear epistemological stance taken as to what constitutes learning and how we might examine it.

In this paper we explore limitations of the current research on distance learning environments, particularly research which relies on analysis of discussion transcripts. We suggest that Stahl's social theory of CSCL may be used as a theoretical framework for understanding these environments and ultimately designing them more effectively.

EPISTEMOLOGICAL STANCE

Traditional notions of learning and assessment tend to favor product-based outcomes over process-based ones, particularly focusing on individual learning. However, assessing process can be just as important as assessing product, especially if educators want to know which learning activities and methods are contributing to collaborative knowledge building. In the case of online discussion, it becomes necessary to first determine the purpose for being engaged in the activity. What is actually occurring as students talk together? Are the students learning from the conversational interactions, or are they simply participating because it is what they are supposed to do (e.g., because someone is counting how many posts they make)? And if their discussion participation is being assessed, does that assessment focus on quantity of messages, quality of messages, or evidence of learning through, for example, a process of constructing new knowledge?

Determining whether or not learning took place as a result of engaging in discussion is not simple. Students often intuitively orient towards discussion as a “show what you know” activity rather than an “explore this topic” activity. In other words, they tend to naturally position themselves toward an objective knowledge that they will try to learn or adopt, assuming the instructor will assess them based on how much of it they have come know. Course assessment methods, as noted above, often favor such beliefs. However, if the purpose is for individual students to communicate what they know to an instructor, why do so in a public forum such as a

discussion board? Clearly there are other underlying epistemological beliefs or needs that drive our desire to engage groups of people in discussion on a particular topic.

There has been some movement away from this transmission view of learning to the notion of learning as mediated communication between people. Hill, Wiley, Nelson and Han (2004) characterize this difference as learning “from” and “with” the Internet to learning “through” the Internet. Online discussions are particularly rich environments for true knowledge creation to take place, but only when designed in ways that engage students in dialogue. Thus far most studies do not clearly delineate what is meant by learning. Rather than viewing participation alone to be evidence of learning, we define learning as a process, demonstrated through conversation, in which learners reflect upon what they currently know and negotiate new meaning and knowledge creation with others through conversation. Together groups come to new understandings through conversation. Closely examining these processes is how we assess learning.

PROMINENT METHODS AND LIMITATIONS

At the present time, there is lack of clear guidance for which data collection and analysis methods might best capture and explain the learning that takes place in online discussions. Campos (2004) points out that “research goals, theoretical perspectives, and methods vary across studies and are not replicated. The result is a very heterogeneous corpus of scientific research that could be defined as exploratory” (p. 4). Rourke and Anderson (2004) also report that most studies remain in the preliminary tryout stage and add that many of these studies lack normative data to be able to generalize the results.

A useful start, then, may be to categorize and review some of these studies in terms of what research questions they address, contexts they examine, and epistemological stance taken. Marra, Moore and Klimczak (2004), Paavola, Lipponen and Hakkarainen (2002) and Meyer (2004) have initiated work in this area. Marra et al. (2004) compared two commonly used coding schemes (Newman, Webb & Cochran, 1996; Gunawardena, Lowe & Anderson, 1997) for their relative advantages and disadvantages. They concluded that it was difficult to apply these content analysis schemes without looking at the *context* of the discussion task and the discourse as a whole, arguing that it is necessary to move beyond looking at only the transcript itself. Meyer (2004) applied four coding schemes (King & Kitchener, 1994; Perry, 1999; Garrison, Anderson & Archer, 2001; Bloom & Krathwohl, 1956) to the same set of data and noted that the type of triggering *question* posed by students in online discussions greatly impacted the outcomes. Meyer suggested that “it might be worthwhile to analyze the ebb and flow of online discussions as a *group* [emphasis added] effort, rather than focusing on the *individual* postings as a reflection of the student’s level of thought” (p. 112). Finally, Paavola et al (2002) moved beyond critiquing content analysis schemes to comparing three knowledge-creating models, emphasizing that all three models posit knowledge as “part of a dynamic process of innovation embedded in various skills, emotions, and hunches of the people involved . . . [and]bring in conceptual artifacts, theories, activities, questions, problems, metaphors, dialectics as mediating factors” (p. 12).

Participation, content, and structure of online conversations all are areas that are being explored by researchers. Each focus yields some useful descriptive results about the interactions that take place, but each also has significant limitations in terms of what we find about how discussion impacts learning processes.

Participation

The very earliest studies of online discussion typically focused on measuring participation as a primary indicator of interaction, which was sometimes the sole determinant of “learning.” Indeed, this type of focus often mirrored the instructor’s assessment of the discussion activity. One cannot dispute that participation is necessary in order to have interaction as well as to enable learning via discussion boards, but it is not a given that participation and interaction will result in learning. Quantity of participation is not the same as quality, and even quality may be broadly defined, since a good question may be just as important as the answer. For example, Pear and Crone-Todd (2001) claim to look at social constructivist learning in a computer-mediated setting by measuring the number of minimal and substantive feedback messages students received from other students. Unfortunately, this study does not address the effects that such feedback had on the learners, nor does it look at the quality of the feedback. It is possible that a brief or minimal feedback message could be sufficient in some cases, particularly if all that is needed is affirmation, and that a substantive one might be too authoritative or could lead the learner off-track.

Participation may well be an indicator of social presence (Rourke, Anderson, Garrison, & Archer, 2001a), a construct that may be important to creating a sense of community among online learners. While we do not minimize the importance of social presence, it does not in and of itself lead to collaborative knowledge building through dialogue. Vicarious learning through lurking is another phenomenon that has not been fully explored and is not accounted for through participation counts (Beaudoin, 2002).

Content

A shift from quantity of discussion to quality of discussion emerged most notably with Henri's (1992) oft-cited coding scheme. Most coding schemes created to investigate quality of online discussions draw upon content analysis methods (Bauer, 2000), translating discourse into either nominal data (e.g., gender, or type of message) or ordinal data (e.g., scale or rubric-based quality ratings). These frameworks provide researchers ways of dealing with potentially large quantities of qualitative data and achieving generalizability, but often suffer from a tension between the rich qualitative data and the resulting interpretive – and often reductionist – quantitative methods.

Concerns about the threats to reliability and validity inherent in these content analysis frameworks have recently been raised (Rourke & Anderson, 2004; Rourke, Anderson, Garrison & Archer, 2001b; Campos, 2004). Studies that are cited quite often in the literature on online discussions (e.g. Henri, 1992; Newman, Webb & Cochran, 1997; Howell-Richardson & Mellor, 1996; Gunawardena et al, 1997; Kanuka & Anderson, 1998) are criticized for including too few details about coding procedures, being inconsistent in the units of analysis, and not detailing a solid epistemological stance.

All too often the transcripts are simply downloaded and the conversation unitized, coded and counted. At the same time, these studies are positioned as case studies, but in actuality provide few details about the context of the study – what tasks were being completed, the role of the facilitator, etc. This reductionist view eliminates the context. Fuller data collection methods are needed to understand the CSCL environment and how learning takes place – not learning as received knowledge, but learning as knowledge creation through interacting with a group that it is then internalized and interpreted by individuals.

Structure

Discussion boards readily generate both quantitative and qualitative data. In terms of quantitative data, one can count the number and length of messages, the depth of threading, the span of time between messages and responses, and the number of hits on a particular message. Each of these data types may be reviewed for the individual contributor as well as in aggregate for a thread or a group of discussants. They can provide indicators of the general structure of interactions that are taking place in a class, but are really lacking in terms of indicating quality or nature of interactions. For example, a one-sentence message could be a thought-provoking question or an idle statement of agreement with a previous post, and a long message might present a lot of useful thoughts and encourage others to contribute or it might become overly pedantic and shut down further discourse.

Social network analysis is a useful method for demonstrating the relationships in a given social network (Scott, 2000). This method can be used in the context of online discussion to demonstrate if discourse is centered around people in positions of power, such as the instructor, or individuals with other notable characteristics. For example, Aviv, Erlich, Ravid and Geva (2003) used network analysis to examine how power roles affected engagement in critical thinking activities in differently structured online courses. They were able to use the method to elucidate cliques that formed within the studied classes and determine who took leadership roles. However, this method still does not shed light on whether or not students are learning via their engagement in the discourse and favors visible engagement (i.e., message posting). It can reflect students who are more dominant or extroverted when it come to argumentation, but does not indicate whether or not their ideas were well-founded, or if others were learning from them.

Similar to social network analysis is sequential analysis (Bakeman & Gottman, 1997), which looks not at how individuals or other social entities interact, but rather at how particular actions or events are sequenced, with characters or roles being only of secondary concern. Jeong's (2003) Data Analysis Tool uses sequential analysis to quantitatively describe student interaction patterns in an argumentation-oriented learning context. Two-message sequences were considered the unit of analysis (e.g., initial message and response) in Jeong's study, which examined the relationship between sequences and potential indicators of critical thinking skills. While this method is quite useful to develop descriptive models and demonstrate probabilities of particular interaction types, such as a statement of agreement following one of disagreement, it does not indicate whether or not learning is taking place through these interactions. Further, it reduces each message to a particular code which might be considered oversimplification in some contexts. For example, in Jeong's study a message of conditional or partial agreement would be coded as neither agreement nor disagreement, but rather "negotiation." Such messages, however, might represent the true spirit of negotiating meaning amongst participants or might simply represent a student with a strong set opinion that does not neatly fit either side of an argument.

APPLYING THE METHODS

In this section we illustrate how the various analysis methods can each lend some insight, but not a comprehensive picture of how groups learn in a social context. Here is a transcript from an asynchronous discussion forum:

Toilets ,Eddie

We, as a society, definitely take running water for granted. A few days ago I had no water because of work on a line. My water was off for about six hours. Horrible. I couldn't make ice tea, take a shower or anything. Eventually the water did return and all is well. Just think of the poor countries where the running water never even appears!

Re:Toilets, Tanya H.

When I was younger, we visited the South and in order to take baths we would go outside and get buckets of water from the well heat the water up and poured it into a white wash tub. Talk about inconvenient. But since I was a little girl I thought that it was fun. As an adult, if I had to do that, I would be annoyed.

Re: Toilets, Laney

Boy I can relate, we had a back up in our basement due to roots from a tree, and my husband and I wanted to stay at my moms because of no water, how spoiled are we? Does anybody remember when Brownsville had to boil their water due to a bacteria? We all were out purchasing water.

Re: Toilets, Clarissa

yeah...i do remember when the people of Brownsville had to boil their water. my grandmother lives there, and we had to bring her jugs of water to keep her in comfort.

Re: Toilets, Donna

I have to agree with you all. I know that I do take the modern conveniences for granted.

An examination of this brief thread yields different results based on the analytic framework used as follows:

Participation: Analyzing traditional notions of participation or social presence can show us who is talking, but not who is lurking. We see that there are five participants posting. Each person posted once. We can see a friendly tone, informal language, and use of the first person, all of which signal information about the *social* nature of the environment. We do not know who may be lurking or what the role of the instructor is, the task, or the context of the course.

Content: This appears to be an off-topic thread, unless the purpose of the discussion has to do with lack of modern conveniences. It would likely be coded as “surface” learning (as opposed to deep), off-task, or purely socializing because there are no explicit references to the course text or concepts. There does not seem to be a lot of content here related to the formal learning of the course material. We do not know what the purpose of the discussion is or what information came before and after this thread.

Structure: The thread would need to be compared to others to have any analytic utility using this method. Of particular note is that the lone male participant is the thread starter (implying gender-interaction patterns), one respondent asks a question that receives its own response, and that all participants are in agreement. Also each new post explicitly connects to a previous post, revealing that there is intention to build on previous posts.

Thus we see that measures of participation, content and structure can all provide useful information about online discussions. However, they don't explicitly address indicators of learning, instead they focus on individual descriptive elements of the messages that were posted and, in the case of structural analysis, how the message interrelate based on some variable (gender, timing, etc.) These methods do not yet take full advantage of the context to shed light on how groups create new knowledge together. In the next section we show how Stahl's social theory of CSCL may help in this area.

NEW PARADIGMS

Stahl's (2002, 2003a, 2003b) social theory of computer-supported collaborative learning focuses on the group as the unit of analysis. Moving from viewing learning as a knowledge-*transmission* process to a knowledge-*creation* process which occurs in conversation with others, Stahl outlines how all individual knowing is in essence an interpretation of a meaning that was first made in conversation with others. But it is only through capturing all verbal and nonverbal communication that we can fully understand the context in which individual utterances function in the context of a group discussion. It is through analyzing the dialogue in context that we can understand how knowledge is created collaboratively:

The fact that collaborative learning *necessarily* makes learning visible provides the methodological basis for empirical analysis by researchers. Researchers of collaborative learning are not restricted to indirect evidence of learning (such as pre-test and post-test differences) because they can analyze and interpret the making of meaning as it unfolds in the data at the group level and in individual trajectories of utterances . . . Of course, the analysis must also take into account the activity structure and other socio-historical content in which learning takes place (Stahl, 2003b, p. 35).

Thus, it is by looking at the discussion in its broader context, through microethnographies, conversation and discourse analysis methods, that we can begin to understand how a group of discussants creates new knowledge while in conversation. Examining the full context and the dialogic artifacts for moments of new knowledge creation *can in itself be* the evidence of an effective group learning environment. To do this we need: 1) closer attention to the context of the environments; and 2) conversation and discourse analysis of knowledge building within the context.

Micro-ethnographies

Providing a more comprehensive picture of the context of the discourse is also key to generating lines of research that will result in useful prescriptive knowledge, such as instructional design theory. With educational experiences increasingly being offered via interacting online forums by novice online instructors and students, the more detail that can be provided about the context in which a particular strategy worked or interaction took place the better. Using additional data collection methods beyond just collecting archives of a class discussion can help provide this contextual information. In particular, surveys, interviews, and field notes should be considered as possible data collection methods to generate contextual information and help triangulate discussion-based findings. Student surveys can be used to see how attitudes affect one's participation and perception of whether or not learning resulted from a particular activity. For example, Dennen (2004) found that student perceptions of how a discussion contributes to learning often differ from what the researcher sees in the data, with students in a less successful treatment feeling more confident that they had learned than their classmates in a more successful group. Collecting data directly from students also can help shed light on other factors, such as unclear directions, technology problems, or competing assignments, that might have affected participation. Interviews with instructors might yield information about behind the scenes instructions students were given or volume of off-board communications, such as private email, that surrounded the activity.

Field notes may seem like an unusual choice of data collection method for studying asynchronous discussion since discussion boards are self-archiving and do not involve real-time activity. Whereas in face to face environments it is possible to videotape the collaborative interactions to capture not only the dialogue, but gestures and other nonverbal communication important to meaning-making, this isn't possible online. However, there is a 'feel' to the online experience that cannot be captured only by reading transcripts after the fact. Thus, tracking a discussion in progress and keeping notes about it can be particularly useful. An observant researcher may choose to take notes from the perspective of a student, instructor, or outside observer. The prolonged and continuous engagement that results from the researcher watching the discussion as it occurs permits the researcher to comment on what the actual participants might have experienced at different times during the course. Our research presently tends to document completed discussions, looking at the act of message posting. However, students engaged in an online course are likely to be affected by what it means to be a reader of messages, looking for places to post a response or waiting to see if a particular message received a reply. Analysis of archived discourse fails to adequately capture times when the discussion board feels "slow" or inactive; has such rapid participation that it almost seems synchronous; is rich or lacking in openings for true dialogue; or is tense based on a message that may be interpreted in multiple ways. For example, a particular message may seem surprising or radical when initially posted, but become less so as classmates enter and adopt that point of view. Capturing these moments during the actual creation of the dialogue may provide insight into

the participants' experience, whereas archives of completed discussions may smooth over or obscure any rough spots that happened during the discussion period.

Conversation and discourse analysis

Rourke and Anderson (2004) and Rourke, Anderson, Garrison and Archer (2001b) describe the enormous difficulty of inferring the presence of an underlying construct, such as knowledge construction, from what is observable in computer conferencing transcripts. "Drawing conclusions about underlying constructs based on frequency counts of the surface content of communication is a complicated analytical process, though it is rarely recognized as such" (Rourke & Anderson, 2004, p. 15). They point out that an iterative process between grounded theory and literature review is often used to come up with behaviors that represent the construct of interest, such as cognition. Campos (2004) adds: "Curiously enough, most of those studies considered qualitative rely on quantitative measurement of qualitative categories. [This can] indeed suggest certain trends. However, such studies are very limited because summing up categories says nothing about the knowledge building *process*. It is only through attention to the process that collaborative conceptual change and learning can be assessed" (p. 4).

When analyzing discussion transcripts, Dillenbourg, Baker, Blaye and O'Malley (1996) admit that "deciding on the meaning of . . . expressions in a given dialogue context is thus quite complex, but necessary if we are to understand when students are really collaborating and co-constructing problem solutions" (p. 18). They point out that a promising possibility is to "exploit selective branches of linguistics research on models of conversation, discourse or dialogue to provide a more principled theoretical framework for analysis" (p. 19). Mazur (2004) and Herring (2004) have begun to explore how linguistic methods of conversation and discourse analysis can be applied to online discussions. Herring's (2004) computer-mediated discourse analysis (CMDA) is "any analysis of online behavior that is grounded in empirical, textual observations . . . [I]t views online behavior through the lens of language, and its interpretations are grounded in observations about language and language use" (Herring, 2004, p. 339). CMDA draws upon theoretical assumptions of linguistic discourse analysis, including the notion that recurring patterns are present in discourse which may be identified by the analyst, even though speakers themselves may not be aware of these patterns. The notion that we *do* things with words can be traced back to Austin (1962) and Searle (1969) and speech act theory. This view of language is particularly useful when seeking to examine how groups complete a *process*. Traditionally, content analysis has revealed *what* participants say online; however, *what participants are trying to do* with what they say online is of particular interest when describing a process such as knowledge construction.

APPLYING THE NEW METHODS AND PARADIGMS

We return now to the sample data thread analyzed above, showing how a deeper understanding of the context and a conversation/discourse perspective is valuable.

Microethnography. Additional information such as the timing of the posts, how this thread fits into the larger discussion forum, the larger context of this particular thread, how many people were lurking, that the students may be communicating face to face or through email in addition to the discussion forum, what was the role of the instructor, what task / prompt were they responding too, and how all of this fits together to capture the knowledge they were creating together. There are often "a-ha!" moments that change the flow of the conversation. These are often not captured, or when used in other methods tend to not be part of contextualization (e.g., looking at timing as a structural element).

In the actual class from which the data sample was taken, these messages were posted in a thread over the course of two weeks. The students were reading about related topics, such as the role that sewages and plumbing technologies have played in developing society. The relaying of personal experiences is actually following a model that the instructor set, encouraging all students to find examples of the concepts being learned in their own lives and to examine what happened when their experiences and knowledge was pooled. Within this course, almost every student was an active participant at some point in time, but they tended to wait and post when they felt they had something to say rather than posting for participation points or to demonstrate that they had done the reading. This particular thread was briefer than many of the others

Conversation analysis: There are four female participants and one male participant. Eddie started the thread and everyone else responded. Each person took one turn. The length of the messages gets shorter as the thread progresses. Everyone generally agrees with each other. Most of the messages consist of statements. There are several questions and some direct and indirect responses.

Discourse analysis:

Toilets, Eddie

We, as a society, definitely take running water for granted. A few days ago I had no water because of work on a line. My water was off for about six hours. Horrible. I couldn't make ice tea, take a shower or anything. Eventually the water did return and all is well. Just think of the poor countries where the running water never even appears!

Eddie begins by making a claim that “modern conveniences are taken for granted”. He supports this with a personal story and example from his own life, followed by an appeal to bring others into the conversation through his exclamation, “just think....!”

Re: Toilets Tanya H.

When I was younger, we visited the South and in order to take baths we would go outside and get buckets of water from the well heat the water up and poured it into a white wash tub. Talk about inconvenient. But since I was a little girl I thought that it was fun. As an adult, if I had to do that, I would be annoyed.

Tanya connects by relating her own personal experience/example along the same lines. This is done indirectly and without direct reference to Eddie's post. She however explicitly connects the idea of “as an adult . . . I would be annoyed” to Eddie's initial claim that we as a society take conveniences for granted.

Re: Toilets, Laney

Boy I can relate, we had a back up in our basement due to roots from a tree, and my husband and I wanted to stay at my moms because of no water, how spoiled are we? Does anybody remember when Brownsville had to boil their water due to a bacteria? We all were out purchasing water.

Here Laney makes a direct connection (reference to the previous post) “boy I can relate” and also brings in her own examples. She also restates the idea of taking things for granted by saying “how spoiled are we?” She searches for an experience that all participants have in common by referring to a local incident in Brownsville. She asks it as a question to draw others in.

Re: Toilets, Clarissa

yeah...i do remember when the people of Brownsville had to boil their water. my grandmother lives there, and we had to bring her jugs of water to keep her in comfort.

Clarissa directly responds to Laney's question, followed by a personal experience. At this point the posts become shorter, and there is less exploration and more direct respond.

Re: Toilets, Donna

I have to agree with you all. I know that I do take the modern conveniences for granted.

Finally, Donna weighs in with a general agreement, plus an interesting connection back to the broader concept of “modern convenience” that Eddie had initiated in the first post. The message serves to provide resolution to the thread, somewhat unusual in asynchronous discussion forums (Hewitt, 2003).

Through this discussion the group is exploring the meaning of modern conveniences and taking them for granted and sharing personal stories to illustrate what they each mean and bring it back together again.

Traditional methods of participation, content analysis and structural analysis reveal important insights about what happens in online discussions. However, adding microethnographies, conversation and discourse analysis techniques to our repertoire provides a more robust look at how the participants in the overall conversation are participating in a process of knowledge creation. By looking at the function that their posts serve in a larger context, meaning making is revealed.

CONCLUSION

In closing, research into online conversations in educational settings should be looking more thoroughly at how groups of learners are engaged in contextualized discourse. As a discipline, distance learning is in need of a rigorous research framework with solid epistemological grounding that will encourage comprehensive study of how learning takes place through group interactions on a discussion board. Such a framework will need to account for all types of participation or learning processes (internal and external, individual and group). It will need to promote data collection beyond just downloading post-course archives of discussion threads in order to capture contextual factors that impact ecological validity. Stahl's social theory of computer-supported collaborative learning may provide the necessary theoretical underpinnings to support the development of a new paradigm of online discourse research, one that looks to methods such as microethnography and conversation and discourse analysis in addition to more traditional participation, content and structure oriented methods.

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