SOCIAL ENGAGEMENT IN AN ONLINE COMMUNITY OF INQUIRY[1]

Human-Computer Interaction

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Abstract

This paper examines a multidimensional set of learning-engagement behaviors by students participating in a community of inquiry. Existing social-inquiry models of learning focus on students achieving shared understanding through solving well-structured problems. These models may not be appropriate for professionally-oriented, graduate online education where students derive distributed and partial understandings of ill-structured real-world problems. Findings are presented from a study of joint knowledge-construction in an online graduate IS Management course. Patterns of interactions between learner role-behaviors are examined, to analyze social engagement in debating course problems. We propose that professionally-oriented online courses should frame course-problems to reflect students' cognitive and professional learning goals. Student engagement in learning may be intensified by the early identification and encouragement of thought-leaders in various domains of professional knowledge who facilitate and complicate community debate. We examine the implications for online learning environments.

Keywords: Social engagement, community of inquiry, online learning, collaborative learning, social constructivism.

Introduction

Online education has experienced a rapid growth in the University sector. The emergence of the Internet as a transport medium has made the prospect of content-rich, remote delivery of education a reality. Champions of online learning point to efficiency gains, flexibility for consumers and the potential for more effective learning (Harasim, 1999; Hiltz et al., 2001). Other commentators are skeptical and point to longer preparation times (Burgess and Strong, 2003), the anecdotal nature of some positive results (McNaught et al., 1999) and the lack of satisfaction with the process experienced by many learners (Ocker and Yaverbaum, 1999). We cannot simply translocate traditional teaching unreflectively to a remote, electronically-mediated arena. The traditional model of learning as a passive transmission of knowledge from experts to novices is now considered inadequate. The notion of learning as an active, socially situated constructive process is becoming widely accepted (Bransford et al., 2000; Lave and Wenger, 1991; Schön, 1987). However notions of *static/dynamic* and *passive/active* in the online learning context are often ambiguous. Learners can appear to be passive but may be actively constructing knowledge as demonstrated by the "vicarious learner" phenomenon (McKendree et al., 1998). Those who are apparently peripheral participants in a community of practice are actively learning, becoming engaged and enculturated into the professional life of the community (Lave and Wenger, 1991). If we are to design useful learning experiences we need to understand how learning proceeds in an online community. This is especially true when we are expecting students to engage with the fuzzy, unbounded problems that they will encounter in professional practice. Most studies of online learning focus

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on experimentation with technology design. We have little research on the nature of student engagement with a community of inquiry, which leaves a major gap in our understanding of how to design online learning systems. This paper reports on an exploratory study that addresses this issue.

Conceptual Background

Socially-Situated Learner Engagement Behaviors In A Community of Inquiry

It is now commonly accepted that people build their understanding of the world, and in turn their own way of knowing, within a socially-situated environment (Bransford et al., 2000; Harasim, 1999). The dominant model now emerging for online learning models is collaborative and asynchronous. Computer-mediated communication tools such as email, ListServs and discussion boards are used, but require a great deal of structuring and instructor interaction, to fit with constructivist pedagogical models that incorporate the richness of experiential learning and reflection needed for deep learning (Muukkonen et al., 1999; Zhang and Peck, 2003). So the recommendation is to situate learning within a collaborative community of inquiry (Hiltz et al., 2001).

The community of inquiry concept has its roots in Dewey's practical inquiry model, which situates learning in both the personal and social worlds.. Dewey argued that practical inquiry required the identification of an indeterminate situation as a problem, an approach to problem-solving that questions accepted methods and knowledge (with an understanding that these develop progressively and sometimes in unexpected ways), and a collaborative approach to problem-analysis and solution testing (Dewey, 1916, 1933). The social aspect of this model was advanced by Vygotsky, who argued that a student can perform a task under instructor guidance or through peer collaboration that could not be achieved alone (Vygotsky, 1978). More recently, learning has been viewed as situated within a community of professional practice, where we learn how to act through participation in shared work-practices. Community practices embed a shared system of cultural norms, values and goals, that define "how we do things here", and differentiate one community from another (Lave and Wenger, 1991). Social reality is developed in three stages: externalization, objectivation, and internalization. Knowledge is externalized as an individual develops a theory of how the world works that is articulated and expressed in language or action. Objectivation occurs when someone's theory or ideas take on an objective reality of their own, being accepted as "fact" independently of the person who first created or externalized them. Internalization is the process through which people learn the objectified "facts" that are valued within a community of professional practice and make them a part of their own internal reality (Berger and Luckman, 1966). It has been argued that constructivist models of learning are incommensurate with socially-situated models. But the two may be reconciled if we accept that learning occurs in the space between the individual and the community (Cobb, 1994). Learning occurs through cycles of interaction between individual, community, and societal realities, as shown in Figure 1.

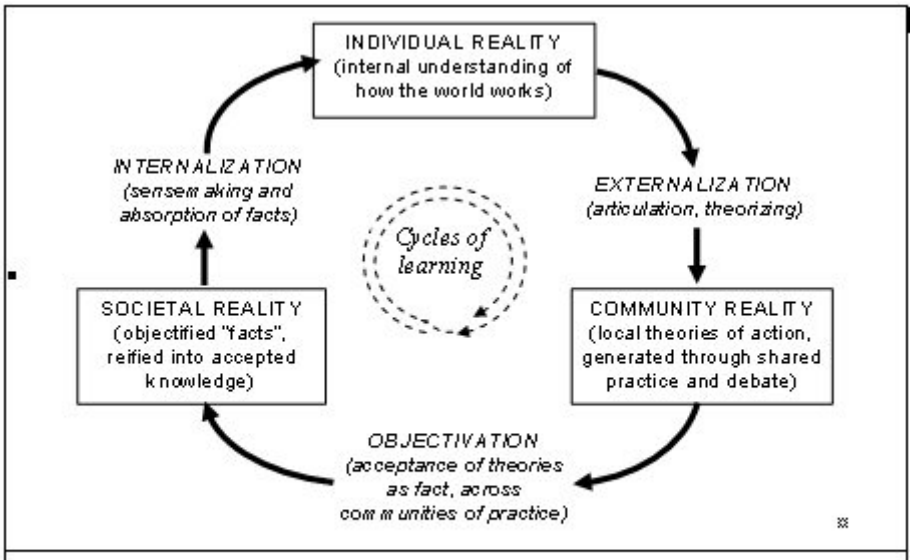

Figure 1. Social Construction of Knowledge In Organizations
adapted from Berger and Luckman (1966)

Garrison and colleagues (Garrison et al., 2001) developed the concept of an online community of inquiry from Dewey's (1916; 1933) practical inquiry model. They emphasize three elements of learner participation in an online community of inquiry. *Cognitive presence* indicates the degree to which a participant is able to construct meaning through sustained communication. *Social presence* is the ability of learners to project their identity and personal characteristics into the community of inquiry to encourage peer interaction. *Teaching presence* is the ability of instructors *or* learners to provide structure and process in learning environments (Garrison et al., 2001). While we may employ these constructs to assess student discourse (externalized knowledge), they examine these behaviors in isolation. They do not help us to assess where students engage in behaviors that indicate that sensemaking has taken place, leading to knowledge internalization, or that students are capable of the theorizing required to inject their knowledge into community debate. Csikszentmihalyi (1975) argues that there is a "flow" channel where individuals are intrinsically motivated to participate. This occurs when activities present a sufficient challenge and engage individuals' existing skills. Students are in the "flow" channel of enjoyable activity when the challenge set by an activity *balances* their expertise or skill in accomplishing it. If the degree of challenge and skill are too low, apathy occurs. Learning takes place when students can be persuaded to move from the "flow" channel to an activity which presents a higher challenge but allows their skills to be employed -- and from which they can derive enjoyment. If the challenge is too far above their skills and expertise, they perceive the activity as hard work. Engagement in learning requires problems that draw upon students' existing skills or expertise and that present a sufficient challenge to move students from the "flow" channel of activity (token participation) to a mode where they engage with learning to develop their understanding of a problem.

We have little evidence of how such engagement operates. Static "learning styles" that relate to preferences for interacting with content in specific formats (i.e. visual, auditory or written) appear to have less effect upon learner participation and collaboration than intrinsic enjoyment. Students who favor specific learning styles do equally well in online learning environments (Hallock et al., 2003). Students in face-to-face classes display collaborative behaviors when these help them to obtain the rewards of the class in recognizing superior knowledge or good "class citizen" behavior. Online students appear to be driven more by intrinsic motivations and less by the rewards of the class, embracing collaborative behaviors if these are expected and if structures and guidance for meeting this expectation are provided (Diaz and Cartnal, 1999). But we have little evidence to suggest how we might identify and develop social-engagement behaviors (Cobb, 1994). Wenger (Wenger, 1998a) proposes a number of behavioral-roles in communities of practice, but these largely reflect relations with the organizational hierarchy and with other communities of practice, rather than specific behaviors associated with community learning. The received wisdom is that students who participate at a token level do not benefit from the presence of the learning community and so continue employing less effective models and practices that result from their individual, prior experience (Lipman, 1991). This position is refuted by studies of vicarious learning, that indicate that students also learn by internalizing

knowledge from the contributions of others, even when they appear not to be participating in interactions with the instructor or peers (Cox et al., 1999). It seems that vicarious learners may be more attracted to the intrinsic motivation of enjoyment in engaging with course-materials, than to the extrinsic motivations of community recognition and rewards (Diaz and Cartnal, 1999).

This gap provides our first research question:

RQ1: What indications do we have of that a student is engaging in constructivist learning within a community of inquiry?

Social Processes Of Learning

It is clear that in collaborative learning students are expected to integrate new material by actively working with it to create new forms of in-the-head knowledge. This knowledge cannot be abstracted from the learning context and is dependent on interaction with peer learners (Bransford et al., 2000; Smith and MacGregor, 1992). A community of inquiry does not arise spontaneously. If we wish to encourage collaborative learning, we must examine mutual exchanges among learners. Knowledge construction results from a collaborative process where multiple perspectives are brought to bear on a problem and where the meanings attached to relevant concepts and knowledge are socially negotiated (Jonassen et al., 1993; Schwier, 2002).

If we examine what is known about social learning processes, we find several models based on Dewey's (1916; 1933) model of practical inquiry and subsequent cyclical models of experiential learning (Kolb, 1984; Lewin, 1951). The practical inquiry model that accompanies the Community of Inquiry framework (Garrison et al., 2001) and Muukonen's model of community learning (Muukkonen et al., 1999) are two popular examples in online learning environments. While these models relate individual learning to a pool of shared expertise in the community, they focus on socially-situated aspects of learning and fail to account for its collaborative nature.

Stahl (2006) presents a description of collaboration in learning that is focused on the construction of shared artifacts. Stahl's model reflects a dialectic between personal knowledge-building and social knowledge-building, as shown in Figure 2. The construction of personal understanding precedes and results from the process of social knowledge building. Learners proceed through cycles of pre-understanding, personal focus and personal comprehension. They leave this cycle when ready to externalize their understanding., entering repeated cycles of social knowledge building where they engage in negotiation of perspectives until they reach a shared understanding or create a shared artifact. At this point they re-enter a cycle of personal understanding (Stahl, 2006).

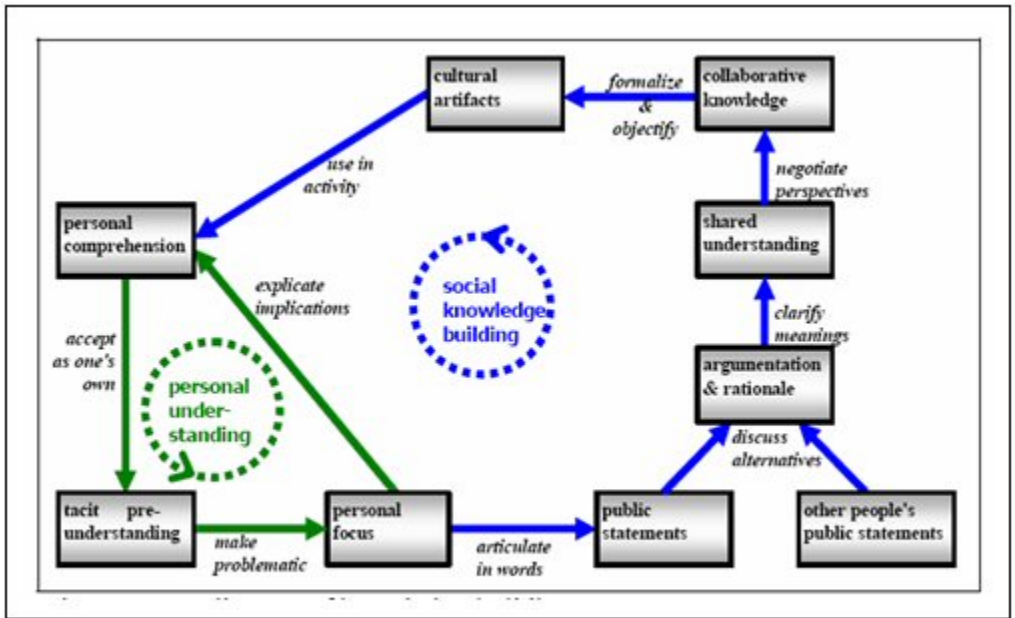

Figure 2. Collaborative knowledge building (Stahl, 2006)

While these models of learning differ in terms of focus (individual/group), the number of learning-stages, and modalities of interaction they each have a similar morphology. One similarity is the assumption that a solution, artifact or shared understanding will become available to be tested, refined, and/or validated by application. A solution potentially exists or can be constructed . For example, Stahl's model relies on the comprehension of shared cultural artifacts and development of the tacit understandings that permit their shared use in problem resolution. The second similarity is an assumption of formal transitions between different phases of inquiry. But these are assumptions related to the use of structured problems. For graduate online education, we need to focus on the resolution of ill-structured problems (Simon, 1973). Such problems require communal debate, to clarify goals and problem-definitions. They also may result in a distributed understanding of how to resolve them, depending upon the prior expertise of the individual (Haythornthwaite, 2002; Hollan et al., 2002). Rather than examining the development of shared understanding, we argue that it is necessary to examine the divergent effects of individual knowledge-construction and their relation to the convergence that is achieved through shared knowledge construction. This study explores the *space between* individual and community understanding (Cobb, 1994). Social engagement with a community of inquiry entails interaction, collaboration, debate, negotiation, cooperation, and – at times -- social loafing (Jonassen et al., 1993; Kreijns et al., 2002; Wegerif, 1998). We thus arrive at our second research question:

> *RQ2: What characteristics of an interactive process of inquiry may be observed through analysis of online debate among learners over time?*

Patterns of Social Engagement In A Community of Inquiry

To provide a framework for social engagement, we employ the constructs suggested by Kappelman and McLean (1992), who distinguish between participation and involvement by users in systems development. They define **participation** as the *observable behavior* of individuals in a collaborative process, while **involvement** is differentiated as a *psychological state of identification* with some object to the extent that the object is perceived as both important and personally relevant (Kappelman and McLean, 1992). But while Kappelman and McLean define **engagement** as the superset of participation and involvement, we prefer to employ a socially-situated definition that is more relevant to community learning. Wenger argues that mutual engagement is required to bind community members together into a social entity that constructs a repertoire of communal resources, such as shared understandings and expertise (Wenger, 1998b). We employ the term ***social engagement*** to denote *active commitment to the social facilitation and direction of the community learning process*. Each construct builds on the previous one. Learner involvement requires participation plus psychological identification with the object of the learning process, while social engagement requires learner involvement plus active commitment to the facilitation and direction of community processes.

Successful knowledge acquisition (learning) depends upon an individual's ability to make sense of knowledge acquired in one community of practice and translate it, to apply to another community context (Wenger, 1998a). Professional workers resolve unstructured problems through the application of knowledge and methods that span knowledge domains (Engestrom et al., 1995). Effective learning environments must therefore encourage students to assimilate knowledge from application domains that are new to them. But new knowledge is only meaningful when the learner can relate it to prior experience in the context in which it will be applied. Many students do not possess such experience. This leads to failures in learning approaches, that rely on a student possessing sufficient knowledge of community practices to be able to abstract and adapt new knowledge (Lave and Wenger, 1991). Effective learning environments must permit students to acquire domain-specific professional knowledge and, equally importantly, to acquire an understanding of how to apply this knowledge in practice.

Members of professional communities engage in brokering activities, negotiating definitions of relevant knowledge, problems, and solutions to derive a generically subjective (jointly held) perspective of the problem at hand (Weick, 1995). We would expect learners to engage in different ways, depending on how they view their degree of expertise relative to the problem in hand. We also expect community behavior to vary with the nature of the specific problem, a group of individuals may behave as a community of practice or a knowledge network depending on the demands of the situation (Créplet et al., 2003). They may behave as a subject expert where they have relevant experience of similar problems, they may question and negotiate assumptional frameworks and norms, and they may adapt and co-construct new forms of combinatory knowledge as a community. Or they may conclude that they have no relevant expertise and observe how others resolve the problem. Findings from our previous work would indicate that shared expertise is not always available or accessed in all learning stages and that some modes of discourse demonstrate an individual or a group focus to achieve very different ends (Waters and Gasson, 2005). We therefore view the three

levels of engagement as three modes of exploitation in the space between individual, community, and professional realities.

This leads to the question of why individuals adopt participation, involvement, or social engagement role-behaviors in community learning. We argued above that this might relate to their pre-existing knowledge or expertise in specific problem-solving contexts, leading to our third research question:

RQ3: What drives the adoption of deeper levels of learner engagement within an online learning community?

Based on the learning indicators discussed in this section, we relate the three levels of engagement to observable behaviors in a community of practice in Table 1. This provides a framework to operationalize the analysis of learning behaviors in the empirical study that follows.

Table 1: Levels of Engagement With Learning Community

	Form of Learning	**Observable Activity**	**Predicted Outcomes**
Participation	Individual internalizes a professional reality reflected in these materials and articulates this to the community.	Behavior that denotes interaction with course materials rather than community, through passive contributions.	Superficial learning, that results from the acquisition of terminology and content-led professional domain definitions of knowledge.
Involvement	Individual develops their own understanding by translating community knowledge to a professional knowledge-domain, internalizing how this knowledge applies, and externalizing the resulting learning back to community.	Behavior that indicates the active application of community perspectives to individual's professional experience.	Contextually-situated learning, that results from the active construction of knowledge through internalizing perspectives from the learning community and externalizing the resulting knowledge. This is equivalent to a single cycle of knowledge-construction..
Social Engagement	A sustained learning process in which individual engages with repeated cycles of translation-internalization-externalization to develop their own and the community understanding.	Behavior that indicates proactive commitment to the facilitation and direction of a *sustained* learning process.	Sustained, internalized, and articulable learning, that results from the active co-construction, debate, testing, and development of knowledge in collaboration with peer learners.

Research site and method

To answer the research questions posed above, we applied the framework presented in Table 1 to the analysis of interactive discussions from an online graduate Information Systems degree course at a North American University. We performed an analysis of 1063 messages posted to the course discussion board by 29 students enrolled on a Management of Information Systems course. Students were required to post messages to the course, but community interactions were not an explicit part of the reward system. The course required students to prepare individual bi-weekly assignments and to participate in weekly discussion forums on associated topics, using commercial discussion board software (Blackboard). Forum topics were set by the faculty member who designed the course and acted as the main course instructor, moderating the online discussion. The software allowed for the capture of basic statistics such as how frequently students viewed messages and visited the discussion board. This study examines data from the discussion board taken from all ten weeks of the course, including the initial "please post something about yourself" topic, which provided background on each student. Most students had prior industry experience and the majority worked in IS-related jobs. Each week, questions were posted, to which students were expected to respond. Most students responded multiple times. Topics ranged from conceptual ("What role does IT play in organizational success") to practical ("Is there any such thing as a turnkey system?"). Course questions were deliberately open-ended. Students were intended to display critical thinking skills, which in turn encouraged the exchange of ideas between students.

Data from individual discourse in discussion board postings were coded qualitatively (Denzin, 1998; Silverman, 1993), using a thematic comparison to discern differences between individual contributions. A content analysis was carried out on the student discourse for the ten weeks of teaching and the introductory forum. Over a ten week period there were 951 non-instructor posts to the discussion board (a range of between 1 and 154). Co-coder agreement was ensured by continual debate and comparison of the analysis performed by the two authors, throughout the analysis. We initially employed an analysis framework based on that employed in online community of inquiry studies by Garrison, Anderson and Archer (2001). But we discovered that this framework was insufficient to discriminate between the different types of social-engagement behaviors discussed in the conceptual background to this paper. So we examined student role-behaviors by means of a grounded analysis (Strauss and Corbin, 1998). As many messages displayed evidence of multiple types of behavior, i.e. social networking or cognitive analysis of course content, it proved most useful to analyze combinations of behaviors that students displayed. These combinations of behaviors were rarely combined in the same message and so we employed role-behavior definitions to categorize the various modes of community interaction. We then explored sequences and patterns of learner and role-behavior interaction in detail. Finally, a social network analysis was performed to analyze changes in student interaction over time and in response to different problems (Haythornthwaite, 2002).

Because of the exploratory nature of this study, we made a conscious decision to examine data in depth from a single course with a relatively small sample of students (29). This meant that data were analyzed qualitatively from multiple perspectives, rather than analyzing specific aspects of a larger sample statistically. It permitted us to explore what aspects of the data were important in indicating depth of learning. Future studies will analyze a larger sample of students to validate our findings.

Research Findings

Each week between one and four open-ended questions were posted by the instructor. There were a total of 951 responses to the questions. Total responses per week varied from a low of 43 (week 8) to a high of 162 (Week 2). There was a weak negative correlation of -0.68 between the number of questions posed and the number of responses per question. The first two weeks were the most active in terms of postings (157 and 162). Over the ten week period there were 25,937 visits made to the discussion board by students; individual patterns ranged from 331 to 2179 visits. There was a positive correlation between frequency of board visit and final course score (0 – 50) of 0.94. For the same period there were 897 non-instructor posts to the discussion board, with students posting between 1 and 136 messages. The correlation between student postings and final course score was 0.95, however student contributions to the discussion-board contributed to their course-grade so this cannot be surprising.

Learner Engagement In Constructivist Learning

Learner Roles Identified

We identified eight primary learner-role behaviors played by students, during this analysis. In the examples that follow, we provide example messages from students acting in each role-behavior, to show the different ways in which students in these role-behaviors interrelated. The examples here were selected from responses to two specific course questions, to provide a clear comparison across message-extracts. *Student identities are anonymized and names, where given, are pseudonyms.* 'S' student ID-codes (e.g. S17) indicate that the student completed the course, 'D' codes (e.g. D4) indicate that the student dropped the course. These students were included in the analysis as most were enthusiastic contributors who dropped because of professional work-conflicts.

Facilitator

The facilitator is one of the key role-behaviors in enabling community debate. A facilitator attempts to maintain impetus in a debate by acknowledging useful contributions and drawing out further debate. A student in the facilitator role-behavior gets things moving by throwing out community-oriented questions, such as "how would this happen?", or "I disagree with XXX but what do you think?". They often resolve external or logistical problems for other students, moderate discussions, warn the community when a debate is wandering off topic, and actively acknowledge other students' contributions.

Sounds like your work in the ABC, might provide you some insights into this class. Do you think so?

A Facilitator will often acknowledge good ideas from other community members, discussing how these can be used.

Fred, I like your definition of a commodity. I think that the Microsoft suite of applications, the operating system, Word, Excel, PowerPoint, Outlook, have become the commodity standards in the industry, for the most part.

A Facilitator may expand others' examples, by providing further insights along the same lines:

That's a good example. Company-X puts some similar intelligence around its customers' behaviors as well. I occasionally get emails advertising new books that would be interest to someone who's bought "such and such" in the past. … I too have bought things as a result of these marketing methods.

Contributor

A contributor adds to a debate but generally in terms of fulfilling a minimal contractual obligation. Posts are often brief and may not have much bearing on the debate in question. A student adopting a contributor role-behavior tends to project their identity through their messages and to add their view on the existing debate, but does not change the nature of the debate. They may give examples from their own experience, but these are brief and they often just quote examples from course readings. Even their socializing is not designed to elicit interactions:

Hi! My name is xx. I live near yy and work in zz. Currently I am a user interface designer for a web application for a mortgage insurance / financial services firm. I think this is my 8th class in the program. I Look forward to working with you!

A simple contributor will add to one argument or another, they frequently do this by using examples from personal; experience, contributors may also explicate positions.

I do agree that there are portions of IT which have already been commoditized. Several of these have been mentioned in other postings and in Carr's article (storage, networks etc). In fact, in Champy's rebuttal he concludes that "IT will eventually become a commodity..."

Knowledge-elicitor

A peer-knowledge-elicitor is a knowledge seeker. These participants seek information regularly regarding meaning of problems without the intent of maintaining debate. Students who adopted a knowledge-elicitor role-behavior appeared to adopt this role-behavior because they lacked confidence or were confused by the debate. The intent of these behaviors is to seek information from their peers about what to do and why. They frequently ask for advice or explication about the current task:

Can somebody please clarify for me what diagram we have to create the one that is on slide 22 or 28 or both? I just wanted to make sure that any of those two is OK. Thanks

Vicarious-acknowledger

A vicarious acknowledger demonstrates recognition that someone else's contribution influenced his or her perspective. A student adopting this role-behavior appears to be acting as much socially as cognitively (for knowledge construction). Behaviors categorized in this role-behavior often display a "me-too" phenomenon, aimed at communicating the value and importance that someone places on the contributions of others. It sometimes builds on the previous contribution, but not in sufficient detail to enable others to respond, so responses to such messages tend to be of the "me-too" type as well:

I completely agree that any communication to high level management (especially the CEO!) needs to be very clear and succinct. I am a bit concerned that a single spaced two-page memo can be brief or succinct.

Complicator

A complicator is a participant who forces the community to reflect on assumptions and who suggests alternative interpretations. The complicator points out inconsistencies in arguments and may reframe questions in an original way. A student in the complicator role-behavior communicates a perspective that redefines an initial position (an initial question or someone else's response) or who suggests alternative perspectives to a proposed point of view and show complications that arise form an approach.

> *That is not an easy question. It depends the business model and the impacts of IT on such models. If IT is restricted to general support then IT doesn't matter. If IT could change from the back office support to reshape the entire business then IT does matter.*

Initiator

The initiator attempts to create and support a social network: looking for points of connection between community members, drawing out other members, and providing the basis for future interactions. An initiator frequently provides an initial understanding of a problem for the community. The core behaviors associated with this role-behavior appear to be social: sending out multiple messages often unrelated to the work in hand, to set up and maintain a social network of people who would recognize the student as someone accessible, with whom to interact. The initiator appears to look for points of connection such as affiliations, occupations or hobbies. Where no obvious connection exists someone in this role-behavior may simply comment on another participant's background and ask general questions. This frequently acts to draw participants out into the community.

> *Hi, xxxx. If your contributions to the XYZ class discussions are any indication, I think you'll be giving the class a few things to think about, as well. Good to see you back!*

An Initiator often starts a debate by providing an initial understanding of the problem or a possible/partial solution. They may also express a framework for a solution:

> *Most critical things to consider in planning for IS?: Here are a few, as I'm sure most people have plenty enough to read by now:; - Is there an enthusiastic key stakeholder at the right level to fund the project? Or, is there an unavoidable business need (e.g. changes/updates for ABC) that drives the project?*

Closer

A closer is a participant who attempts to pull together a final or coherent answer to the question. This role-behavior involves synthesis and the reconciliation of differences.

A student in closer role-behavior often acts to bring a debate to a conclusion. They reconcile differences and combine threads of arguments to provide an overview or summary for other community members. It was observed that elements of closer contributions were frequently echoed by other students.

> *Does IT really matter anymore? Just ask Wal-Mart, UPS, Amazon, eBay or even Xerox and Apple if it really matters. All of these companies are continually attempting to innovate current technology to develop an edge over their competitors. Even though Apple & Xerox are currently minor players in their fields, as long as innovation continues to drive IT forward, they could be at the top of their class 10 years from now.; In my opinion, IT, science and medicine will never become commodities. All three will continually progress forward and will always truly matter.*

Passive-Learner

The passive learner makes no overt contribution to debate, though they read the posts of others and construct their own meaning privately. A student in passive-learner role-behavior makes minimal contributions and provides little or no projection of self. Passive-learners may learn vicariously or may bring learning from the online community into the real world. However, they decline to engage with the community, so there is little evidence of their presence.. There was a significant correlation (0.94) between the frequency of read accesses and the student's course grade. The correlation between student discussion board access and discussion board postings was 0.69, leading to

the conclusion that many students read and reflected on others' contributions, before contributing themselves – a type of "engaged lurker" behavior.

Indicators of Social Engagement in Constructive Learning

The most powerful indicator appeared to be that students responded to other students' contributions, externalizing a view of the other's perspective that either reflected this with a different example (*Facilitator* role-behavior), or challenged or reframed it (*Complicator* role-behavior). We examined which students' messages were most frequently read and which were most frequently responded to. Figure 4 summarizes the popularity and volume of student contributions, broken down by role-behavior, over the period of the course. We allowed each posting to contribute only once to the categorization, as each message appeared to fulfill a primary student objective and this prevented more verbose students biasing the analysis. Popularity is weighted as a percentage of the number of reads for most popular student's contributions.

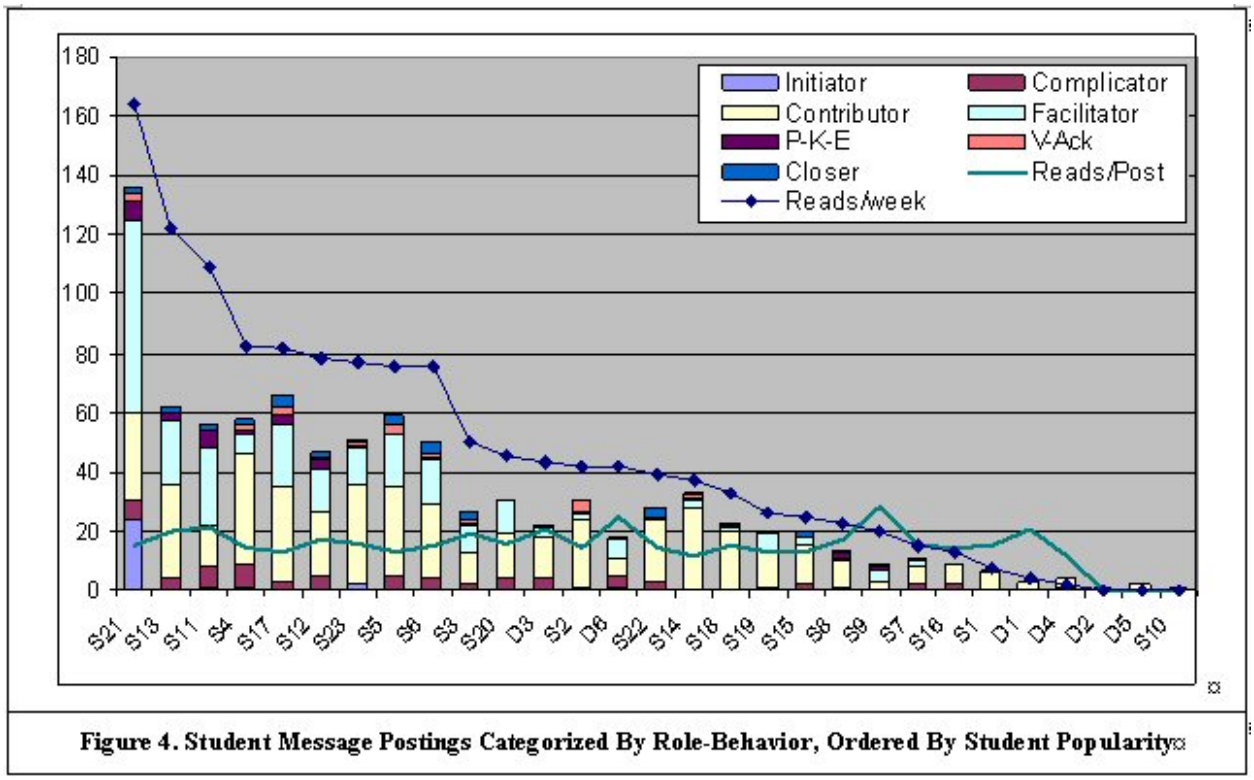

Figure 4. Student Message Postings Categorized By Role-Behavior, Ordered By Student Popularity

The volume of contributions did not appear to affect the popularity of a student's contributions (although this did bias the analysis for very low-volume posters, such as S9). Instead, message-popularity appeared to be related to the number of *Facilitator* posts *(*acknowledging useful contributions and drawing out further debate) and *Complicator* posts (forcing the community to reconsider assumptions and suggesting alternative interpretations of a problem) made by an individual. This reflects a preference, on the part of other students, to direct available time to reading postings by students who were perceived as contributing to the impetus in a debate.

Sub-threads always contained a *Facilitator* or *Complicator* message as their second or third contribution. This thread divergence appeared to permit other students to identify community "thought-leaders" and to respond to them with more enthusiasm than other contributors. The most prolific thread facilitators or complicators appeared to be considered the most knowledgeable contributors by other students, as demonstrated by the chart in Figure 5. Students who regularly posted *Facilitator* or *Complicator* contributions read much more frequently than other students. The number of student-contributions obviously also has an effect, but this finding cannot be explained by volume alone.

Special attention should be drawn to the behavior of the (social-network) *Initiator*. This summary includes the "introduction" messages, where one student (S21) conducted an enthusiastic round of social networking, categorized under the Initiator role-behavior. Five other students (D4, D6, S4, S11, S21) displayed one or two instances of this role-behavior but S21 was outstanding for initiating social contacts across the whole class (22 instances). The contributions of S21 were valued much more highly than other students – possibly because S21 established very strong social ties at the beginning of the course, or possibly because S21 demonstrated the early pattern of deep course engagement discussed below.

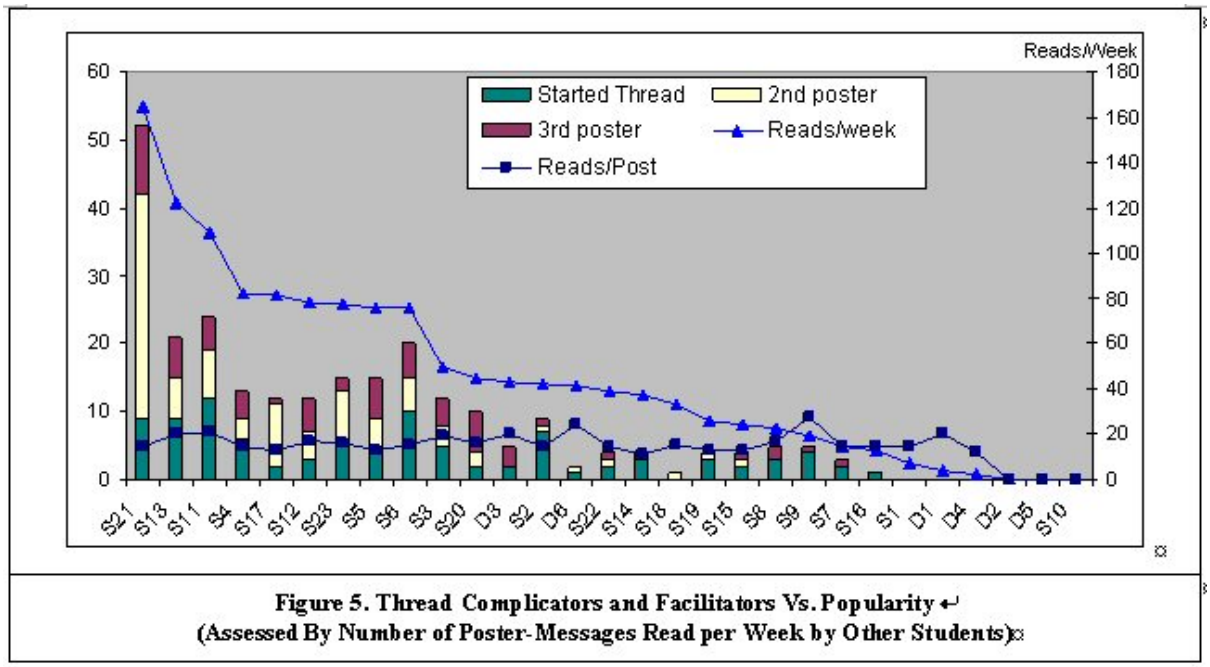

Figure 5. Thread Complicators and Facilitators Vs. Popularity ↵
(Assessed By Number of Poster-Messages Read per Week by Other Students)

Characteristics of Interactive Processes of Inquiry

We detected at least two "constructive" sub-thread exchanges for all but the two least-responded-to questions that were set for discussion (a sub-thread was considered constructive if it consisted of more than 4 interactive messages). In the more productive debates, community members appeared to construct a "knowledge map" by debating a stream of related ideas through repeated interactions. A typical sequence is shown in Table 2. The sequence of interactions demonstrate how knowledge was *co-constructed* through student debate around a theory or model applicable to the problem. The key element appeared to be a student becoming inspired by a broadcast message and responding with a development of the first student's argument that encouraged further debate. The turning-point that generated interactive debate leading to community knowledge construction was generally provided by the second or third contributor, who adopted a *complicator* or *facilitator* role-behavior that advanced the debate. In the example shown in Table 2, the second poster attempts to construct a theory-of-action that explains the phenomena observed by the first student. Such contributions were categorized as complicator role-behaviors as the student appeared to be attempting to articulate and externalize their own mental model of the problem-context, encouraging other students to add to the model in turn. In other cases, the debate might be developed through a question to clarify the point made by the first student (peer-knowledge-elicitation), or via a vicarious acknowledgement that agreed, disagreed, or otherwise drew the attention of others to an idea in another student's posting. A third or fourth poster would complicate the debate with a new example, or facilitate wider debate by introducing ideas from another student's posting.

Table 2. Example of a Sub-Thread Sequence			
The value chain model doesn't fit today's business model… The correct sequence should put marketing and sales in the first place. Manufacturing, storage, distribution should rely on customer orders. …	S4	All	Contributor
The value chain bugged me, too, when I first read it. On reading it again the light dawned. The text is only showing one version of the value chain, when in fact there are several. Which one is applicable to a business depends on their business model. … I am most familiar with engineer-to-order (ETO) which is is generally for very large, expensive, and one-of-a-kind items like ships, communications satellites, and power plants… ETO is characterized by long cycle times (surprise!) and many component parts are not procured until the design is nearly complete. For ETO I would definitely place "Design" as a primary value chain activity (rather than secondary as part R&D). "R&D" is TOTALLY separate from design - R&D involves discovery of new design techniques, design for a customer order uses already proven techniques. In any case I am not sure why they list "Procurement" as supporting and "Inbound logistics" (what I'd call "receiving") as primary. But in my ETO world parts are mainly purchased for a specific sale, so that is why I see it as part of the value chain.; Maybe the text covers this stuff later on, but I didn't see it so I thought I'd throw it out there.	S11	S4	Complicator
I just showed my value chain bias too - I only talked about models that create a product. I imagine there are a whole 'nother set of v-c's for companies that provide services in different ways.	S11	S4	Peer K. Elicitor
I think it is also difficult to understand the value chain because we are reading it from a static standpoint. Depending on what phase the product is in, i.e. is it new and the first batch is being processed, has it been around for a while. I would certainly like to see #4, Marketing & Sales to be first or second. If initial market studies were unfavorable and potential customers did not respond favorable to my product, I certainly would not want to invest heavily in the incoming materials. I think this is where we could begin to look at IS in assisting with our supply chain.	S12	S11	Complicator
I agree with S12. Product maturity is not so relevant in an ETO world because most end items are built only for one sale. But in a typical retail world I can see how there would be differences based on product maturity.; The text's value chain almost looks like it is for a brand new product …	S11	S12	Vicarious Acknowledger
I have to go the other way. To me, the text's value chain seems best suited for an established product. As others have observed, there is no initial step where the need for the product is determined. That seems to imply a known demand that is being met. … S11 made some great points about different delivery processes. I think this model could be used for all of those.	S13	S11	Facilitator
This is really great, S11! I have often struggled myself to define variations on the value-chain, but I came back to one or two: as an instructor I have to try to be "generic". But I am *more* than happy to have a discussion of business model variations on the value-chain, within your assignments(!)	Instr	S11	Peer-Acknowledger
I've been doing some thinking in this area. Education is different in many respects from manufacturing. … I got the sense that there is a kind of chicken/egg thing going on with the value-chain model. Without sales there is no need for inputs, but without manufacturing, etc. there is nothing to sell. Unless products are marketed, there is no sales. So it's circular.	S9	I	Closer

We examined the most sustained threads of debate, to determine patterns of interaction that maintained these threads. It was apparent that the most productive and hotly-debated threads (from a knowledge-construction perspective) consisted of large numbers of *Facilitator* and *Complicator* messages. In week one, a sub-thread dealing with the question "Does IT matter?" contained 20 messages with a thread-depth of 5. This sub-thread had a strong pattern of intertwined *Complicator* and *Facilitator* posts that sustained the debate. It appeared that students were internalizing knowledge from others, reflecting on this knowledge, then externalizing the results, generating new perspectives and maintaining an ongoing cycle of joint knowledge-construction. A similar sub-thread in week 2 contained 26 messages and was almost entirely sustained by *Facilitator* messages posted in response to other *Facilitator* messages -- a form of positive-feedback-loop.

Adoption of Various Levels of Learner Engagement

Patterns of Role-Behavior

Patterns of behavior changed over the period of the course, as shown in Figure 6. In some weeks there was substantially more complicator and facilitator behavior than in others. Some questions attracted substantially more quantity of and enthusiasm in debate than others.

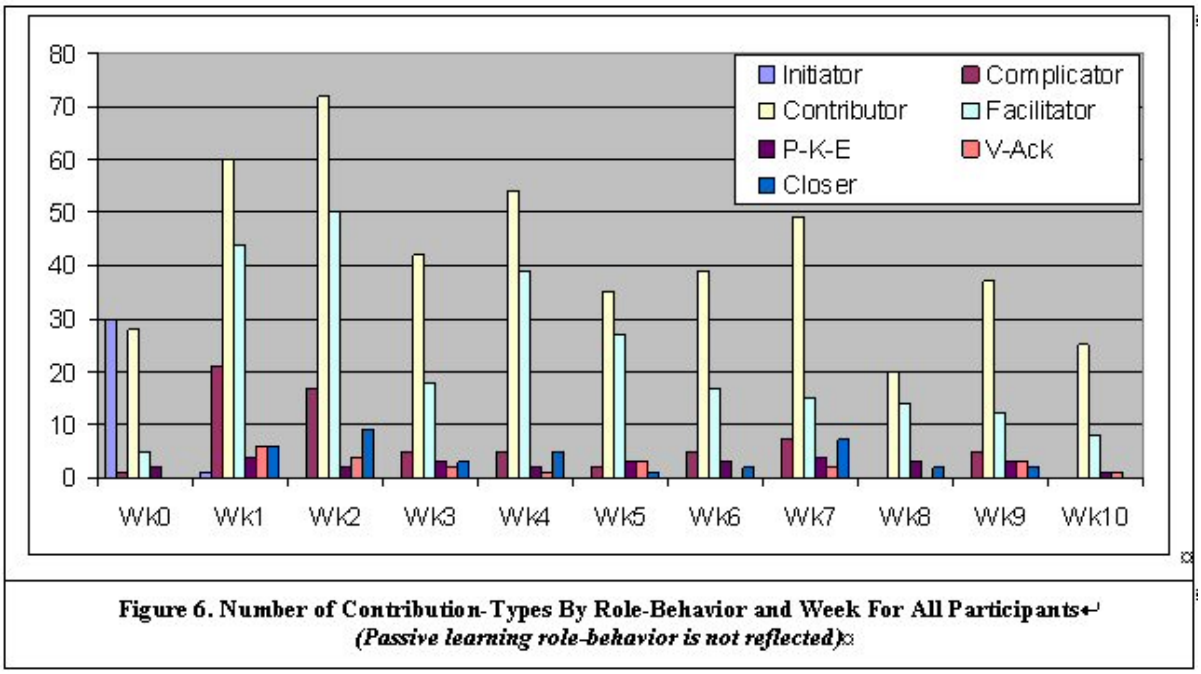

Figure 6. Number of Contribution-Types By Role-Behavior and Week For All Participants
(Passive learning role-behavior is not reflected)

To pursue reasons for differences in student role-behaviors over time, we plotted the social network of interactions between students, then analyzed the content of responses to assess why and how students responded to postings by other students. It appeared that the more constructive threads of debate were associated with three aspects of the problem set:

(i) students appeared to relate the problem directly to their individual experience or areas of expertise,

(ii) students perceived that the problem related to their professional development or personal-learning objectives,

(iii) the way in which a question was framed communicated a clear problem-structure, without too much complexity or ambiguity of purpose.

All three elements were required: open-ended questions only maintained cycles of debate when students related the problem strongly to elements (i) or (ii).

We present examples of responses to three questions to illustrate levels of learner engagement, explaining how elements (i) to (iii) were reflected in the problem-structure.

High Social Engagement Across Community of Inquiry

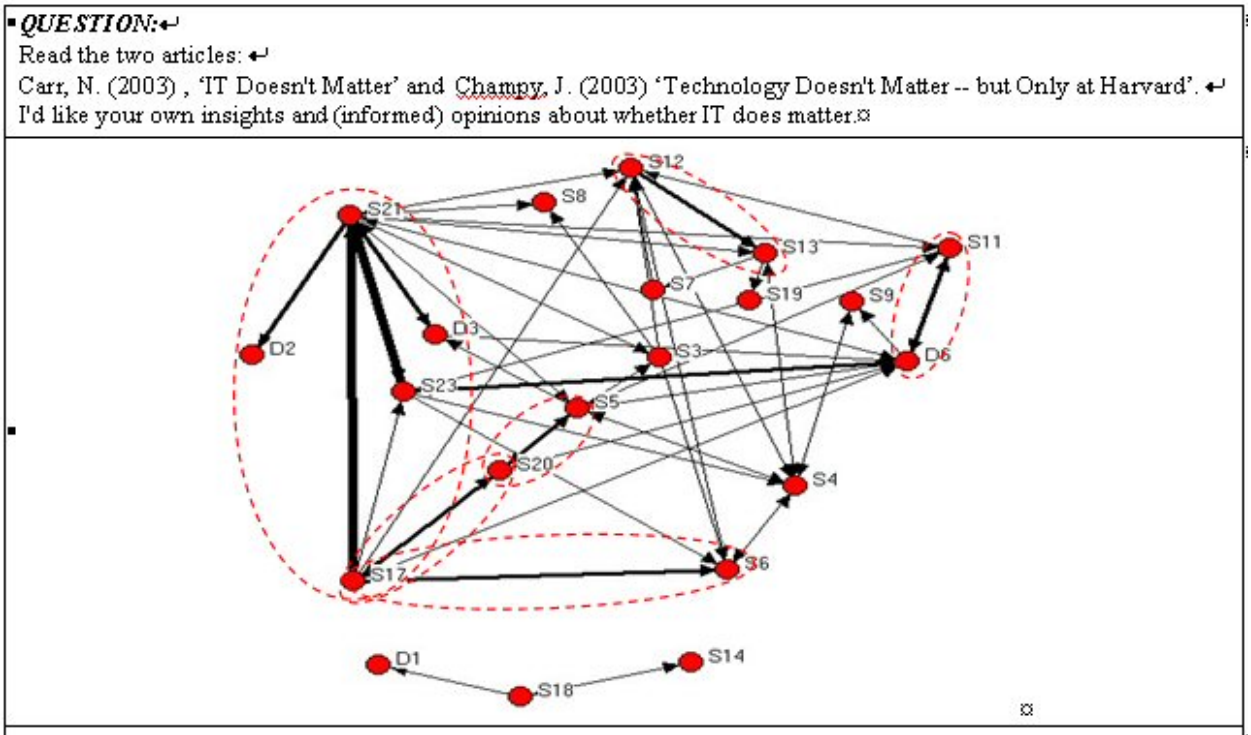

Figure 7. Social Network Generated In Response to "Does IT Matter?" Question

The social network shown in Figure 7 maps interchanges between participants in response to the question "Does IT matter?". Thick lines indicate extended interchanges between participants, with multiple messages passing between the same individuals. A pattern of repeated cycles of internalization and externalization is exhibited here. Learners are reading each others' posts, reflecting on them and responding to them; these responses themselves cause reflection and response.

Several things identify this question as potentially engaging. Firstly participants are asked to provide insights and opinions. There is a strong connection here between student existing expertise and the question topic, students are explicitly asked to draw upon this expertise as well as discuss the material in an abstract sense. The question draws on a critical evaluation of 2 academic papers. This is a question that is challenging but bounded.. Examining student responses it is clear that students became quite heated as this was seen as an issue that affected them fundamentally thus they identified strongly with the issues. Importantly we also note that there is a lot of interaction between students whom we earlier identified as playing strong facilitator and complicator role-behaviors (S21, S12, S17, S23, S13, S11, S5 and S6).

Learner Involvement But Little Social Engagement

QUESTION: What type of firms do you think will survive, and which will dominate the travel industry in years to come? Why? If you ran a travel agency, what would be your critical success factors for the future and how would you use IS to support these?

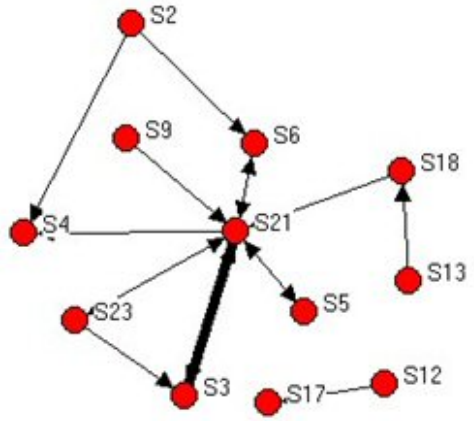

Figure 8. Social Network Generated In Response to Travel Industry Question

The social network of Figure 8 maps a pattern of involvement, with limited cycles of internalization and externalization. Participants read each others posts, reflected on them and posted responses that are explicitly directed at the originating individual. But there are no repeated cycles of internalization and externalization, with the exception of an interaction between S21 and S3. Most students are content to consider a post and craft one reply rather than engage in a critical discourse

This question generated moderate debate but not the kind of excitement that the previous question generated. This topic did not call directly on student expertise. Students did not have professional experience in the problem-context (the travel industry). So although they had experience of the problem-context, they could not call directly upon their professional expertise. There appeared to be a disconnect between the learning-goals of professional IS students and the question, which resulted in lower engagement by the core of students who frequently displayed complicator or facilitator role-behaviors (S21, S12, S17, S23, S13, S11, S5 and S6).

Participation But No Involvement or Social Engagement

QUESTION: How do we plan to use IS, taking into account business pressures, organizational responses and supporting critical response activities? What are the most critical things to consider, in planning for IS? What issues and elements have caused you problems, because you failed to anticipate them? When discussing this, think especially on the distinction that I made between IT systems and Information Systems in the lecture notes.

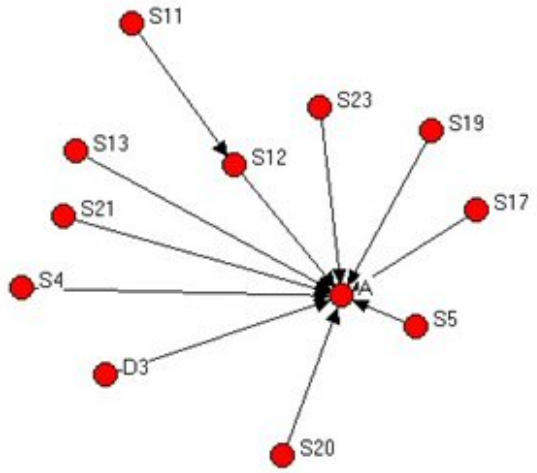

Figure 9. Social Network Generated In Response to Critical Issues of IS Planning Question

The social network of Figure 9 maps the lowest pattern of interaction found. The node at the center of the network [A, for all] indicates that participants have broadcast an answer to all students, without reference to other individuals' contributions. There is almost no interaction between participants (with the exception of S11 responding to S12, probably an attempt by S11 to maintain a social network across questions.) and no apparent pattern of internalization and externalization cycles. Many students made no postings.

This question appeared to be too complex to engage students. Respondents to this question typically addressed one or two sub parts with answers much shorter than for the previous two questions. Students did not engage with the question, as it was too abstract and lacked a problem-structure they could relate to their own experience. This contrasted with many other equally open-ended questions, but where the problem-structure was explicitly related to students' own learning or professional outcomes. For example, a question discussing outsourcing generated a huge degree of social engagement, as students related the problem-structure to their professional interests.

Discussion

Learner Engagement In Constructivist Learning

RQ1: What indications do we have of that a student is engaging in constructivist learning within a community of inquiry?

Interpreting our findings by reference to the degrees of Social Engagement that we defined above, we can identify qualitatively different levels of interaction that are summarized in Table 3.

Table 3. Learning Engagement Reflected By Community Role-Behavior

Level of Engagement	**Learner Role-Behaviors**
Participation	Passive-Learner Contributor Peer-Knowledge-Elicitor
Involvement	Vicarious-Acknowledger Closer
Social Engagement	Initiator Facilitator Complicator

At the participation level the *Contributor* and *Peer-Knowledge-Elicitor* demonstrate limited social engagement. Offering opinions or soliciting information, they are externalizing their ideas but not showing evidence of internalizing a community understanding.. A deeper level of involvement in the community is shown by acknowledging the contributions of others (*Vicarious-Acknowledger*) and synthesizing solutions (*Closer*) these participants clearly reflect on community knowledge, and it shapes their externalizations in a single cycle. At the deepest level the *Initiator* has an understanding of the need to create a community and actively creates this environment. In our sample the two key Initiators were students with extensive prior experience in online education courses and also with experience in negotiating virtual social relationships. The *Facilitator* encourages the flow of debate, consciously externalizing ideas that they have internalized from others' contributions to make these explicit for other students. Finally the *Complicator* takes on the risk of challenging assumptions and moving the discourse into possibly uncomfortable territory. It is notable that this role-behavior only becomes frequent after the community is relatively well established, indicating that trust among members is required for *Complicator* behavior to have the desired result of increasing the depth and diversity of learner perspectives. he great majority of student postings were categorized in the *Contributor* role-behavior. This is to be expected: as part of a student's grade depended on their contributions, they add their view to the debate without substantially changing the debate. This type of behavior incurs a lower cognitive cost than more synthetic discussions (Anderson, 1981). *Facilitator* was the second most frequent role-behavior adopted, which demonstrates that students saw participation in a community as a critical part of their online presence. It is also illustrates that many students felt intrinsically motivated to engage in debate and not defer the task of maintaining impetus to the instructor (Csikszentmihalyi, 1975).

Students appear to adapt their learning behaviors by choosing dynamic role-behaviors that permit them to engage with the community, as required by the nature of the problem they are given, the process by which they perceive effective help may be obtained, and their prior experience in online communities. Our findings support the notion that different learning behaviors demonstrate increasingly deep levels of interaction in the community that finds its highest expression in the social engagement behavior of students adopting *Initiator*, *Facilitator*, or *Complicator* role-behaviors. These individuals are key to the discussion of alternatives , negotiation of perspectives and clarification of meanings central to Stahl's social knowledge-building model (Stahl, 2006). Their development of community debate is key to the iterative cycles of externalization, translation and internalization shown in Figure 3. *Facilitator* and *Complicator* role-behaviors are critical for the translation process that relates a community understanding to professional expertise and domain-knowledge. We can view students who provide these translations as "thought leaders" in the community of inquiry.

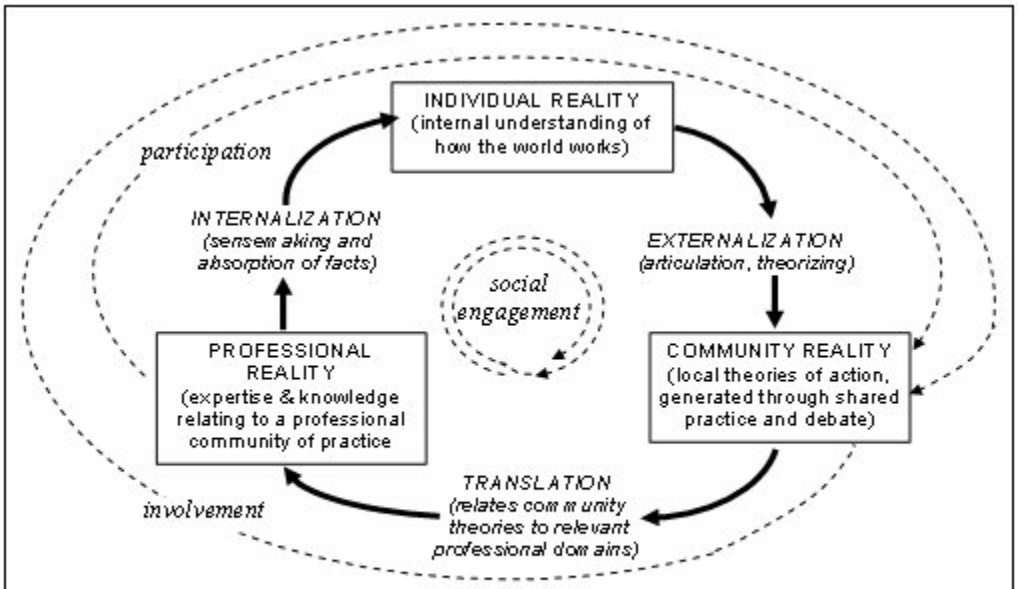

Figure 3. The Social Construction of Knowledge Related To Three Levels of Engagement With A Community of Inquiry

Implications for learning system design (HCI)

A learning system predicated on the importance of deeper levels of engagement needs to show affordances for such engagement. A system that simply rewards participation will not encourage knowledge building. Feedback techniques such as explicit rewards for important contributions will encourage deeper engagement. For instance a formal system of attributing kudos to key posts has been used by numerous discussion forums such as ExpertsXchange [2].

Characteristics of Interactive Processes of Inquiry

RQ2: What characteristics of an interactive process of inquiry may be observed through analysis of online debate among learners over time?

What have we learned about encouraging participation, involvement, or social engagement?

Patterns of community interaction seem to support the model of inquiry shown in Figure 3. The findings suggest that online discussions with respect to the ill-structured problems dealt with by students in this study generate the deepening cycles of critical reflection necessary for an effective knowledge building experience (Scardamalia and Bereiter, 1994). The *Complicator* role-behavior appears to more prevalent in later weeks. This role-behavior is important as it allows debate to be reframed, widened and refined (Waters and Gasson, 2005). Why is this so? It may be that over time participants feel confident enough to engage directly in debate with the faculty member as well as with their peers. Or it may be that trust has increased, as students become familiar with community-peers and are willing to take risks. Messages in later weeks are more likely to be responses to peer-messages than responses to the instructor, reflecting a move to greater positive interdependence between students. In later weeks, *Facilitator-Facilitator* messages decline. This may be attributed to a focus on instrumental learning at the expense of social-engagement as course-deadlines loom. The decline in *Facilitator-Facilitator* messages is accompanied by an increase in *Facilitator* responses to *Contributor* posts. The volume of posts does not decline significantly over time

[2] http://www.expertsxchange.com/

so participants are not contributing less overall. But the way in which patterns of interactions change over time is an important finding that warrants further study.

Identifying Thought-Leaders In The Community of Inquiry

Social engagement in debate seems to be driven by a small number of community thought-leaders. While the instructor is an obvious thought-leader, a number of students stood out in their interaction-behaviors. These students engaged in deeper levels of course engagement than other students, adopting *Facilitator* or *Complicator* role-behaviors that generated diverse sub-threads of discussion, and maintained enthusiasm and interest in a debate. Through their formulation and direction of debate-topics, they encouraged ongoing and explicit engagement by other students.

Five out of the eight students identified as key thought-leaders (S6, S11, S13, S17 and S21) showed a consistent pattern of *Facilitation* role-behavior as early as week 2 of the course, maintaining this pattern over the ten-week period of the course. The other three students identified as thought-leaders showed a less consistent pattern of behavior. Only one student (S5) showed a consistent pattern of *Complicator* behavior over the ten-week period. So it seems that we can identify some key players early, but not entirely. This warrants further investigation.

Implications for learning system design (HCI)

The identification of thought-leaders may be critical in maintaining cycles of social engagement. We consider that providing gentle approbation and feedback from the instructor will ensure that thought-leaders continue to play an important role. This means that learning environments must display discussion postings in a format that would permit early identification of key community members.

Adoption of Various Levels of Learner Engagement

RQ3: What drives the adoption of various levels of learner engagement within an online learning community?

How does course or question design affect willingness to engage in deeper forms of engagement?

Our examination of persistent threads of debate exposed the mechanism underlying the cycles of social knowledge construction and engagement shown in Figure 3. There was a strong pattern of intertwined *Complicator-Facilitator* or *Facilitator-Facilitator* interactions in the most constructive threads. We could identify a clear process of engagement where community-members were internalizing, reflecting and externalizing, generating new perspectives and maintaining critical inquiry in a further cycle of joint knowledge-construction. We categorized these cycles as positive-feedback-loops, noticing that the thought-leaders identified above appeared to be consciously engaging in joint-knowledge construction, identifying equally-engaged thought-leaders with whom to debate issues, to build a social network of like-minded individuals who would engage in *collective* critical inquiry. This finding provides a mechanism that supports the argument that distributed learning networks are sustained through social networks (Haythornthwaite, 2002).

The depth of social engagement with critical inquiry appeared to be associated with three aspects of problem-framing: (i) students appeared to relate the problem directly to their individual experience or areas of expertise, (ii) students perceived that the problem related to their professional development or personal-learning objectives, (iii) the way in which a question was framed communicated a clear problem-structure. Open-ended questions only maintained cycles of debate when students related the problem strongly to elements (i) or (ii). It seems that a question must be challenging, but bounded, and avoid over complex question construction. A successful question was related to two elements. The first element is relevant experience in the knowledge domain required by the problem (similar contexts). The second element is students' professional career interests or course learning objectives. If course challenges are related to students' learning goals, the core thought-leaders are more likely to sustain the cycles of internalization/externalization and other students are more likely to engage in debate.

What happens if students do not participate in debate?

We found a significant relationship between reading discussion board posts and course grade; this would appear to give support to the vicarious learner theory (Mayes, 1995; McKendree et al., 1998). Students construct knowledge from reflecting on other students contributions: vicarious-learning, or "lurking" may be a critical part of educational participation (Jonassen et al., 1993; Nonnecke and Preece, 2001). Previously, students not actively contributing were considered high-risk in terms of learning . It would appear that low contributors may also engage, but in a less social way. We conclude that most students employ a type of "engaged-lurker" behavior, where they read and reflect on others' contributions, before committing themselves to articulation of their own perspective.

Implications for learning system design (HCI)

There are two major implications for online course design. Firstly, while this is an exploratory study, our findings indicate strongly that student debate in a community of inquiry that is directed towards professionally-oriented education (as opposed to well-structured problem-solving found in lower-level courses) results in distributed rather than shared understandings. This indicates that assessing the construction of shared artifacts or problem-solutions indicated by Stahl's (2006) model is unlikely to be successful. Rather, course and learning-environment design must be directed to encouraging thought-leaders in their complication and facilitation of debate, or providing mechanisms for the instructor to engage in these behaviors. We have demonstrated that learning does not take place in the community, rather in takes place in the space between the individual and the community, as suggested by Cobb (1994) and developed in Figure 3. **This model of learning emphasizes the design of learning-environments that provide space for students to submit and evaluate partial and intermediate solutions to course problems as a community, rather than the current focus on submission of complete solutions.**

Secondly, the importance of vicarious learning cannot be downplayed. Students fail to participate in debate for all sorts of reasons: work-commitments, pressure of course-workload, shyness, or a failure to associate course problems with their own expertise. Our findings indicate the centrality of vicarious learning for participants as well as non-participants in community debate. Iterative cycles of social engagement require this "invisible" learning, as students internalize theories-of-action proposed by others. Effective learning environments must make the work of all students in the community accessible to other students, for vicarious learning to take place.

Conclusions

We have presented an exploratory study to fill three lacunae in theories of how communities of inquiry function. The main contribution of this paper is to suggest a conceptual framework that defines different levels of social engagement (Table 1) and to develop a process model of social-construction in a community of inquiry (Figure 3). We have derived a categorization schema for dynamic community role-behaviors, by which individual interactions with the community may be understood. We have explored the mechanisms of social engagement with an online community of inquiry, viewing this as a progression from participation, through involvement, to active engagement with the social nature of learning. Our findings present an in-depth view of dynamic cycles of social engagement in an online community of inquiry -- as distinct from a group of students collectively using an online learning environment for individual inquiry.

Our findings refute static and passive theories of learner behavior, instead supporting a dynamic and adaptive set of learning-behaviors that are related to situational, instrumental, and social aspects of course design. The findings appear to suggest that as social-relationships deepen over time students become more willing to take risks and to engage in more cognitively challenging discourse. Our findings suggest that deeper levels of engagement are demonstrated by qualitatively different behaviors. It appears that the success of the social network may depend upon a small number of "thought-leaders", whose engagement needs to be encouraged. We have exposed the centrality of vicarious learning, by participants as well as non-participants in community debate. This enriches our understanding of how "invisible" learning forms the basis for cycles of social engagement in a community of inquiry. We propose that the design of online courses and environments should focus on the early identification of student thought-leaders in specific areas of knowledge and should encourage student interactions in debate with these individuals. This requires changing course assessment systems to reward the reuse of appropriate community knowledge.

These findings raise many issues that challenge current assumptions of online communities of inquiry and individual learning behaviors in online course environments. Our study suggests that existing models of socially-situated

inquiry may not be appropriate to guide the design of online learning environments and so technically-focused designs based on these models may be ineffective. These concepts of social engagement will be investigated further, across multiple courses and different types of problem-solving, to explore generalizable patterns of engagement in a community of inquiry. The vicarious learner role-behavior also requires further exploration, so that we can determine how to engage learners who choose not to participate actively as community members. These are topics for future studies.

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