# Distributed Knowledge Construction In An Online Community Of Inquiry[1]

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## Abstract

*This paper examines sustained, socially-situated engagement in online learning communities. We propose three levels of engagement that are examined through an empirical study of joint knowledge construction in an online community of inquiry. We find that the social, informational, and/or pedagogical content of peer-interaction is related to specific types of problem-structure and its relationship to learner experience. We discuss online course design indicators, based on the social engagement construct.*

## 1. Introduction

Online education has experienced a rapid growth in the University sector. Champions of electronic remote delivery in education point to efficiency gains, flexibility for consumers and the potential for more effective learning [6; 19]. Other commentators are less convinced by these arguments, pointing to the anecdotal nature of many positive outcomes [9] and the lack of satisfaction with the process experienced by many learners [11]. While not entirely discredited, a model that views learning as the passive transmission of knowledge from experts to novices is considered didactive and inadequate [12]. Learning is now viewed as an active process of social-construction, that is situated within the cultural norms of a specific community of practice [8]. Deep learning requires sustained social engagement: ongoing, psychological commitment to community knowledge-building. We cannot simply translocate traditional teaching to a remote electronically-mediated arena, but need to provide online environments in which reflective, interactive, and participative learning is possible [5; 12]. If we are to design useful learning environments and experiences, we need to know how learning proceeds in an online community and understand how to prepare students to *engage* with the unstructured and unbounded problems that they will encounter in professional work [8; 13]. This paper explores how sustained social engagement takes place in an online community of inquiry and how this is affected by the distributed nature of domain-specific knowledge.

## 2. Conceptual Background

In the literature on user-participation in systems development, Barki and Hartwick [1] observe that *participation* in a process, typically assessed by the degree to which individuals perform specific activities, should be contrasted with *involvement* in the process. Involvement requires a psychological state of identification with some object or goal, to the extent that it is perceived as both important and personally relevant [1]. Kappelman and McLean [7] develop this construct with a behavioral-attitudinal model of IS success in which both user participation and involvement in the development process are required for a successful system to result. We extend these constructs to online learning in the model shown in Figure 1 and elaborated in Table 1. We propose a third level of engagement, *social engagement,* required for processes that involve joint knowledge-construction to be successful, such as group systems development or online learning. Each of these constructs builds on the preceding one, as shown in Figure 1. Learner involvement requires participation, while social engagement requires involvement in learning. Social engagement leads to various forms of community knowledge-building, which in turn leads to the deep learning outcomes explored in this study.

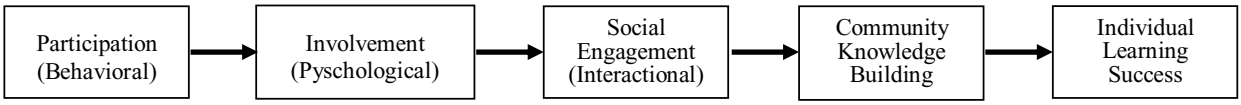


**Figure 1: A Behavioral-Attitudinal-Social Model of Online Learning Success**

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**Table 1: Levels of Engagement With Learning**

| *Level* | Form of Activity | Predicted Outcomes |
|---|---|---|
| *Participation* | Observable behavior that denotes interaction with course materials through passive activity. | Superficial learning, resulting from the acquisition of terminology and content/domain definitions of knowledge (Externalization). |
| *Involvement* | Behavior that indicates a psychological state of identification with course objects. | Contextually-situated learning, that results from the active construction of knowledge within the learning community. (Internalization). |
| *Social Engagement* | Behavior indicating commitment to the facilitation and direction of sustained learning. | Deep learning, that results from the active co-construction of knowledge with peer learners. (Cycles of internalization & externalization). |

## 2.1. Learner participation in the community

In the literature on communities of inquiry, a core model is proposed by Garrison et al. [4], who suggest three "presences" required for effective learning to take place. Cognitive presence represents the extent to which learners are able to construct meaning through communication with others. Teaching presence is indicated by the degree to which instructors provide structure and process in computer-mediated learning. Social presence results from the ability of learners to project their identity and personal characteristics into the community of inquiry [4]. A weakness of this model is that student behaviors are analyzed in courses that present relatively structured problems. In professional work, people deal with open-ended, unstructured problems that are best resolved through joint knowledge-building processes between members of the local community of practice [2; 8; 13]. When the cognitive load of course involvement is too great because multiple elements of a problem need to be assimilated simultaneously, students revert to token participation [18]. The analysis of structured problems may falsely assume a shared understanding because the problem-structure is relatively familiar to students and so they rapidly reach a consensus. This weakness locates the practical inquiry model [4] as an instructor-led model of community interaction, with learner *participation* (as defined in Table 1) appearing to constitute the dominant mode of behavior. The behaviors assessed through the three modes of community presence are largely individual rather than interactional behaviors. To prepare students for professional practice, we need online environments and processes that foster transformational thought:

> *"the best way to do this is to replace classroom-bred discourse patterns with those having more immediate and natural extensions to the real world, patterns whereby ideas are conceived, responded to, reframed, and set in historical context." [12, p. 265]*

In less structured problem-solving environments, students appear to be more actively involved in joint knowledge-construction [5; 12; 14]. Modes of student engagement are related to problem structure.

**Research question 1.** How do various types of problem drive different forms of participation in knowledge construction across online community participants?

## 2.2. Learner involvement in the community

Learner involvement with a community of inquiry requires behavior that achieves a psychological state of identification with course objects. This may be indicated by engagement with debate, negotiation, or disagreements that result in the joint construction of accepted knowledge [2; 3; 8]. Learner involvement may be distinguished from participation in that students recognize, value, and reuse the contributions of their peer-learners. The result is a distributed community of knowledge, providing an ongoing resource for all its members to call upon. This requires the design of information system environments that allow community members to build a "transactive memory" of who-knows-what [10]. In face-to-face environments, knowledge-sharing is achieved through personal interactions. In an online learning environment, we need to establish a community within a short space of time, permit students to form strong social bonds, and allow them to develop knowledge-resources to support a transactive memory [5; 10; 12]. We need to understand how individual and shared perspectives build into a knowledge resource for the community and how learners use this resource:

**Research question 2.** What sequences or patterns of interaction between learners indicate learner involvement with a community of inquiry?

## 2.3. Social engagement with the community

Social engagement is necessary for the deep learning that enables students to acquire professional expertise. Expertise is not acquired through the acquisition of domain-knowledge alone, but requires an understanding of how to apply domain-knowledge

within the conventions and accepted work-practices of a professional community of practice [8]. Sustained interactions with a community result in "perspective-taking", where the individual internalizes the method and rationale of community practices, thus acquiring expertise. The individual applies this understanding to new problems, developing new understandings that are in turn externalized back into the community through processes of "perspective making", debate that develops a new community view of expert practice [2]. Deep learning results from repeated cycles of internalization and externalization that develop the understanding of both the individual and the community in tandem [2; 15]. Sustained learning involves distributed cognition, where knowledge is "stretched across" rather than shared between community members [8; 16]. Individuals only possess a partial understanding of the problem, so group problem-solving is akin to assembling a jigsaw puzzle. Each person must contribute their part of the picture without being able to comprehend the whole, which is gradually constructed through sustained debate. In this way, a community of inquiry builds a joint, yet distributed understanding of their domain of practice [2; 8; 13]. Social engagement in joint knowledge construction appears to rely on serendipity. A diverse and often unpredictable set of peer-learners guides community knowledge-building according to individual areas of expertise. This engenders high levels of ambiguity and the potential for conflicts and disagreement [12]. We have little understanding of how to encourage such exchanges of knowledge.

**Research question 3.** What learner behaviors are required for social engagement in a community of inquiry and how do we encourage such behaviors?

## 3. Research site and method

We examined community interactions in an online, asynchronous, graduate Management of Information Systems course at a North American University. Most students had prior industry experience: the majority were employed in IS. We analyzed 997 messages posted to the course discussion board by 28 students over the 10-week course period. Each week, 3-4 questions were posted for discussion. Topics ranged from the conceptual (e.g. "What role does IT play in organizational success") to the practical ("Is there any such thing as a turnkey system?"). Students were required to post messages to the discussion board, but community interactions were not graded explicitly. The Blackboard learning-environment captured statistics such as how many students viewed messages or visited the discussion board. We analyzed the data using a grounded, qualitative analysis of posting and interaction behaviors [17]. First we categorized individual role-behaviors using the schema of Table 2, which employs eight forms of interactive role-behavior derived from an earlier study of online learning [20]. Then we analyzed interactive "threads", sequences of message-posting and response, to understand community engagement patterns. Finally, we analyzed the social networks indicated by student interactions via the course discussion board.

**Table 2: Role-Behaviors in a Community of Inquiry**

| Role | Analogy | Behavior |
|---|---|---|
| Initiator | Spider | Initiates debate |
| Facilitator | Middleman | Enables debate |
| Contributor | Journeyman | Adds insights |
| Peer knowledge-elicitor | Seeker | Requests insights or knowledge from others |
| Vicarious-knowledge acknowledger | Me-too | Draws attention to and acknowledges contributions of others |
| Complicator | Reframer | Draws attention to inconsistencies or presents new evidence |
| Closer | Synthesizer | Summarizes models or results of debate |
| Passive-Learner | Freeloader | Makes few or no contributions. |

## 4. Findings

### 4.1. Problem Structure and Domains

***Research question 1.*** **How do various types of problem drive different forms of participation in knowledge construction across online community participants?**

We examined how question formulation and content affected joint knowledge construction. We arrived at a distinction between good questions, where students posted a great many responses and actively responded to the posts of others, versus bad questions, where only a few students posted responses and there was little interaction or debate across the class.

Figure 2 provides a summary of the number of messages, the number of student threads generated, and the messages posted to each thread, by week and question (three questions were posted by the instructor each week, Q4 was an FAQ for assignment and course issues, when required). We analyzed questions and responses semantically, to determine why students responded to some questions more enthusiastically and with more debate than others. Some examples are presented here, to explain what makes a good or a bad

question for the purposes of eliciting community knowledge-construction. The three most responded-to and interactive questions are compared to the least responded-to and interactive questions in Table 3.

**Table 3: Best Three Vs. Worst Three Questions, In Terms of Interactive Knowledge Construction**

| Posts | No. of Posters | Week/ Order | No. of Threads | Question Topic |
|---|---|---|---|---|
| 108 | 21 | 1/1 | 13 | Discuss Carr's article, "IT Doesn't Matter". |
| 83 | 21 | 2/1 | 11 | Discuss globalization and global competition trends. |
| 47 | 20 | 4/1 | 7 | Discuss Drucker's "The Next Info. Revolution" |
| | | | | |
| 11 | 11 | 1/2 | 1 | Discuss critical things to consider in planning IS. |
| 11 | 11 | 6/1 | | Discuss tech. problems of integrating info svcs & IT. |
| 13 | 12 | 6/1 | | Difference between info. service mgt. & data mgt. |

### 4.1.1. Elements of a "Good" Question

A question appeared to have the best chance of generating a high and interactive response if it was the first question in the order for that week. Earlier weeks were more interactive (and constructive generally) than later weeks in the course, when students appeared more focused on completing course assignments. The formulation and relevance of the question to students' understanding and experience were also important.

***Question 1 Week 1*****:** *Read the two articles outlined in the syllabus, Carr, N., 'IT Doesn't Matter'; and Champy, J. 'Technology Doesn't Matter'.*

This appeared to be the most thought-provoking question of the course. This presented an open question that informed students with readings before they answered and also permitted them to call upon their personal experience with IT in organizations – an area with which they were all familiar. It was also the first question that students were asked to respond to, in this course. Many students took a sideways approach and critiqued the papers rather than answering the question directly. But there was a great deal of debate among students, with multiple examples from individuals' work experience and responses comments such as:

> *Good point. I tried to say something similar in a previous response. Some companies such as SAP, PeopleSoft, etc. seem to be creating IS applications that could become commodities because many companies do the same type of general operations, BUT you made my point in that there is a large amount of customization of these applications to a specific companies processes. These applications could not become commodities because of this.*

There were also a great many variations on

> *IT had *better* matter. That's how most of us make our living!*

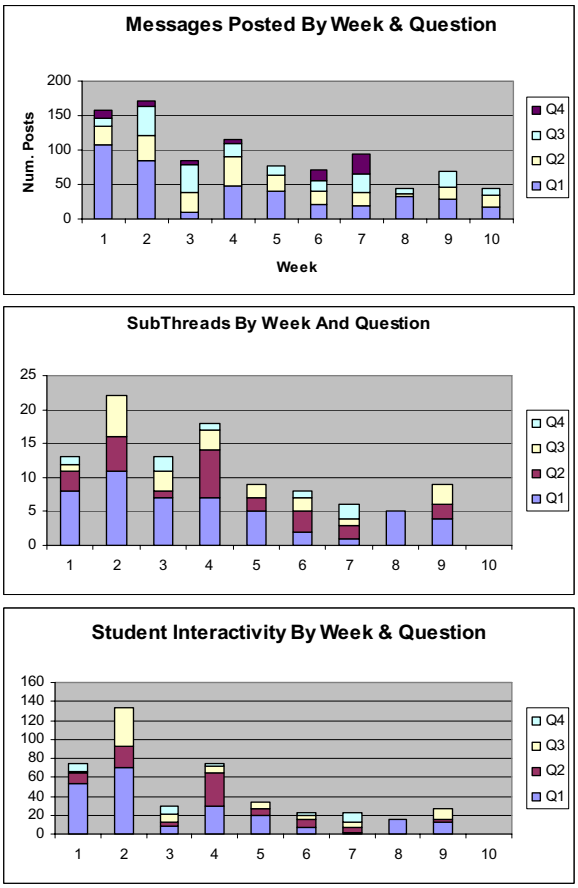



**Figure 2: Discussion Posts By Week & Question**

***Question 1, Week 2:*** *How are trends such as globalization, increased competition and improved information availability affecting how we compete and how can IS help?*

This question provoked the second most enthusiastic response. It contained four elements that students could discuss or combine: globalization, increased competition, improved information availability, other IS trends. As for the first question, it appeared that students were able to make use of their own experiences in answering the question, as they were all familiar with the impacts of such trends. Of particular interest was the extent to which students related this to their career prospects (as they did in question 1). The topic of offshore-outsourcing formed a significant thread for this question, generating 26 messages that involved over half the class in debate.

***Question 1, Week 4*****:** *I have set two readings by Peter Drucker: "The Next Information Revolution" and "Beyond The Information Revolution". What do you think are the main points that Peter Drucker is making and do you think he is right?*

Like the most popular question, this question referenced two thought-provoking articles. Students could draw on their own experience, or discuss the content of the articles (or both). The topic was open but also directed, in that Drucker argues for a specific interpretation of historic events that relate to changing demand for expertise. Students related this question to questions set in weeks 1 and 2 to debate the future of their profession – a topic of intense interest to them. This generated popular threads, such as a comparison between 15th century printing families and the Recording Industry Association of America's attempt to stop their business models being undermined by digital music technology. Students were able to call on personal experiences to generate deep insights:

> *I have a distinct memory of someone that I was working with at Y Corp. lamenting that the coming of the world wide web would commercialize the whole thing and ruin it. That was in 1993. … although I somewhat agree, I think that so many useful tools have also come about that the commercialization is just part of the bad with the good -- like Google, it's great! … I think Google's mantra, "know your customer" will indeed help them to survive.*

#### 4.1.2. Elements of a "Bad" Question

A question appeared to generate a low and non-interactive set of responses if it followed a highly-interactive question, if it was cognitively complex (containing multiple parts that needed to be considered in turn), or if students possessed little personal experience to which to relate the question and so had to deal with the topic in abstract. Questions in later weeks were also less interactive and constructive than earlier weeks, indicating a decline in engagement as the assignment workload (and fatigue) increased.

***Question 3, Week 1:*** *How should 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?*

This appeared too big and complicated for a second question especially as students had just discussed the epic "Does IT matter?" question" which seemed to have exhausted them. In attempting to elucidate and guide the students in their discussion of this question, the instructor also appeared to close off discussion of topics that might have interested students. Only the more experienced students on the course (in terms of expertise and length of IT work-experience) attempted to post a response to this question.

***Question 4, Week 6:*** *What are the technical problems of integrating information services and IT systems and can a corporate information or data portal solve some of these problems?*

This question followed three related, technology-focused questions and presented the highest cognitive load as it required students to relate an abstract course concept to practical IT management. This type of question may have been difficult for those who were not familiar with data portals. The main posters appeared to be those with most IT work-experience.

> *The greatest technical difficulty in integrating IS and IT is incompatible file structures. … Using a web based portal can provide a user on a Wintel system to access data on a UNIX system. However, this doesn't solve the problem of how to archive or store data for the long term. … We will probably rely on some sort of a solution that utilizes a mix of XML tags for searching, and PDF for long term data archive.*

Follow-up postings were largely didactive, possibly to cover the insecurity of those with less experience. There was no debate between students.

***Question 3, Week 6***: *What is the difference between managing information services and managing data?*

A question concerned with differences between data and information could have been expected to generate a good response. If there had been fewer questions (3), or if this one had appeared first in the order, it might have done so. But students seemed to interpret this in a narrow way. There were a couple of rich responses, posted by managers with responsibility for managing cross-functional systems, for example:

> *I used to work at one of the largest health insurers in the nation. … The structure generally goes like this - OLTP (transactional, line of business) systems feed data to data warehouses and/or data marts. There are multiple warehouses and a gazillion marts. Many of those warehouses/marts deal with healthcare provider data (e.g. billing address for a doctor). Suffice it to say that quality industry-wide is typically pretty poor. One doctor may have three or four different ID's in a claims payment system. That physician could theoretically submit the same claim four times (and get paid four times!) using each identifier. One would think that a national registry uniquely identifying all providers in the country*

*would solve this problem. Unfortunately, this type of system doesn't exist. Data by itself isn't useful.*

The rest of the class appeared to decide that they had no relevant experience to add and adopted the mantra that "managing data is part of managing information". Unusually for this group, there was no discussion between class members on this question. Other posts were unusually didactive or abstract with no examples.

### 4.2. Community Patterns of Interaction

***Research question 2.*** **What sequences or patterns of interaction between learners indicate learner involvement with a community of inquiry?**

We categorized students' messages in threads of discussion as belonging to one of the eight behavioral types categorized in Table 2. We then classified thread-messages on a second dimension, that examined whether they were displaying behaviors that could be said to indicate course participation, involvement, or engagement (as defined in Table 1). From this analysis, we obtained a profile of each student's behavior, for each week of the course.

Some students exchanged social messages from the outset, revealing personal details and constructing a strong social network from week 1 by constantly interacting with others. Sample comments were "How interesting that you work for X/come from Y. I had a cousin/friend/job there …". Prolific interactors attempted to create connections even when there was little common ground. Less experienced students posted less personal messages and responded to messages directed to them briefly if at all. Their behavior appeared to be more directed towards interactions with the instructor and formal course materials. They responded to messages but did not initiate social contacts. We detected at least two "productive" thread exchanges (having >= 5 interaction messages) for each week's topic. In the more productive debates, community members appeared to construct a "knowledge map" by debating a stream of related ideas through repeated interactions. Threads without a complicator message tended to peter out rapidly (in 2-4 messages between 2-3 students). Those with a complicator message lasted between 5 and 20 messages, with an average of 8 posts and 6 contributors per thread. The behavior of frequent posters of facilitator, peer-acknowledgement and complicator messages appeared productive in terms of popularity, shown in Figure 3.

The most frequently-read messages were posted by community members who frequently interacted through the more socially-oriented role-behaviors, either in peer exchanges, or in community-broadcast

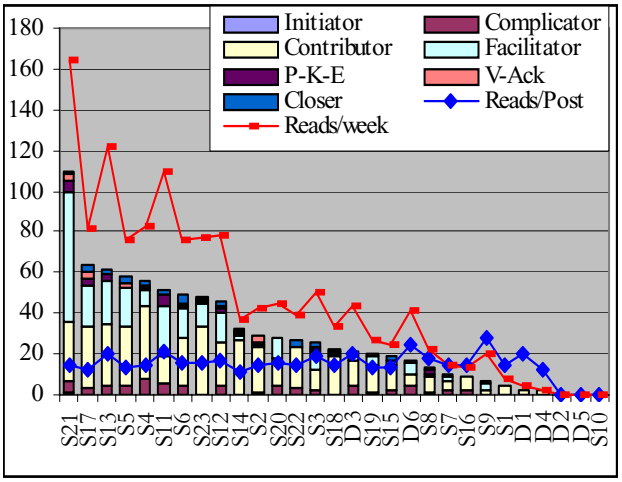



**Figure 3: Popularity of students by role-behaviors**

messages that highlighted another's ideas. These students appeared to possess most experience in professional work and in prior online courses (inferred from personal information revealed by posters).Volume of postings also contributed to popularity. Students who posted more messages tended to have more reads per week. Students who posted fewer messages tended to have more reads per post, as shown in Figure 2. This indicates that the community members generally sought out a variety of opinions in constructing their "internal-reality knowledge". A typical sequence of discussion-thread interactions is shown in Table 3. These message extracts 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 in turn developing the other student's argument, which encouraged further debate.

The turning-point that generated interactive debate leading to community knowledge construction was generally provided by the second or third contributor to a thread, who *complicated* the debate. In the example above, the second poster attempts to construct a theory-of-action that explains the phenomena observed by the first student. This student attempts to articulate and externalize a new model of the problem, encouraging other students to add to the model in turn and *complicating* the debate. The debate might then be developed through a question to clarify an earlier point (peer-knowledge-elicitation), or by a vicarious acknowledgement that agreed, disagreed, or otherwise drew the attention of others to another student's ideas. A third or fourth poster would complicate debate with a new example, or facilitate wider debate by questioning the model.

**Table 3: Example of a Message-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 generally for very large, expensive, and one-of-a-kind items like ships, communications satellites, and power plants… For ETO I would definitely place "Design" as a primary value chain activity (rather than secondary as part R&D) …. R&D involves discovery of new design techniques, design for a customer order uses already proven techniques. | 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-Know. 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 |
| 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 | All | Closer |

### 4.3. Encouraging Social Engagement

***Research question 3.*** **What learner behaviors are required for social engagement in a community of inquiry and how do we encourage such behaviors?**

We analyzed social networks of joint-knowledge construction for each week (a sample is presented in Table 4). We examined threads of debate, identifying pairs of knowledge-exchangers, to derive sequences of "from-to" dyads for each question (the poster and an identified recipient or a peer-learner whose ideas were acknowledged). The number of interactions between two individuals provides a "strength" of relationship, indicated by line-thickness in the sociograms below. The degree of social engagement across course-members is indicated by the size of the network core.

**So What?** A good question has a large core of learner interactions, with strong social ties. This indicates that a majority of course-members are engaging in cycles of knowledge construction through repeated interactions. A poor question has a weak core, with many isolated students and few interactions. This indicates that the question is too complex or abstract, presents a high cognitive load, is poorly related to students' experience, or poorly-related to the vicarious experience available from course materials. Even the most prolific social engagers fail to engage with these questions.

**Table 4: Question structure related to degree of social engagement in community knowledge-building**

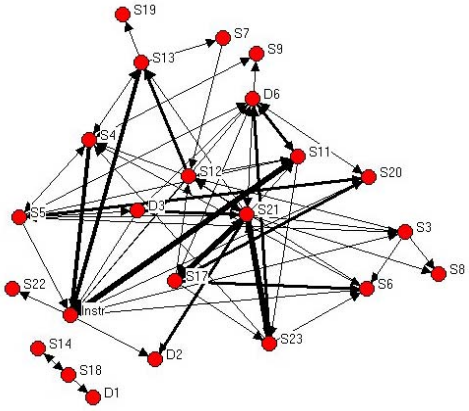
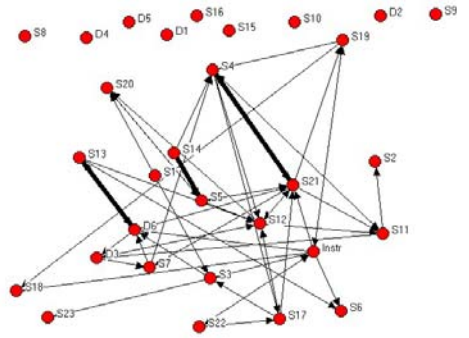
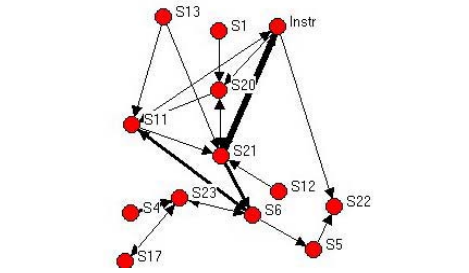
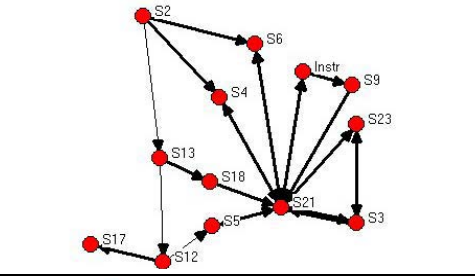
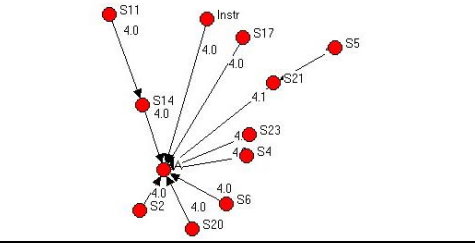
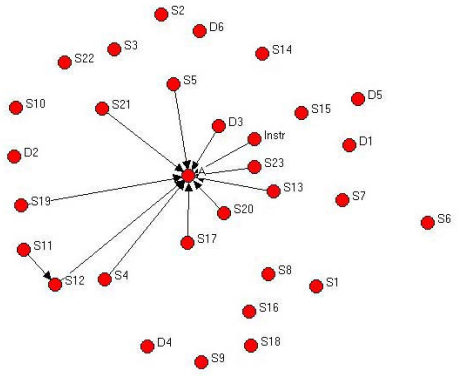
| | |
|---|---|
|  | **Good Question #1.** *Week 1 – Does IT matter?*<br>***What is happening here?*** 18 of the 23 students are involved in mutual message sending in that they are either responding directly to another members post or creating a post that stimulates a direct response. At the center of this network there is a core of active posters S21, S11,S17, S23, S6 ,D6,S12, S5, S13 and S20. Of these S21, S17, S23 and S11 are the most active. This is a fairly democratic network: several individuals are responding to several others on the same question and there is no clique behavior, as there is in later weeks. |
|  | **Good question #2.** *Week 4 – Discuss Peter Drucker article, "The Next Information Revolution".*<br>***What is happening here?*** Overall involvement is lower than the week 1 question, with many members content to simply post broadcast posts. However there is an active network of members at the center: S12, S4, S5, S21, S11, S17, D6, S20 , S19 and S13. These are mutual responders who keep a momentum going by encouraging each others posts. We can see cliques beginning to form, such as the strong ties between S14 and S5 And S4 and S21 (indicated by line thickness). |
|  | **Average Question #1.** *Week. 3, Travel Industry Case*<br>***What is happening here?*** This is a typical question with 30 messages (mean) and with the thread occupying 35% of the posts for that week – i.e. the thread has a number of messages proportional to the total messages for that week (there were three questions). Here we can see a small but fairly compact network with S21 at the center but with other key members such as S11, S20 and S23 making their typical contributions. Already by week 3 the number of mutual posters has fallen to a small core. |
|  | **Average Question #2.** *Week 4 – How do we manage the chicken and egg situation between changing business processes vs. changing IS use?*<br>***What is happening here?*** This pattern is similar to the pattern for the week 3 Travel Industry case, although inter-member ties are stronger. S21 is at the center as before. S11 does not play an important part, but S12, S17 and S23 conduct several mutual post-interactions. The core size is the same for week 3 and 4 questions even though members at the core are slightly different. |
|  | **Bad Question #1.** *Week 6 – Technical problems of integrating information services and IT.*<br>***What is happening here?*** Very few members post at all and most messages are broadcasts – some clique activity but even this is not as strong as normal. Less than 50% of members make any kind of a post. |

**Table 4 *(contd.)*: Question structure related to social engagement in community knowledge-building**

| | |
|---|---|
|  | **Bad question #2.** *Wk 1 – How should we plan to use IS, taking into account business pressures, organizational responses and critical response?*<br>***What is happening here?*** In this sociogram we can see that all but one of the messages (S11 – S12) are broadcasts (messages sent to all members). Even members who are normally community-minded (such as S21, S13, S11, and S17) are content to make only minimal "contractual obligation" postings. |

## 5. Discussion of findings

### 5.1 Learner participation in community

We see the need for two conditions for learner participation in a community of inquiry. The first is that the course reward system must provide incentives for different forms of participation. In this case, observable participation was rewarded with a grade percentage, but enthusiastic and frequent participation was also made an explicit part of the reward system by specifying that the quality of contributions would be assessed. The second condition for participation appears to be that students can relate course questions and topics to their prior experience or existing knowledge. When the cognitive load of responding exceeds the perceived reward (i.e. when the number of points lost is not seen as worthwhile for the additional research effort required to extend the individual's internalized knowledge schema), students will fail to participate or will participate in a token manner. This extends cognitive load theory to online learning [18].

### 5.2 Learner involvement in community

For learners to become involved with the community of inquiry, a course needs to provide the conditions required for students to identify psychologically with course objects and goals [1]. Individuals must be able to engage with the joint construction of communal models to guide problem resolution. It appears that a key condition for this is that someone complicates the community model early in a debate, providing a turning-point that causes the group model to evolve [2]. The mechanisms observed here are deeper than simple complication. In effect the taken-for-granted model adopted by community members needs to be exposed as inadequate, requiring students to engage with collectively framing a new model. This requires topics and questions to be set that call upon the known expertise of at least some of the community members, so they may adopt a complicator role-behavior. If a learner does not adopt this role, the instructor must, triggering a breakdown of assumptional knowledge by suggesting inconsistencies and inadequacies of the taken-for-granted model.

### 5.3 Social engagement with community

Social engagement has been demonstrated through an analysis of the detailed learner interactions and the core network of "thought-leaders" whose ideas guide, facilitate and complicate cycles of interaction. These appear to follow a pattern of internalization, where individuals make sense of information from others to develop their internal model of reality, and externalization, where individuals further develop the community model of reality [2; 15]. Sustained cycles of interaction require students to co-construct a shared knowledge-base over time. It would appear that this is contained within the personal memories of a core set of individuals (the thought-leaders), who constitute a distributed knowledge-base for the community. Because of their prior experience and their expertise in related domains of practice, these individuals appear to replicate successful patterns of behavior learned from participation in other communities. These "key players" have developed the ability to recognize each others' expertise rapidly, developing a clique of contacts with whom they interact. The clique appears to strengthen as the course progresses. Other community members access this distributed knowledge-base through regularly reading the messages contributed by core community members, but engage in little interactive debate with these community "experts". Members of the community appear to rapidly develop a shared model of *who-knows-what* that permits individuals to locate knowledgeable sources of information with minimal

effort [10], targeting their use of key players' posts more effectively as the course proceeds.

## 6. Conclusions

We asked what leads to sustained student engagement in a community of inquiry. We have concluded that learners attempt progressive levels of community engagement according to their prior knowledge-domain expertise and their experience of successful online community participation. Our contribution in this paper is threefold:

- We have differentiated conceptually between participation, involvement, and sustained engagement in a community of inquiry and demonstrated these differences in our findings;
- We have demonstrated how specific sequences of interaction lead to joint knowledge construction, identifying the role of key players in facilitating and complicating community debate and the use of transactive memory resources to access distributed community knowledge;
- We have analyzed the conditions required for students to engage effectively with community learning, relating these to perceptions of cognitive load and the learner's prior expertise.

We would argue that an understanding of the relationship between these elements is key to effective online course design. We conclude by observing that it students appear to value and enjoy courses with higher levels of community engagement. This leads to a more enthusiastic social engagement in joint knowledge construction, which indicates involvement with course objects and results in deep learning.

## 7. References

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