Social Network Behavior, Thought-Leaders and knowledge building In An Online Learning Community.

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Abstract

This paper investigates the relationship between student role-behavior and position in a Social Network and the processes of creating sustained collaborative knowledge building in online learning communities. Through an empirical study of an online learning community, we analyze how core student participants (thought-leaders) interact with peers and how this impacts on the collaborative knowledge building process. The findings indicate that core participants can be distinguished by a combination of patterns of interaction and types of contribution.

1. Introduction

Distributed knowledge management in online learning environments

We can usefully regard an online learning environment as a distributed cognition[1] system. Not only is knowledge distributed amongst the participants[2] but it can be regarded as existing in the physical and cognitive artifacts that form parts of the environment[3]. Thus an online learning system may be regarded as a knowledge management system. For such knowledge to be helpful it must be available for critique, refinement and negotiation[4] in a collaborative framework[5, 6] For individuals to learn their must be an effective means of sharing and managing this group knowledge[7-12] However an online learning group also exists as a social network [13] in which both knowledge and social capital can be interchanged[14], without such interchanges individual learning will not take place. Learners learn both with[5, 12, 15, 16] and from their peers [17-19]. Students gain insights both from explicit collaborative knowledge building[6] but also from the experiences of others[20]. Similarly even if a useful body of knowledge exists , it may be worthless unless individuals know who possesses it[21], it is reasonable to assume that an uneven distribution of knowledge may lead to some learners having more influence on the knowledge building process. .

The role of thought leaders in knowledge building

Knowledge construction is best achieved in a collaborative environment where multiple perspectives can be brought to bear on a problem and where meaning can be socially negotiated [22]. It is argued that deep learning is achieved when all participants are involved in collaborative engagement. Students must participate actively in a community of inquiry for this to occur [23, 24]. A community of inquiry as modeled by Dewey[25] presupposes a level of participatory democracy. However there are some key issues about if and how such a community should be led [26] discusses such issues from a Dewian/Pragmatist perspective.

> *Leaders that are fixated in belief systems, unwilling to confront evidence they do not expect, unwilling to listen, and uncomfortable with uncertainty and doubt undermine the formation of a community of inquiry. Further, leaders that adopt a pessimistic attitude foreordain failure. Alternatively, leaders that are unfettered optimists are unwilling to "see" problems or are ill prepared to adjust their approach when negative/unexpected information needs to be processed.*

Others [27] maintain that recognized and strong leadership is essential to the success of online education. Leaders can be regarded as central players in an online network but can be effective as either triggers or responders [28].
Yoo and Alavi[29] studied the performance of US government executives in virtual teams and found that emergent leaders sent more and longer emails than non leaders and tended to perform *initiator*, *scheduler* and

integrator behaviors. In summary the emergent leaders started the process (or were very near the start) organized activities and assembled individual contributions into a finished product. Interestingly they observed leadership to be highly concentrated in a single individual. Carte et al. [30] discovered that higher performing virtual teams showed greater levels of leadership communications and especially strong monitor and producer leadership behaviors. Monitor leadership tended to be shared while producer leadership tended to be highly concentrated.

While firmly established in management and business literature[31-34] the study of leadership in online educational communities of inquiry is comparatively rare [35]. In general for online learning we are most concerned with emergent leadership [29], it is unusual to focus on formal leadership roles as these are infrequently assigned, although leadership of online discussions may be designated to individuals for specific discussions [36-38]. A strong facet of emergent leadership seems to be the importance of communications [29, 30, 35].

Social engagement in a community of inquiry[39] calls for repeated cycles of knowledge internalization (assimilating knowledge that is accepted by the community) and externalization[40] (articulating knowledge in ways that are meaningful to the community). Online discussions are seldom models of democratic participation[25]: some participants tend to perform more central roles than others. These can be viewed as community thought-leaders[39].

These "Thought-Leaders" often seem central to sustained (deep) knowledge construction as they initiate and maintain social momentum in discussions. They tend to have in-depth, wide professional experience, previous online course or professional community experience, are reflective and interested debaters, reframe and/or facilitate discussions. Their contributions are central to vicarious learning[20, 41-43] which is a powerful complement to instructor resources[44].

Social network analysis of thought-leader behavior

Social Network Analysis is a set of tools for studying the structure of social relations between individuals[13]. With Social Network Analysis we are interested in the pattern of interactions between individuals rather than the individuals themselves[45]. These interactions show us "*patterns which let us see how social groups organize themselves to accomplish certain goals"* [46]. A pattern of interactions between network members can be used to derive a set of ties between individuals. These ties can be strong ties such as Family or Friendship ties or weak ties such as those between work colleagues[47]. Weak ties have the potential for wider information exchange and drawing on multiple perspectives.

Recently Social Network Analysis has been used to analyze the behavior of students in online learning groups [48-52]. These studies have shown that Social Network Analysis can provide important insights. A students position in different types of Social Network such as advice or information networks can materially affect their learning experience and satisfaction[50]. It has been suggested even that high participation in online networks can lead to more physical social isolation. Students who are highly central in online learning networks may be held in higher esteem by peers[48] and both network prestige and network centrality were robust predictors of cognitive learning outcomes[52].

Social network analysis provides a set of useful metrics for analyzing interactions between individuals on an aggregate and ego-centered basis. Centrality measures such as in-degree and out-degree show us the extent to which an individual communicates with more or less peers either sending messages (out-degree) or receiving messages (in-degree) A student's overall degree centrality is a simple combination of their in-degree and out-degree. Central players tend to be more readily attended to. Tie strength indicates how frequently two individuals exchange messages. Closeness indicates the extent to which a person has very close paths to others and Betweenness indicates how many shortest paths between any two participants an individual is on We can also examine overall network properties such as density which indicates how many of the possible 1;1 ties between individuals exist and reciprocity which indicates the extent to which people send and receive messages to/from the same individuals.

Student role-behaviors

As well as considering a student's position within a Social Network we can also investigate the kinds of contributions that individuals make in online learning environments. Waters and Gasson [53] characterized student role behavior using grounded theory [54] and derived a set of specific role-behaviors listed in Table 2. Of these the Facilitator (maintains and encourages debate) and Complicator (challenges assumptions and reframes problems) appear to be highly important[55]

Table 2: Role-Behaviors in a Community of Inquiry [53]

Role	Analogy	Community Presence [56]
Initiator	Spider	Social
Facilitator	Middleman	Social, Teaching
Contributor	Journeyman	Social, Cognitive
Peer knowledge-elicitor (P-K-E)	Seeker	Social, Cognitive
Vicarious-knowledge acknowledger (V-Ack)	Me-too	Social, Cognitive
Complicator	Reframer	Teaching, Cognitive
Closer	Synthesizer	Social, Teaching, Cognitive
Passive-Learner	Freeloader	Cognitive

2. Elements of a learning experience

Having outlined a set of interesting elements we may now ask in what way are these elements related. Does a student's position in a Social Network relate to how crucial they are in generating or sustaining debate? To what extent does student role-behavior relate to students position in the Social Network? To what extent does a student's behavior relate to the extent to which they are held in esteem by peer students? Can Social Engagement exist with a democratic model of participation or must we expect some kind of benevolent oligarchy ?

3. Research Site and method

To answer the research questions asked above, we examined online discourse from an online, asynchronous graduate Information Systems degree course at a North American University. We assessed discourse in the form of messages posted to the course discussion board.

Students were required to post messages to the discussion board (this was worth 10% of their course grade), but community interactions were not made an explicit part of the course assignment system. Postings to the discussion board provide a relatively complete view of student interactions with both their peers in the community of inquiry and the instructor. The course was conducted entirely online. Students were required to prepare individual bi-weekly assignment reports and to participate in weekly discussion forums on associated, but not directly-related topics, using commercial discussion board software (Blackboard). 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?"). Discussion-board forum topics were set by the faculty member who designed the course and also acted as the main course instructor, moderating the online discussion. Students were encouraged to ask questions online, so a small number of postings related to an FAQ thread for the assignments. Most students had prior industry experience: the majority were employed in IS.

This study examines all message data from the discussion board taken from the all ten weeks of the course. We performed an analysis of 997 messages posted to the course discussion board by the instructor and 28 students enrolled on a Management of Information Systems course. The Blackboard software allowed for the capture of basic statistics such as how frequently students viewed messages and visited the discussion board, which formed part of the data for this study. We analyzed the data in three steps. We categorized messages posted by students and the Instructor to the course discussion-board using a qualitative analysis method [57, 58]. Initial categorizations of our data examined eight forms of interactive role-behavior, derived from an exploratory study [53]. These categories are shown in Table 2, where they are related to the social, cognitive, or teaching community presences of Garrison et al. [56].

We then analyzed sequences of message-posting and response, to determine which types of message generated most responses, what type of messages were posted in response to what type of prior message, and common sequences of role-categories and posting behavior for sub-threads of debate.

Finally, we analyzed the social networks indicated by student interactions via the course discussion board. The Social networks were derived by mapping the pattern of all messages sent by individual students and all messages received by individual students. Messages could be directed explicitly to an individual by use of a "reply to" function or implicitly by referring to content in a prior message. Messages which did not make such references were categorized as broadcasts and the recipient coded as A for All. The findings from these analyses are presented below. We have anonymized all message-extracts and references to posters in the findings below. Students are referred to by an ID number.

4. Findings

Does a students position in a Social Network relate to how crucial they are in generating or sustaining debate?

An analysis of deep sustained knowledge building threads revealed that there were 8 core individuals who were essential to successful threads. These individuals were identified as S11, S12, S13, S17, S21, S23, S5 and S6. Threads which did not include these participants did not develop. Applying a Social Network Analysis revealed some interesting patterns. All the identified Thought-Leaders showed higher than average In-Degrees (Table 2) indicating that they received messages from a higher number of different peers. All identified thought-leaders showed higher than average Out-Degrees (Table 3) indicating that they sent messages to a higher number of different peers . For instance in the tables below S11 has an overall degree centrality of 29 consisting of an in-degree of 12 and an out-degree of 17. Thus S11 sent messages to 17 different individuals but received messages from only 12 different individuals.

Table 2 Thought-leaders and In-Degree

Degree Centrality:

Node	Degree	InDeg	DegNorm	IDNorm
S11	29	12	100.000%	41.379%
S12	25	12	86.207%	41.379%
S13	28	12	96.552%	41.379%
S17	30	12	103.448%	41.379%
S23	22	13	75.862%	44.828%
S21	40	17	137.931%	58.621%
S5	27	11	93.103%	37.931%
S6	20	9	68.966%	31.034%
S4	27	12	93.103%	41.379%
S20	19	11	65.517%	37.931%
S3	19	9	65.517%	31.034%
S9	11	6	37.931%	20.690%
S19	11	5	37.931%	17.241%
S7	9	5	31.034%	17.241%
S2	9	6	31.034%	20.690%
S15	9	5	31.034%	17.241%
S18	8	4	27.586%	13.793%
S8	8	5	27.586%	17.241%
S14	7	3	24.138%	10.345%
S22	6	3	20.690%	10.345%
S1	2	0	6.897%	0.000%
S16	2	1	6.897%	3.448%

Table 3 Thought-leaders and Out-Degree

Degree Centrality:

Node	Degree	OutDege	DegNorm	ODNorm
S11	29	17	100.000%	58.621%
S12	25	13	86.207%	44.828%
S13	28	16	96.552%	55.172%
S17	30	18	103.448%	62.069%
S23	22	9	75.862%	31.034%
S21	40	23	137.931%	79.310%
S5	27	16	93.103%	55.172%
S6	20	11	68.966%	37.931%
S4	27	15	93.103%	51.724%
S20	19	8	65.517%	27.586%
S3	19	10	65.517%	34.483%
S9	11	5	37.931%	17.241%
S19	11	6	37.931%	20.690%
S7	9	4	31.034%	13.793%
S2	9	3	31.034%	10.345%
S15	9	4	31.034%	13.793%
S18	8	4	27.586%	13.793%
S8	8	3	27.586%	10.345%
S14	7	4	24.138%	13.793%
S22	6	3	20.690%	10.345%
S1	2	2	6.897%	6.897%
S16	2	1	6.897%	3.448%

In-degree and out-degree show how many different people a person interacts with but we may also consider volume of messages sent and received. All thought-leaders were greater than average senders of messages (Table 4). Similarly all thought-leaders had higher than average overall message receipts (Table 4).

Table 4 Thought-leaders and Message Volume

Student	Messages Sent		Student	Messages Received
s21	110		s21	49
s17	64		s11	31
s13	61		s6	24
s5	58		s4	23
s4	56		s13	21
s11	51		s5	21
s6	49		s23	19
s23	48		s12	18
s12	46		s17	17
s14	32		s20	15
s2	29		s3	13
s20	28		s2	11
s22	27		s9	6
s3	26		s19	5
s18	22		s8	5
s19	20		s15	4
s15	19		s7	4
s8	13		s14	3
s7	10		s18	3
s16	9		s22	2
s9	7		s16	1
s1	5		s1	0

Another way of looking at a Student's relative position in a network is to examine closeness and Betweenness. Closeness indicates the extent to which a person has very close (but not direct) paths to others and Betweenness indicates how many shortest paths between any two participants an individual is on. In Fig 1 below A has the highest degree centrality but D has a higher closeness and B has a higher Betweenness

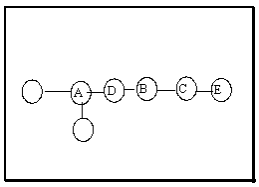

Fig 1 Degree centrality, closeness and Betweenness

Seven out of eight thought-leaders occupied places in the top 10 Closeness metrics (Table 5) , all eight showed average or better closeness. Six out of eight thought-leaders occupied places in the top 10 Betweenness metrics (Table 6) , however only three had average or better Betweenness.

Table 5 Thought-Leaders and Closeness

Node	Farness	Closeness	Normalized Closeness
S21	35.0	0.029	82.857%
S17	38.0	0.026	76.316%
S11	39.0	0.026	74.359%
S4	40.0	0.025	72.500%
S12	41.0	0.024	70.732%
S5	41.0	0.024	70.732%
S13	41.0	0.024	70.732%
S23	44.0	0.023	65.909%
S3	44.0	0.023	65.909%
S20	46.0	0.022	63.043%
S19	50.0	0.020	58.000%
S7	50.0	0.020	58.000%
S2	50.0	0.020	58.000%
S15	50.0	0.020	58.000%
S18	52.0	0.019	55.769%
S8	52.0	0.019	55.769%
S9	53.0	0.019	54.717%
S22	53.0	0.019	54.717%
S14	53.0	0.019	54.717%
S16	57.0	0.018	50.877%
S1	58.0	0.017	50.000%

Table 6 Thought-Leaders and Betweenness

Node	Betweenness	Normalized Betweenness)
S17	46.428	11.436%
S21	42.122	10.375%
S4	12.230	3.012%
S11	9.755	2.403%
S12	7.834	1.930%
S13	7.471	1.840%
S5	7.037	1.733%
S20	6.394	1.575%
S18	3.917	0.965%
S3	2.143	0.528%
S23	1.563	0.385%
S6	1.002	0.247%
S14	0.933	0.230%
S19	0.858	0.211%
S7	0.385	0.095%
S8	0.367	0.090%
S9	0.291	0.072%
S15	0.250	0.062%
S22	0.000	0.000%
S1	0.000	0.000%
S2	0.000	0.000%
S16	0.000	0.000%

Aggregate measures are useful but it is also illuminating to examine patterns of change over time. In general all activity declined slightly over a 10- week period, and all students showed declines in both in-degree(Fig 2) and out-degree (Fig 3).

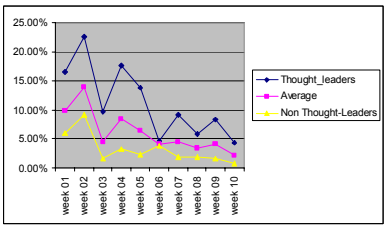

Fig 2 In-degree over time

Whereas Out-degree seems very closely tied to Thought-leader status the picture is much less clear cut for in-degree. That is to say that not all thought-leaders are consistently above average message receivers. The strongest example of this is S12 who from week 5 onwards receives zero messages yet overall has an in-degree higher than average and also has a higher than average out-degree. S4 who was not considered a thought-leader shows an above average In-degree for 5/10 weeks.

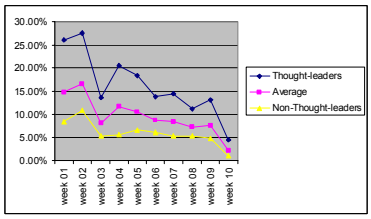

Fig 3 Out-Degree over time

Whereas Out-degree seems very closely tied to Thought-leader status the picture is much less clear cut for in-degree. That is to say that not all thought-leaders are consistently above average message receivers. The strongest example of this is S12 who from week 5 onwards receives zero messages yet overall has an in-degree higher than average and also has a higher than average out-degree. S4 who was not considered a thought-leader shows an above average In-degree for 5/10 weeks.

To what extent does student role-behavior relate to students position in the Social Network?

To investigate this a role-behavior profile was created for each student. Each message posted was categorized according to the role-behavior scheme described earlier. From this analysis student posting behavior was categorized by the percentage of messages they sent which fell into each category. The correlation between the percentage of messages sent that are facilitator messages and the in-degree for individuals was 0.708, this is the only notable positive correlation with respect to message type. This means that a person that posts a higher percentage of facilitator messages is more likely to be responded to. The correlation between the number of facilitator messages sent and In-degree is 0.785 this was the strongest positive correlation between message type and in-degree.

To what extent does a students behavior relate to the extent to which they are held in esteem by peer students?

The correlation between the number of facilitator messages sent and overall messages received is 0.685, this was the only significant positive correlation involving message type and messages received. In general the receive to send ratio for messages was 35: 100, i.e. for each 100 messages sent by a person 35 would be received by that person. However for facilitator messages the send to receive ratio was 1:1 so that for each facilitator message sent one facilitator message would be received by the same person. Thus sending a facilitator message often starts a "positive feedback loop" where further encouragement of debate naturally follows an initial facilitation message.

All 8 identified thought-leaders posted an above average percentage of facilitator messages, the average percentage of facilitator messages posted was 22% **the range of facilitator messages sent for thought-leaders was 23% to 54%.** However s19, s20, s3 and s9 all also posted above average percentages of facilitator posts but were not considered thought-leaders. However s19, s20, s3 and s9 were all below average posters in terms of volume, whereas all members rated as thought-leaders were above average posters in terms of volume. No below average posters were rated as thought-leaders. **Thought-leaders both posted a higher than average number of messages and posted a higher than average percentage of facilitator messages**. The relative frequency with which messages were read was also related to message type.

The average reads/message was 19 , direct questions received the highest number of reads/message (24 reads per message) and facilitator messages received an average of 23 reads per message. Initially it was expected that complicator messages that focus on reframing debate or challenging assumptions would turn out to be equally important in terms of reads and responses. However in terms of reads/message and responses to individual messages they are less popular than average. However we had previously found that many of the successful threads had included such reframing messages [39].

Can Social Engagement exist with a democratic model of participation or must we expect some kind of benevolent oligarchy ?

Our analysis found that there were 8 core individuals whose participation was crucial to deep involved knowledge building threads. When these individuals were not active threads tended to peter out quickly or be linear consisting of single broadcast responses. However this does not indicate whether such thought leaders necessarily dominate these knowledge building threads. To investigate this further we examined the pattern of messages between participants in more detail.

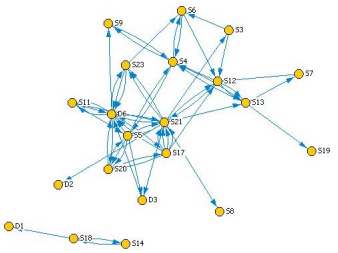

Fig 4 "Does It matter ?"

Fig 4 illustrates the messages sent by students to students in one of the most successful knowledge building threads based on the question "Does IT matter ?:". In this thread there were 97 student messages spread amongst 23 participants. The average number of posts per student was 4.2. The eight thought-leaders contributed a total of 53 messages (54%) to this thread at an average of 6.7 messages each, i.e. significantly higher. Of the 97 student messages sent 28 were broadcast messages. Of the remaining 69 messages, the thought-leaders sent out 38 (55%) and received 30 (43%) . Of the messages received by thought-leaders 17 out of 30 (56%) were from other thought-leaders. A Social Network Analysis (Table 7) of this question reveals that of the 11 most central participants 8 are the identified thought-leaders. In this example taken from week 1 of the course the thought-leaders are already showing a pattern of high posting activity and are

responding more to other thought-leaders than to non thought-leaders. Despite the generally high participation from other participants we see a slight pattern of the thought-leaders forming a central core.

Table 7 "Does IT Matter?" Centrality

Node	Degree	InDegree	OutDegree
S21	14	4	10
D6	13	7	6
S5	9	4	5
S4	9	5	4
S12	8	5	3
S17	6	2	4
S20	6	3	3
S13	6	3	3
S6	5	3	2
S11	4	2	2
S23	4	2	2
S18	3	1	2
D3	3	2	1
S3	3	1	2
S9	3	2	1
S7	2	1	1
S14	2	1	1
D1	1	1	0
D2	1	1	0
S19	1	1	0
S8	1	1	0

AVG:	4.95	2.476	2.48
STD:	3.71	1.651	2.34
MIN:	1	1	0
MAX:	14	7	10

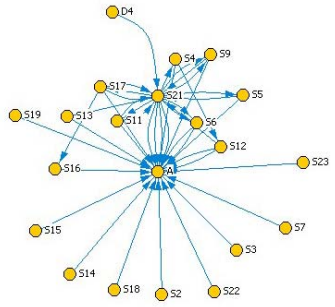

Fig 5 The next information revolution

Fig 5 shows the messages sent for a question discussing Peter Drucker's "The Next Information Revolution" . For this question there were 45 messages of which 24 were broadcasts ("A" in Fig 4) . Of the peer-to-peer messages 17 (80%) were sent by thought-leaders and 16 (76%) were received by thought-leaders. The thought-leaders are clearly dominating this discussion with a high degree of internal communication. The patterns shown in Figs 3 and 4 are fairly typical of the behavior in the more productive threads. In both of the above threads the thought-leaders showed a strong pattern of posting facilitator messages. We also analyzed several other threads and found that as the number of messages sent declined the concentration of activity from the thought-leaders stayed relatively consistent. It seems then that for this group and in this environment the most productive debate relied on a small number of participants being extremely active.

5. Discussion of Findings

The findings within the context of online learning outlined above give some support to general principles found in the study of emergent leadership in Organizational literature[29-32, 34]. Firstly leadership does seem to be important in this educational context. The most effective knowledge building threads simply did not exist without notable leadership behaviors. Secondly this leadership followed a largely shared pattern; we did not see one or two dominant figures but typically six to eight members who steered debate. This pattern is not quite the Dewian participatory democracy[23, 25], but neither is it a dictatorship, possibly we might consider this a benevolent oligarchy. Thirdly leadership here was not a matter of simple domination of discussion [48] but was exhibited in the careful facilitation of discourse. This is quite similar to Carte et al's [30] monitor and producer behaviors. Since overall course performance was largely decoupled from discussion board activity we can examine thought-leader behavior and course performance independently. When we do so we find that of the 23 participants none of the eight thought-leaders had low grades (below A), however 5 A graded students were not characterized as thought-leaders. This tends to imply that leadership behavior is not related (in this case) to some general measure of ability or personal commitment to learning. Cho et al [48] suggested that Social Network centrality was highly predictive of the esteem given to online peers. The findings seem to bear this out to a large extent the most central participants were most frequently attended to. There is though one important proviso. It was not simply volume of messages and the number of ties that was important it was the nature of the messages that was crucial. Facilitating messages were much more influential than other messages and thought-leaders were the ones most frequently exhibiting these role-behaviors. The online community under study here was a highly effective knowledge building [11, 59, 60] experience. Over the 10 week period there was a tremendous amount of knowledge interchange and critical inquiry leading to great knowledge building. Knowledge is clearly effectively distributed among peers, but this distribution seems somewhat uneven

with the key participants contributing rather more to the knowledge pool. From the pattern of message reads and responses it is evident that students very quickly learn who knows what, thus we have an effective transactive memory system [61, 62] at work here.

There is clear evidence that a social network analysis provides useful insights. The Social network analysis indicates that thought-leaders really are more central in some key social network metrics (in-degree, out-degree and closeness) as well as being more vociferous. The precise value of Betweenness and closeness may however need further analysis. Unlike social networks which consist of heterogeneous groups an online group has a single biosphere and in principal there are no reasons to prevent everyone from talking to everyone else. That some individuals may act as boundary-spanners is an artifact that may require further study.

We can also see that knowledge cliques form over time, as the course progressed students communicated with fewer different individuals, in terms of maintaining an active distributed cognition system this is a trend that may be of some concern.

5.1 Implications

A key concern that emerges here would appear to center on how to engage non-thought-leaders in online discourse. Elsewhere [39, 44, 63] we have attempted to address this question. Some possible approaches include attempting to build a quick profile of students which may allow an instructor to fine-tune questions for discourse. Poorly designed or badly aligned questions may generate minimal discourse. Secondly an instructor must tread a fine line between being overly intrusive and having too much of a laissez faire approach, gentle but visible approbation allows students to know that their contributions are noticed and valued. Of course none of this will help with students who simply have no social commitment to group knowledge building; in this case a suitable reward or kudos system based on the quality of contributions may be appropriate.

The distributed facilitating behaviors exhibited by thought-leaders in this online learning community are somewhat similar to models of monitor leadership behaviors which have also been found to be highly distributed [30] in organizational contexts. This would hint that similar kinds of processes are happening in these two different contexts. It may then be possible to use this framework as an analytical tool for studies of organizational Knowledge Management. It would be interesting to see whether a Social Network Analysis approach would show the same connection between thought leadership and centrality (at least in informal networks) in broader organizational contexts.

6. Conclusions

This paper has shown that an online learning community can be modeled both as a knowledge management system with persistent knowledge objects and knowledge creation, and as a social network. Further we have seen that social network metrics strongly coincide with analyses of student role-behaviors and may prove to be useful predictors of knowledge building and knowledge management behavior. We have seen that knowledge is clearly distributed amongst the system and individuals and yet that there are clearly identifiable core participants who make greater contributions. Further research will investigate if these findings are generalizable and cross knowledge domains. We hope to study whether the apparent domination of knowledge building by small oligarchies has damaging effects on student satisfaction. We have also seen that the thought-leader paradigm may be a useful analytical framework for Knowledge Management research.

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