# A study of the relationship between student social networks and sense of community

**Shane Dawson**

Centre for Learning Innovation, Queensland University of Technology, Australia // sp.dawson@qut.edu.au // Tel: +61 7 3138 5417 // Fax: +61 7 3138 3986

## ABSTRACT

As the integration of community-centred teaching practices intensifies, an understanding of the types of relationships that manifest in this network and the associated impact on student learning is required. This paper explores the relationship between a student's position in a classroom social network and their reported level of sense of community. Quantitative methods, such as Rovai's (2002b) Classroom Community Scale and social network centrality measures, were incorporated to evaluate an individual's level of sense of community and their position within the classroom social network. Qualitative methods such as discussion forum content analysis and student interviews were adopted to clarify and further inform this relationship. The results demonstrate that the centrality measures of *closeness* and *degrees* are positive predictors of an individual's reported sense of community whereas, *betweenness* indicates a negative correlation. Qualitative analyses indicate that an individual's pre-existing external social network influences the type of support and information exchanges an individual requires and therefore, the degree of sense of community ultimately experienced. The paper concludes by discussing future recommendations for teaching practices incorporating computer-mediated communications.

## Keywords

Social networks, learning communities, computer-mediated communication

## Introduction

Recent education literature has highlighted the importance for practitioners to adopt a community-centred pedagogy as a strategy for facilitating student learning (e.g. Brook & Oliver, 2003; Fink, 2003; Johnson, 2001). The dominant tenet of this pedagogical approach can be traced back to the works of Dewey (1938/1963) and Vygotsky (1978) who maintained that the process of learning is facilitated through individual participation in social interactions. This pedagogical model is framed within social-constructivist principles with a focus on developing activities that promote learner-to-learner interactions to support the co-construction of knowledge and the sharing of information and resources. In this context, learning activities involving group work and collaboration are commonly implemented practices.

However, opportunities for the contemporary learner to engage with peers in a collaborative environment are problematic given the spatial and temporal requirements associated with traditional classroom settings (Squire & Johnson, 2000). The integration of online technologies, such as computer mediated communication (CMC), within the education sector can be seen as one approach for addressing these challenges and therefore, facilitate the implementation of collaborative learning activities. For instance, the adoption of CMC software provides individuals with the capacity to interact via computer networks regardless of spatial and temporal limitations (Kreijns, Kirschner, & Jochems, 2002). De Wever, Schellens, Valke, and Van Keer (2006), suggested that an additional advantage underlying the integration of asynchronous CMC is the capacity for students to reflect on postings and access additional resources before (re)contributing to the overall discussion and therefore facilitating the development of higher order learning outcomes.

The benefits derived from implementing CMC also extend to faculty and researchers as a source of evaluative data. As Meyer (2004) has noted, written communication exchanges occurring among learners are readily accessible for future review. Ahern, Peck, and Laycock (1992) analysed CMC transcripts when investigating the impact of moderator intervention techniques on student participation. In examining the interactions in lieu of the specific written content, Garton, Haythornthwaite and Wellman (1997) have demonstrated that the communication exchanges conducted via CMC can also be used to form a representation of the social network and identify potential relational patterns. The interrogation of these relational networks may inform education practitioners of the extent of community experienced among the student cohort and the progress and outcome of implemented learning activities.

While education research has primarily focussed on developing a greater understanding of the learning process and the activities that promote learning in an online environment (e.g. Gunawardena, 1995; Hara, Bonk, & Angeli, 2000; Schellens & Valcke, 2006; Vonderwell, 2003) there has been limited research examining the types of relations and networks that develop within the education milieu (Cho, Gay, Davidson, & Ingraffea, 2007) and the impact these networks have on an individual's psychological sense of community. The present study seeks to contribute to this field of knowledge by investigating the relationship between a student's position in the social network and their overall sense of community. To address this aim, the paper firstly discusses the application of social network analysis (SNA) as a methodology for education studies. The paper then reports on the findings of an initial study juxtaposing Rovai's (2002b) sense of community scale with SNA in an education environment.

## Social Network Analysis

The concept of social network analysis (SNA) has attracted much attention in the social and behavioural sciences. Wasserman and Faust (1994) attributed this interest to the ability of SNA to describe the relationships that occur among social actors and the associated patterns arising from these interactions. Social network analysts actively investigate the exchange of resources between social actors and how these interactions afford the establishment of relationships within a social system (Haythornthwaite, 2002). From these investigations, analysts map and visually display the interactions that occur in order to ascertain the emergence of two types of patterns – social groups and social positions. Social groups relate to the collection of actors and the associated social interactions that arise from participation in the social system and social positions refer to the classifications of the sets of actors that are similarly linked to the social system (Freeman, 2000).

SNA has also been applied in community studies to investigate the social relationships and patterns that evolve through member interactions (Cho, Lee, Stefanone, & Gay, 2005; Haythornthwaite, 2002; Reffay & Chanier, 2002). The application of SNA to community studies typically involves an investigation into the types of resources exchanged, frequency, quantity and flow in order to describe the elements comprising the social system (Haythornthwaite & Wellman, 1998). For example, Reffay and Chanier (2003) incorporated SNA to describe relationships and interactions occurring among students and staff participating in computer-supported collaborative learning. The authors maintained that the use of SNA provides an opportunity to gauge the communicative interactions that take place and to assess the degree of cohesion within the group. Girvan and Newman (2002) have drawn similar conclusions regarding the applicability of SNA to ascertain the degree and strength of social ties developed within a social system in developing models of community structures.

### Social ties and social capital

Central to SNA studies is the notion of strong and weak social ties. Granovetter (1982) argued that the social bonds established between individual actors can be classified as either strong or weak ties. Strong ties are often represented in close knit networks such as personal friendships and relations. In contrast weak ties are seen as linkages between different networks. Granovetter (1982) described weak ties as bridges - linking separate cliques into a larger network. Furthering this research on weak and strong ties in social networks, Haythornthwaite and Wellman (1998) demonstrated that the strength of the social bonds formed between actors in a social network influences an individual's choice of communication medium, and the frequency of interaction. Individuals with weak ties tend to adopt more socially rich mediums, such as face to face meetings, as the mode of communication and interact less frequently, in contrast to individuals exhibiting strong social bonds.

Social capital has gained wide acceptance as a theory for understanding the social rules and relations intertwined within the social structures of communities, and more broadly society (Lin, 2001). Putnam (1993) defined social capital as the "features of social organisation, such as networks, norms and trust that facilitate coordination and cooperation for mutual benefit" (p. 67). Lin (2001) proposed an analogous definition of the term noting that social capital is an: "investment in social relations with expected returns in the marketplace"(p. 19). While this definition implies an economic return on initial investments, the marketplace may represent a variety of contexts such as political, economical, or importantly for this study, educational.

In the education context, students potentially invest in developing social relations for returns of support, both personal and academic in order to progress their individual academic goals (Cho et al., 2007). Students bring to class a wide subset of pre-existing social relations that are external to the education environment. In this context the education setting forms a small component of a student's social system. Consequently, students have a wide degree of potential social capital that can be drawn upon to assist in developing an understanding of the subject content.

The identification of the position a student occupies within the established social network may inform practitioners of the role that an individual plays in the co-construction of knowledge and the types of resources and support they require. By viewing online communities as comprised of a set of social networks (Wellman et al., 1996) SNA affords a method to examine the overt interactions that occur in the online environment, the strength of those interactions, and the types of resources exchanged that foster the development of communities online (Haythornthwaite, 2002). As the formation of a cohesive social network is integral for effective social learning, the examination of the formation and structure of these social networks and the sense of community experienced among the student cohort provides new approaches to informing practitioners of the effectiveness of implemented practices. The present study investigated the relationship between sense of community and an individual's position within a social network in a higher education environment. Specifically the study examined the following research question:
Is the composition of social networks evolving from a unit discussion forum related to the sense of community experienced among the student cohort?


## Methodology

### Study overview

This research study forms a component of a larger investigation examining the relationship between student communication interactions and sense of community in the higher education environment. To answer the research questions the study incorporates a mixed method approach utilising both quantitative and qualitative measures. Quantitative methods, such as Rovai's (2002b) Classroom Community Scale and SNA centrality measures, were incorporated to evaluate an individual's level of sense of community and their position within the social network. Qualitative methods such as discussion forum content analysis and student interviews were adopted to clarify and further inform the relationship between an individual's position in the social network and their perceived sense of community.

Education students enrolled in second semester (July- December) 2005 undergraduate and postgraduate courses at a large metropolitan university were invited to participate in the study. All teaching units (N = 25) selected for the study contained an online component of supplementary learning resources including CMC software (e.g. discussion forum, listserve, email, synchronous chat). The term unit is defined as a focussed course of study of approximately 13 weeks in duration comprising a part of a larger program leading to a specific degree.

The sampled teaching units were available for both external and internal study modalities. An external modality is defined as study undertaken off campus. In this instance more traditional teaching methodologies such as face to face lectures are excluded. Teaching content and associated learning activities are delivered and accessed via the institution's online environment. An internal modality refers to study undertaken on campus. Traditional modes of education delivery such as face to face lectures, tutorials, and workshops were included, with additional online resources and learning activities also integrated into the subject curriculum. In this context, an internal study modality can be seen to be more analogous to a blended model of learning.


### Methods of data collection

The quantitative methodology comprised the primary source of data collection for this study. Quantitative data were derived from both student self-report responses to an online survey and student online user-behaviour with the University's in-house learning management system (OLT). Online user behaviour was generated automatically using the OLT evaluation system. The data generated by this system permits an insight into the way learners and designers interact with the online learning environment, such as who (student or teaching staff) is posting and replying to the discussion forum; or the time and frequency of interactions.

Qualitative methodologies such as a case study and content analyses of discussion forum postings were also undertaken in order to verify conclusions derived from the quantitative component. Yin (1993) suggested that in instances where the phenomenon under investigation is complex and interwoven with the context, the incorporation of multiple data sources provides a method of triangulation. Studies of community and social networks represent such phenomena. The diversity of data sources included in this study can be seen to be complementary and enable the verification of each unique data set and the subsequently derived conclusions (Silverman, 2000).

**Sense of community**

Data relating to sense of community were collected from student responses to an online survey that was administered via the teaching units' online space and via email notification. The online survey was based on Rovai's (2002b) Classroom Community Scale (CCS). The CCS consists of 20 self-report items designed to evaluate the degree of community an individual experiences within an education setting. The scale comprises two subscales termed social community and learning community. The subscale social community relates to the students' perceived levels of belonging, trust and cohesion. The learning community subscale is defined as the degree to which students share similar learning values and goals.

An initial pilot study (N = 160) was undertaken to confirm the survey instrument's factorial validity. The constructs emerging from the exploratory factor analysis were found to be equivalent to Rovai's (2002b) study. Additionally, reliability and internal consistency analyses were conducted to ensure generalisability of results. Cronbach α and Guttman split-half for the instrument was 0.90 and 0.89 respectively, indicating excellent reliability and consistency. Analysis of the two subscales also demonstrated excellent reliability and consistency with a 0.86, 0.85 (Cronbach α, Guttman split half respectively) for social community and 0.84, 0.76 (Cronbach α, Guttman split half respectively) for learning community. As the survey instrument demonstrated factorial validity and excellent reliability, the survey was then offered to the broader study participants (N=464).

**Social Network Analysis**

Social network analyses were applied to the captured communication logs (discussion forum posts) in order to investigate the level of participation and relationships manifesting within the sampled units. Although other additional communicative software such as chat and listserv were incorporated into the teaching units, these types of CMC were not widely utilised by a diversity of students or were merely used by the teaching staff as a means for updating and informing the student cohort. In contrast, the discussion forums were widely adopted by both students and teaching staff in a conversational manner. From this "direct active communication" (Harrer, Zeini, & Pinkwart, 2005, p. 192) data social relationships were interpreted from the identification of individual nodes and ties within the network. Nodes are defined as the individual actors while ties refer to the bonds that link actors in a network (Freeman, 2000).

Unit discussion forum logs were extracted as xml files for further network analysis using NetVis 2D (NV2D), a java based graph visualisation tool. The open source software processes the discussion forum xml files and generates a sociogram based on the communication interactions occurring between students. The software has the capacity to calculate the various SNA centrality measures for each node generated through the initial graph visualisation step (Figure 1).

Social network calculations such as *betweenness*, *closeness* and *degrees* were conducted to provide a greater insight into the dynamics of the formed relationships. These SNA measures are commonly used to determine an individual's centrality in the network (Otte & Rousseau, 2002). Haythornthwaite (2001) maintains that measures of centrality illustrate "how well positioned an individual is to receive and disseminate information" (p. 216) among the social network. For example *betweenness* refers to the frequency an individual occurs within the shortest path between other nodes (actors) (Otte & Rousseau, 2002). Participants exhibiting a high *betweenness* value are often referred to as gatekeepers or brokers as a result of their controlling position in influencing the flow of information and resources in the network (Lipponen, Rahikainen, Lallimo, & Hakkarainen, 2001). The measure of an individual actor's *closeness* in the network is taken as a more general indicator of centrality. *Closeness* is defined as the degree of relationship an actor has with the entire network. For example, an actor with a high *closeness* value will demonstrate

a linkage to other actors through a small number of paths (Otte & Rousseau, 2002). The final SNA calculation conducted was the determination of an individual's number of ties with other actors. The *degree* centrality is the number of connections each actor possesses in the network (Otte & Rousseau, 2002). Figure 2 illustrates an example sociogram generated from the present study. I – represents a high closeness centrality, in this instance 'I' is the academic staff member associated with the teaching unit. II - indicates a student with a high betweenness centrality within the network. III – illustrates a student with a high degree centrality. IV represents a student disconnected from the main network structure.
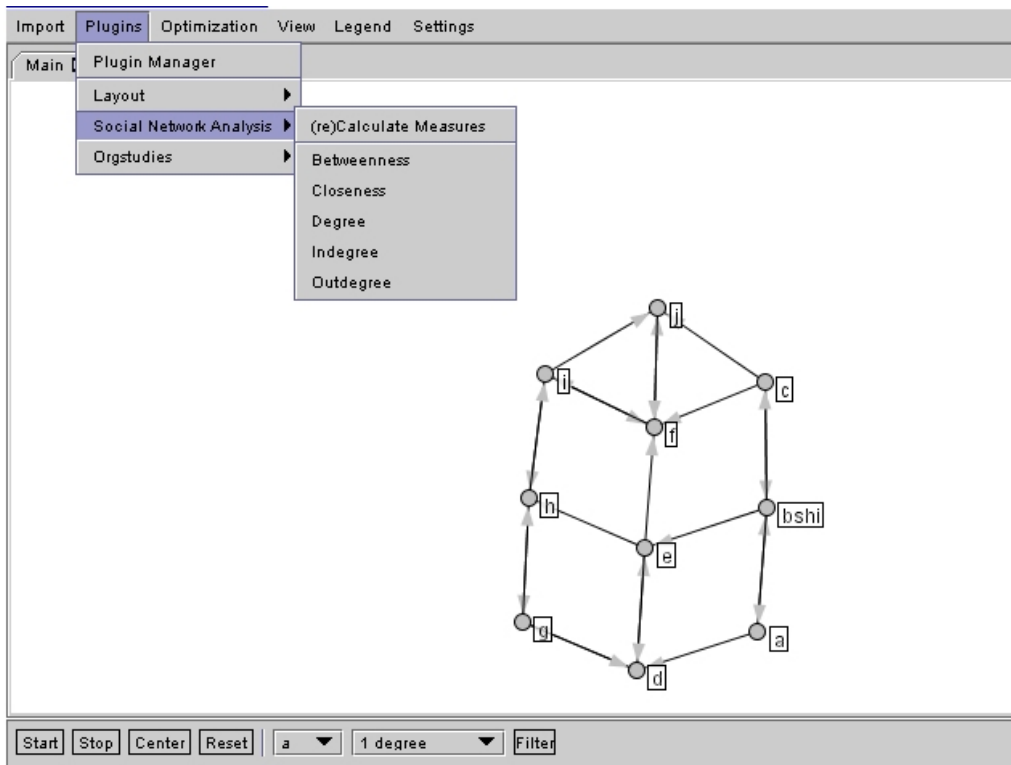


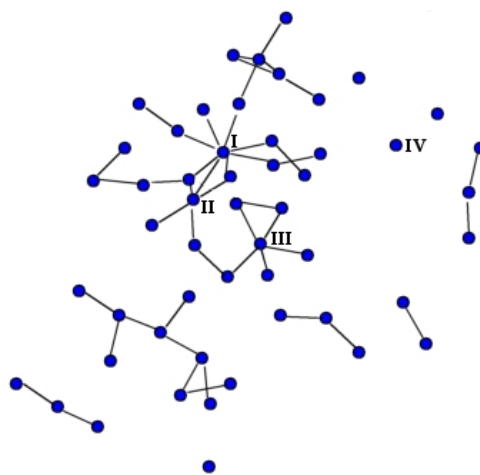*Figure1*. Screen capture of the open source software NetVis 2D



*Figure 2*. Sociogram of discussion forum interactions

**Discussion forum analyses**

The analysis of discussion transcripts is a common methodological approach adopted by researchers investigating CMC environments. For example, Gunawardena, Lowe, and Anderson (1997) utilised content analysis techniques to investigate the process of co-constructing knowledge in computer conferencing. Similarly, Hara, Bonk and Angeli (2000) conducted content analyses to identify the cognitive skills and meta-cognitive strategies employed in a student discussion group. The present study analysed the forum communication artefacts to identify the quantity of discussion related to the various dimensions comprising sense of community. As Rovai's (2002b) CCS is comprised of two constructs; social and learning, the forum contributions (n = 899) were categorised according to the dimensions underpinning this scale.

Discussion forum transcripts from eight teaching units were analysed according to Rovai's (2002a) definition of classroom community and the time of the posting. Selection of the units for analysis was based on the quantity of discussion forum contributions. As each post made to a discussion forum is time stamped, the analysis of discussion content can be conducted along a time scale. Codification in this time-dependent manner serves to illustrate how the discussion forum content transitions through social and learning orientations during the course of the semester. The unit of analysis adopted in this study comprised a sentence in a discussion forum contribution (Hara et al., 2000). Consequently, the posted messages (n = 899) could potentially demonstrate elements of the various community dimensions. In such cases the message is recorded for each specific dimension exhibited.

The codification of the forum transcripts consisted of reading each posting and classifying the message according to a revised version of Rovai's (2002a) four dimensions of classroom community – *spirit*, *trust*, *interaction* and *learning*. Postings made by the teaching team (Facilitator) were listed as an additional dimension. The monitoring and reporting of facilitator posts serves to provide an indication of the learning tasks associated with the discussion forum activities and the types of intervention methods that are incorporated to shift the student body from a social to a more learning oriented discourse. In this context the role of interactions relate more to a linkage between the two constructs of sense of community (social to learning). As such, all posted messages (interactions) can be seen to link the two constructs of classroom community. Hence, the dimensions examined for this study included: *spirit*, *trust*, *learning* and *facilitator* with the amalgamation of spirit and trust forming the social construct. The codification of the posted messages in this format also corresponds to the factors emerging from the Classroom Community Scale (Rovai, 2002b). Table 1 illustrates the classification schema and associated examples.

*Table 1.* Content analysis codification schema modified from Rovai (2002a)

| Dimension | Definition | Themes | Examples from content analysis |
|---|---|---|---|
| Spirit[a] | The feeling of belonging and connectedness with other class members | Belonging, support, and reference to other members | "My heart goes out to the …. student you are faced with a larger struggle than most of us. If I can assist you in any way – please let me know" |
| Trust[a] | The feeling that class members can be trusted regarding possible feedback and support | Self disclosure, humour, identity building and personal reflection | "Hi all, my name is …. I live out in the middle of nowhere (closest habitation is ….)" |
| Learning | The notion that knowledge is co-constructed with fellow class members | Critique, opinion, debate, discussion of content | "I am now convinced that everything 'smacks' of creativity and that the convergence of artistic and scientific processes to produce 'anything' deserves much closer scrutiny now than I was prepared to give in the past." |
| Administrator | Posts by the teaching team associated with the delivery of the unit content and learning activities | Facilitator posts are identified and coded based on the name associated with the contribution | "Wright (2003) says that novelty alone does not mean creativity. When a two year old does a finger painting, this is new to them, but is it creative? Do you agree with Wright? What other writers are you reading on creativity?" |

[a] Social community is comprised of both spirit and trust.

**Case study**

A case study was undertaken to provide additional clarification of the relationship between a student's position in the social network and their perceived sense of community. Data derived from the case study included student interviews, CCS data and SNA.

For the case study unit, student responses to the online survey were quantified and sequentially ranked according to the individual's reported sense of community. Based on this ranking, students representing the highest and lowest CCS scores were selected for individual informal, semi-structured interviews (N = 4). Thus, the interviews were designed to further clarify and inform the quantitative data by investigating the deviant cases (high and low community scores) (Patton, 2002). As such, the interview data are seen as supplementary and complementary to the previous data sets. As the teaching unit was offered via an external modality, access to individual students was limited to telephone interviews.

All student interviews were conducted at the end of the teaching semester with each interview lasting approximately one hour. The interview questions focused on clarifying the social, educational and environmental reasons for each student's individual community score. Students were asked to comment on certain aspects of the unit relating to their perceived level of community and the degree of additional socialisation and contact with class members and other peers associated with their individual networks. For example: How many different students did you interact with in this unit? What did you mostly discuss? Were there other individuals or groups outside of the teaching unit that you had contact with for support? Students were requested to elaborate on any additional themes that were of interest that may not have arisen through the general discussion such as professional networks, competition for assessment or resources, and the perceived value of the implemented online resources.

**Statistical analyses**

Data derived from the study were analysed using the software package SPSS for Windows © (Vers 12.0.1). Statistical analyses incorporated ordinary least squares regression analyses and basic descriptives.

**Limitations of the study**

The investigation of community dynamics is a complex study influenced by numerous external factors. Consequently, the research design and subsequent analyses have a few potential limitations that may impact on the broader derived conclusions. The generalisability of the conclusions is limited as a result of the study being confined to a single institution. However, the research methodology adopted confirms the CCS scale and the applicability for SNA to inform educators of the design of implemented learning activities. It is envisaged that the results emerging from this study will provide a benchmark for future comparative analyses.

An additional limitation of the study resides in the unknown number of communication exchanges undertaken by the sampled population external to the monitored online environment. This study investigated discussion forum artifacts as a measure of the social network formed among the student cohort. While the discussion forums are the primary mode of communication among students and educators in the institution, additional communication exchanges are likely to have occurred.

# Results

**Participants**

The overall response rate for the CCS survey was 23% (N = 464) of all students enrolled in the sampled units. Although the response rate appears to be relatively low, the survey participants demonstrated a comparable demographic profile with the faculty at large (Table 2). Males represented 16.16% and females 83.84% of the study participants and the majority of the study participants were enrolled in full time study (87%) via an internal modality (80%). The mean age of the study participants was 26.20 (SD = 8.0). The sampled population also undertook an

average of 16.19 hrs (SD = 11.9) of paid employment per week. Table 3 illustrates the mean CCS score and the constructs comprising the CCS for the participating student cohort. Community scores range from a maximum of 80 to a minimum of 0. The mean CCS score for the internal student cohort was 49.0, while the external demonstrated a mean CCS score of 41.8.

Table 2. Demographic profile

| | Female | Male | Full-time | Part-time |
|---|---|---|---|---|
| Survey response | 84% | 16% | 87% | 13% |
| *Faculty student demographics | 78% | 22% | 87% | 13% |

* Results derived from the University's census data for 2005

Table 3. Mean sense of community scores

| | Community* | Social community | Learning community |
|---|---|---|---|
| Mean [a] | 47.5 | 22.1 | 25.5 |
| | (SD = 11.0) | (SD = 6.1) | (SD = 6.2) |
| Internal Students | | | |
| Mean [b] | 49.0 | 23.1 | 25.9 |
| | (SD = 10.2) | (SD = 5.4) | (SD = 5.9) |
| External Students | | | |
| Mean [c] | 41.8 | 17.8 | 24.0 |
| | (SD = 12.5) | (SD = 6.9) | (SD = 6.9) |

* Community is equal to the sum of the two constructs: social community and learning. Community scores range from a maximum of 80 to a minimum of 0.
[a] N = 464, [b] n = 372, [c] n = 92

**Predictors of student sense of community**

An ordinary least squares (OLS) regression procedure was conducted with measures of social network analysis as the predictor and CCS as the criterion variables. The adjusted $R^2$ value with all measures of SNA was 0.253 with an associated F of 13.21, indicating that a significant yet moderate proportion of the variance in community was accounted for by the measured variables (Table 4). The adjusted $R^2$ value for the social community and learning community sub-scales was .23 (F = 11.51) and .21 (F = 10.26) respectively (Table 4). While closeness and degrees were positive predictors of community and its associated sub-scales, betweenness indicated a negative correlation.

Table 4. OLS regression of student sense of community on all SNA variables

| Variables | Community | | Social community | | Learning community | |
|---|---|---|---|---|---|---|
| | $R^2$ (adjusted) = .25 | | $R^2$ (adjusted) =.23 | | $R^2$ (adjusted) =.21 | |
| | $F = 13.21^{***}$ | | $F = 11.51^{***}$ | | $F = 10.26^{***}$ | |
| | $df_1 = 3, df_2 = 105$ | | $df_1 = 3, df_2 = 105$ | | $df_1 = 3, df_2 = 105$ | |
| | $\beta$ | $t$ | $\beta$ | $t$ | $\beta$ | $t$ |
| Betweenness | -.38 | $-3.86^{***}$ | -.34 | $-3.37^{**}$ | -.36 | $-3.60^{***}$ |
| Closeness | .29 | $3.02^{***}$ | .27 | $2.73^{**}$ | .27 | $2.72^{**}$ |
| Degrees | .36 | $3.24^{***}$ | .36 | $3.20^{**}$ | .31 | $2.69^{**}$ |

*** Correlation is significant at the .001 level
**Correlation is significant at the .01 level

**Discussion forum analysis**

Content analysis of the forum postings (n = 899) revealed that during the first 6 weeks of the teaching period social postings are the dominant interactions (Figure 3). Learning interactions demonstrate an increase from 28% to 45% of the communication interactions for the entire teaching period (Figure 3). Facilitator posts appear to influence the level of learning oriented discussions undertaken. For example in week 5 there is a substantial increase in the percentage of facilitator posts – a subsequent increase in learning interactions follows for the week 6 teaching period.

A similar trend is observed in week 7 with an increase in facilitator posts and a subsequent and more sustained rise in learning interactions.
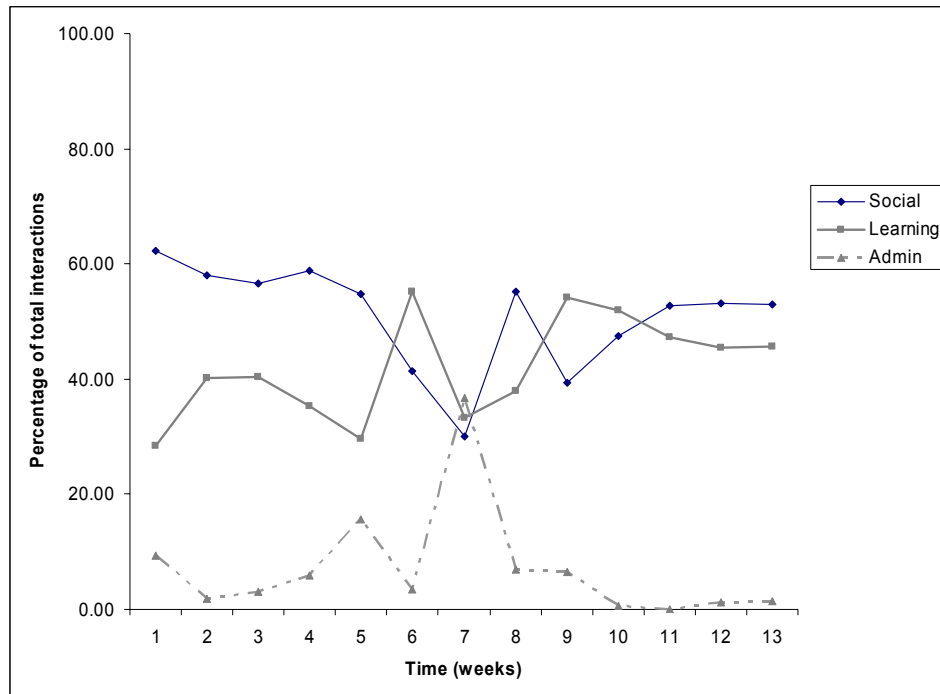


*Figure 3*. Percentages of CCS constructs of the total interactions

**Student interviews**

Comments and data deriving from the student interviews (n = 4) is located within the context of the discussion to illustrate examples and augment the interpretation of the quantitative and qualitative findings. Interview comments are presented as Students A and B reporting high CCS scores and Students C and D reporting low CCs scores (Table 5).

*Table 5*. CCS scores for the interviewed students

|  | Community | Social community | Learning community |
|---|---|---|---|
| Student A | 64 | 30 | 34 |
| Student B | 64 | 27 | 37 |
| Student C | 39 | 17 | 22 |
| Student D | 33 | 18 | 15 |
| Class mean[a] | 48.4 (SD = 8.9) | 21.7 (SD = 4.5) | 26.7 (SD = 6.3) |

[a] n = 13

## Discussion

This study investigated the relationship between an individual's position within the social network and their overall perceived sense of community. The findings demonstrate that a relationship exists between student sense of community and the position within the formed social network. The results indicate that the SNA centrality measures of closeness and degrees are positive predictors of an individual's perceived sense of community. In contrast the SNA measure betweenness, demonstrated a negative correlation with sense of community (Table 4). Furthermore, qualitative analyses indicate that an individual's pre-existing social network influences the type of support and information exchanges an individual requires and therefore, the degree of sense of community ultimately experienced.

A common theme emerging from the literature relating to community studies is the requirement for social interactions to occur in a regular and timely fashion in order to foster a sense of community among members (Palloff & Pratt, 1999; Wood & Smith, 2005). Although this may appear obvious there has been minimal large scale empirical research undertaken to substantiate this claim. Dawson (2006a) empirically demonstrates that not only is the quantity of communication episodes an important driver for community development but the types of interactions that occur within the online learning environment also influence a student's sense of community. The author maintained that discussion forums exhibiting a high level of learner-to-learner interactions demonstrate a greater student perceived sense of community.

The closeness and degree centrality measures conducted in the present study also illustrate that students engaged with a greater number of learners report a higher level of sense of community than their less socially active peers (Table 4). The degree and form of reciprocation an individual receives among a group of learners may be an influencing factor in the degree of community an individual experiences (Dawson, 2006a, 2006b). For example Vonderwell (2003), suggests that students contributing to a class discussion forum experience a degree of frustration when their messages are not reciprocated. The author also noted that an individual's specific learning requirements impact on their perception of the overall group cohesion and the effectiveness of the CMC environment to facilitate learning. Thus, the monitoring of an individual's evolving social network may act as a lead indicator of sense of community by informing practitioners of an individual's learning support requirements. For example, students demonstrating a high closeness or degree centrality may be co-located in tightly formed cliques. Hence, in this instance, students may already be receiving the forms of support and information exchanges necessary for their academic progression through the course. In contrast, students unconnected to the network may be experiencing a degree of frustration as a lack of response to their initial inquiry or statement. In this case, the isolated student requires additional bridging support to assist them in linking back to the main internal social network (See figure 2 – IV). Through active monitoring of a student's level of interaction and position in the social network practitioners are able to offer a more personalised education experience.

Cho, Stefanone and Gay (2002) have noted that the types of information and how information is shared within the CMC setting is influenced by the network structure and the interactions in which a student participates. Thus, the quantity and quality of the communication exchanges conducted can be seen to be largely influenced by an individual's personal learning and social requirements. Students exhibiting a strong content knowledge may be less inclined to engage in early elementary disciplinary exchanges. Conversely, students with limited external networks may seek a greater social attachment with the internal network and therefore invest a greater proportion of their available time in discussing a broad range of unit related and social content. Social capital is a theory that can be used to inform why students choose to invest, or not invest, in particular discussion forum activities and therefore shape the form of content and topics the cohort discusses and the manner in which the information flows through the network.

**Social capital**

Research on social capital has broadly focussed on the notion that individuals with diverse social networks have the potential to draw upon and generate a greater level of social capital (Cho et al., 2005). In the education context, students have the opportunity to access the new developing learning network in addition to any established pre-existing networks outside of the immediate environment. As such the education setting forms only a subset of the student's broader social system.

The betweenness centrality data observed in this study suggests that students occupying these positions act as bridges between previously separate cliques. Students exhibiting high betweenness scores also demonstrate high levels of interaction. The students appear to be investing substantial resources into the internal social network structure. However, the CCS scores observed for students with a high betweenness value, suggests that the expected returns did not match the overall investment. This might be a result of students exhibiting a high betweenness value accessing an effective pre-existing external social network in comparison to other class members. As such, students occupying these 'brokerage' positions may be seeking very specific supplements to their existing social capital. Consequently, these individuals might require a more specialised level of support that is not realised through the general communicative exchanges with other learners.

The quantity and quality of resources and information exchanged among the student cohort has the potential to influence their experience and hence willingness to further invest in this social organisation. Analysis of the data derived from the student interviews revealed that individuals reporting a high degree of sense of community had limited external (to the institution) contacts that could assist and discuss the unit content and review forthcoming assessment items. For example, interviewed students were asked if time spent reading and participating in the unit discussion forum was beneficial to their learning.

> Student A (high CCS score): Yes very. I live in an isolated country town and sometimes there is no adult interaction, the discussion forum gave me some sanity and connection with other adults.
> Student B (high CCS score): Yeah.. I could make sure I was on-track and my thinking about the assignments was on the same lines as the others.
> Student C (low CCS score): Yeah – it was ok if I needed more I would have done more.
> Student D (low CCS score): Not really, the comments were a bit mushy.

The comments noted above illustrate that the level of commitment and satisfaction derived from the participation in the online learning environment is influenced by the perceived benefit of student discussions. Comments made by Students C and D indicate a low commitment and level of satisfaction with the learning community.

When students were questioned about the level of additional external networks for academic and personal support utilised in completing the unit, Students A and B reported having limited external contact in contrast to Students C and D. Student A noted that additional external contacts were limited to a single family member, currently residing inter-state, and an international acquaintance. Consequently, Student A was extremely reliant on the relationships formed through the unit discussion forum in order to access additional information and materials that may assist in their academic completion. Student B, similarly indicated that external contacts were limited. This student referred to a "few work colleagues" as external contacts providing additional support, however, conversations relating to study in these circumstances were noted to be infrequent. In these instances, Students A and B had limited additional social capital to draw upon to aid in the completion of the unit tasks and as such invested considerable effort in developing and maintaining social relations with fellow class members. Conversely Students C and D both noted they had access to a high number of additional external relationships in order to discuss unit content and forth coming assessment tasks. For example, Student D stated that additional external support was frequent (fortnightly) and specific to their current area of study (work colleagues in early childhood professions). In this context, students C and D can be seen to be attempting to supplement their potential external resources via the unit discussion forum. Thus, the level and type of support a student requires becomes increasingly specialised and the ongoing lack of fulfilment results in the individual potentially considering two options. Firstly, students may opt to re-invest further in the relationship in an attempt to satisfy their expectations and requirements or alternatively, the individual abandons the relationship and re-establishes and invests in existing external social structures.

The high degree of betweenness observed in Student D is reflective of this individual re-investing in establishing social connections through the unit discussion forum. Examination of the forum postings related to this individual and the subsequent replies illustrates a mismatch between the social and learning community. Comments posted to the forum by Student D reflect a learning discourse however, subsequent replies reflect a more social and supportive discourse. Reflecting on this in the interview Student D commented:

> *The discussion weren't very (pause) the questions posted were too obscure to answer practically. The comments were all very personal and soul searching. There wasn't much education value or theoretical veracity. Too many students were talking about their children being creative - it was all very personal.*

This mismatch between investment and return impacted upon the student's overall level of community experienced.

### Social ties

Numerous authors have commented on the social dynamics between weak and strong ties and the degree of resource exchange occurring in a network (Granovetter, 1982; Haythornthwaite & Wellman, 1998; Marsden & Campbell, 1984). Essentially actors connected via weak social ties are less likely to share resources in contrast to actors connected via strong ties. Within a learning domain the development of strong ties can therefore be seen to be a goal in order to facilitate sharing of resources and information and extending this further, the co-construction of

knowledge. Analysis of the data emerging from this study indicates that the social connections formed among the student members were predominantly weak ties. For instance the overall level of sense of community reported among the student cohort appear relatively low (mean = 47.5, see table 3). Distilling the cohort into both internal and external students revealed that students undertaking the distance education program reported even lower scores (mean = 41.8, see table 3).

The codification of discussion forum interactions along a time-line (Figure 2) illustrates the consistency of the social community for the duration of the teaching period. The observed reliance on the social discussion (e.g. messages re-confirming a sense of belonging and instances of social support) could be interpreted as indicative of a community that is composed of weak social ties. As the community progresses towards a more learning oriented discourse the occurrence of students disagreeing, debating and offering contrary opinions increases. Early literature investigating asynchronous computer-mediated communication often described the medium as devoid of social cues (Sproull & Keisler, 1986). Although authors such as Rheingold (1994) highlight the benefits of this anonymity to lower social inhibitions and generate more candid conversation there is an associated increase in the risk of *flaming* or mis-interpretation which may lead to a diminishing of trust and sense of community (Daft & Lengel, 1986).

Walther (1992) argues that the CMC environment can be as rich in social cues as offline settings given sufficient time and interaction among members. However, within the education context there is a restricted time frame to form strong social bonds among members. Figure 4 illustrates a conceptual interaction pattern occurring within an educational discussion forum. In this instance, the limited degree of social interactions is used merely to supplement the learning interactions which can be seen to be the dominant discourse. The formation of this trend is more aligned with a community formed on strong social ties whereby debate and opinion are presented without affecting the trust and sense of belonging previously established through the socialisation phase. This conceptual framework is akin to Salmon's (2000) 5 step model of e-moderating. Salmon (2000) poses a methodology for online facilitators to progress a cohort through a socialisation phase (steps 1 and 2) towards discussions centred on the co-construction of knowledge (steps 3-5). The difficulty arising in the adoption of this model is the rapidity at which a cohort needs to progress through the socialisation phase in order to establish strong ties that scaffold future discussions of unit content.
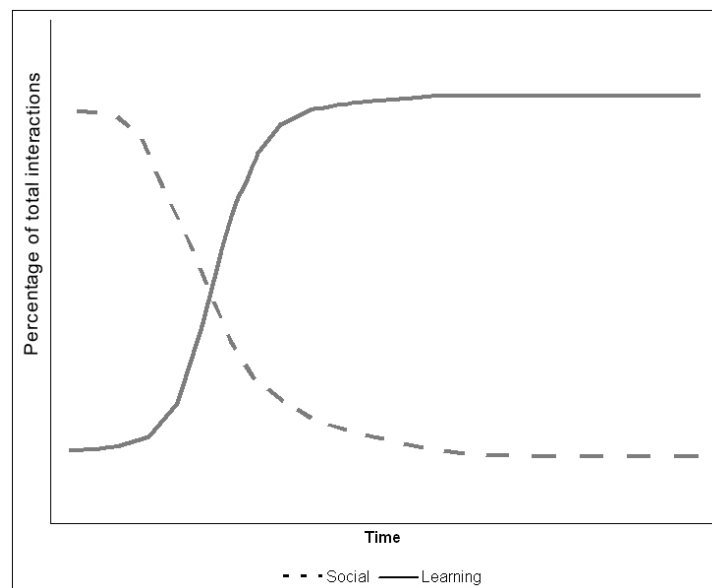


*Figure 4.* Conceptual discussion forum interaction trend

The development of the specific learning activities that promote the conceptual trend are influenced by the size of the cohort and the time restrictions associated with the administration of higher education courses. Schellens and Valcke (2006) codified 38 discussion groups to identify instances of knowledge construction. The authors note that in smaller groups there is a greater proportion of discussion devoted to knowledge construction. The findings suggest that the time required to form a strong social tie among community members is reduced as result of the small group size.

**Practical implication: Role of the facilitator**

A recommendation arising from the present study is to open the CMC environment to the student cohort prior to the official course commencement date in order to promote early socialisation. It is theorised that the shift to a learning focussed discourse will therefore, occur earlier in the course allowing for an increased opportunity for students to co-construct knowledge within a learning community.

A further recommendation is to promote and monitor facilitator input to assist in the transition of community members from social to the learning focussed discourse. Northedge (2003) has argued that the adoption of constructivist principles in higher education has resulted in a pedagogical shift from didactic teacher to facilitator (*sage on the stage* to *guide on the side*). The author further noted that this adoption is not necessarily indicative of sound learning practices. Northedge (2003) stated that a balance between "delivering knowledge" and more student-centred practices is necessary. Hence, a conscious and purposeful learning intervention is often required to shift student discourse from the social to a learning orientation. McWilliam (2005 p. 5) describes this teaching role as the "meddler in the middle". Considering the paucity of social cues and the necessity for developing a social presence in an online education environment active and substantial early involvement by academic staff can be seen to be critical for assisting students in developing a strong and effective learning network.

# Conclusion

This paper presents the findings from a study investigating the relationship between a student's position in the social network and their perceived sense of community. The findings suggest that the position an individual occupies in the social network is indicative of both their degree of perceived sense community and the nature of the academic and social support the individual requires for future progression through the course. Furthermore, the qualitative analyses illustrate that the time required to transition student discourse from a social nature towards a learning orientation forms a large proportion of the available teaching period. Therefore, additional socialisation activities are required to both facilitate the rapid formation of social relationships and to enhance the overall strength of the social ties formed.

Contemporary government and education policy continue to emphasis the requirement for institutions to demonstrate the provision of quality outcomes and practices. The integration of SNA measures with the institutionally adopted LMS can be utilised to inform practitioners of the degree of personalised support an individual student requires. Further research is required to investigate the relationship between student social networks and other dimensions influencing the student learning environment such as the specific pedagogy employed, practitioner personality and the cohort demographic profiles.

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