

Online forum discussion interactions as an indicator of student community

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Given the current diversity of communication tools at an educator's disposal, what role (if any) does the discussion forum play in the development of a strong sense of community among students? This study sought to investigate the relationship between discussion forum interaction and perceived student sense of community. The results of the study demonstrate that while mere quantity of discussion forum postings is not an indicator of community development, a significant relationship is observed when contributions are codified into the various discussion interaction types (learner - learner; learner - content; system). An implication emerging from these findings is the ability for the institution to implement evaluative measures to gauge levels of student sense of community in a just in time environment. As discussion interactions are automatically captured and reported, the data provides an indication of the degree of community developing among the student population at a specific snapshot in time. As multiple snapshots provide an ongoing indicator of community development, practitioners have the capacity to develop intervention activities designed to promote further peer to peer discussion and therefore, facilitate the development of a strong sense of community.

Introduction

The concept of community within the education milieu is becoming increasingly significant for practitioners and managers. Hargreaves, Earl and Ryan (1996) convey the significance of the concept in noting that a priority reform required in contemporary education is to foster a caring and supportive community. The emergence of community in the educational context has been demonstrated to enhance student learning through the implementation of an overarching pedagogical framework (Bielaczyc & Collins, 1999), and also addresses systemic concerns such as student attrition and levels of course satisfaction (Rovai, 2002c; Tinto, 1998). However, there exists little in the way of developmental indicators to guide practitioners in generating a sense of community among the student cohort or to evaluate the level of community experienced by students, as well as the effect of any learning and teaching activities on the student sense of community. Education studies have often utilised the various manifests of communication episodes, such as discussion forum contributions, chat logs and listservs, to determine achievement of community among the student population (e.g. Dueber & Misanchuk, 2001; Harasim, 1987; Hew & Cheung, 2003; Svensson, 2002). These studies have relied predominantly on manual codification of keywords within communication artefacts, and interpretations of quantitative measures such as number of posts and message length, to ascertain the establishment of community among the student population. While the findings derived from this research approach have provided valuable information regarding strategies for implementing community centred teaching practices, the evaluation methodologies employed are often reactive and limited in generalisability due to the small experimental design. Rather than seen as a criticism of previous research, the sheer volume of data involved for large scale qualitative analyses renders such studies as impractical. The adoption of more quantitative approaches affords the implementation of a scalable and proactive evaluation methodology. This paper explores potential scalable, quantitative indices of community that may

serve to guide and inform practitioners of the progress of implemented learning and teaching episodes.

This study aimed to investigate the relationship between asynchronous forum contributions and the degree of sense of community established among the student population within a large Australian metropolitan university. To address this aim, the paper firstly explores the dynamic between government policy and education practice, leading to a discussion of the concept of community as a psychological construct. The paper then presents a case for assessing community through quantitative methods incorporating the tracking of student (IT) user behaviours. Finally the paper discusses the findings of a large scale quantitative study, illustrating the applicability for data mining techniques to inform teaching practice and the relationship between student communication interactions and sense of community.

Background

Recent Australian government policy changes regarding the higher education sector have resulted in a reduction in the level of government funded support for tertiary institutions (Minister for Education Science & Training, 2002). One consequence of this change in government funding is that universities have developed alternative sources of income. In particular, enrolment of international students has been targeted by the Australian universities as an avenue for additional income (Gomes & Murphy, 2003; Mazzarol, Soutar & Seng, 2003).

Changes in government policy have not only altered the day to day functioning of institutions but also has impacted upon the study and employment characteristics of the traditional student cohort. The rising cost of education has resulted in an increased number of traditional on campus students undertaking part time employment (Ford, Bosworth & Wilson, 1995). Consequently, student participation in on campus learning activities is often secondary to personal and financial commitments.

The growing demand for increased student numbers and the associated increase in student diversity (Gomes & Murphy, 2003) has required universities to adopt more flexible approaches to delivering education. In particular, the integration of information and communication technologies (ICTs) has been promoted as a means for providing flexible delivery (Flew, 1998) whilst maintaining quality of education standards. The distinction between distance and traditional modes of education is becoming blurred as both on and off campus students access education material through multiple modes of delivery. Lecture content is now placed online and may also contain components of audio or video streaming. Thus, the dissemination of course content is being supported for multiple modes of enrolment through various formats of delivery. However, while the current student cohort can access unit information, the degree of collaboration between peers and teaching staff is potentially inhibited as a result of reduced face to face opportunities for interaction.

The integration of computer mediated communication (CMC) is one approach to overcome the spatial and temporal barriers often associated with collaborative learning (McKenzie & Murphy, 2000). Although many authors advocate the integration of both synchronous and asynchronous CMC for collaborative learning activities (Curtin, 2002; Haythornthwaite, Kazmer & Robins, 2000; Wang & Newlin, 2001), the flexible affordances associated with an asynchronous medium have resulted in greater acceptance and adoption among educators. In particular, discussion forums have gained popularity, providing avenues and opportunities for social interaction among an increasingly disparate student cohort.

Resulting from this almost ubiquitous integration of discussion forums among education practitioners is the capacity to track and analyse the evolving student discourse (Holt, Kleiber, Swenson, Rees & Milton, 1998). These data can be applied with novel methods to generate new insights into the design of learning and teaching practices, and the overall student experience. As

educators are called upon to illustrate quality learning experiences, the quantitative data generated through CMCs may be readily applied to an overarching theoretical framework to inform practitioners of the achievement of student outcomes, and alignment with the initial learning design.

The concept of community as a theoretical framework for teaching and learning is gaining increasing momentum within the academy. Thus, the application of scalable, automated, fine grained, quantitative analyses may further our understanding of how community develops and the types of interactions necessary to foster a strong sense of community among the student cohort. The following section frames and defines the term community within the context of this study.

Defining community

Educators' understanding of the learning process is transitioning from cognitive theories based on the individual to theories that stress the importance of the social nature of learning (Barab & Duffy, 2000). Central to this epistemology have been the foundational theories of Vygotsky and Dewey who view learning as a social process. Dewey (1938/1963) suggests that the value of education is only realised when the individual becomes a component of the social group. Current popularity of the term community illustrates this epistemological transition and adoption of socially oriented theories of learning by education practitioners.

Literature relating to social constructivist practices has emphasised the importance of developing a community of learners (or learning community) for effective and efficient collaboration and knowledge construction among the student cohort (Bielaczyc & Collins, 1999; Gabelnick, MacGregor, Matthews & Smith, 1990). The educational benefits deriving from fostering a community of learners have been well documented. For instance, Rovai (2002c) in his study on community and learning suggests a positive correlation exists between sense of community and cognitive learning. Rovai demonstrates that students indicating a strong sense of community exhibit increased perceived cognitive learning, course satisfaction, and feel less isolated and are, therefore, more likely to persist with their course of study than their less community oriented peers. Similarly, Tinto (1993) links the establishment of learning communities with reduced student attrition rates in community colleges.

While research in these areas has advanced our understanding of the learning process and community development, the direct comparison between educational studies undertaken is problematised through the variety of definitions and contexts adopted. For example, the term has been applied to a range of educational strategies from collaborative virtual environments (Stacey, 1999), integrated course curricula (Smith, MacGregor, Matthews & Gabelnick, 2004; Tinto, 1998), and undergraduate interest groups (Staasen 2003), to residence based programs (Shapiro & Levine, 1999, p. 36). Despite this diversity of applications of the term within the literature, there is a growing consensus among educators to define and measure community as a psychological construct (Anderson, 2004; Brook & Oliver, 2003b; Dueber & Misanchuk, 2001; Rovai, 2002a). Thus in this context, the notion of community is often expressed as a sense of attachment or belonging to a particular group.

Defining community as a psychological construct also provides researchers with alternative methods of measuring community. The current primary method of evaluating community within education studies is to formulate a set of characteristics that underpin the definition of community. The analysis of the data is then framed within this developed schema to provide an indication of the presence or absence of community (Dueber & Misanchuk, 2001; Holt et al., 1998; Wang, Sierra & Folger, 2003). What is often lacking in these studies is a quantifiable determination of the strength of the social ties among the student cohort and, therefore, the level of community developed. One approach to address this deficit is to adopt a psychological scale to measure an individual's perceived sense of community. Rovai (2002b) developed and validated the Classroom Community Scale (CCS) to quantitatively measure the degree of student sense of community. Although the scale incorporates

the theoretical framework posed by McMillan and Chavis (1986), the instrument has been designed specifically for the education context.

Quantitative approach

The difficulties in gathering qualitative data concerning student sense of community have often resulted in methodologies being restricted to a single unit of study. However, the adoption of a quantitative approach offers new opportunities of scalability to ascertain indicators of community development across a broad range of organisational levels. Heathcote and Dawson (2005) espouse the incorporation of user and systems information derived from student and staff interactions with the institution's specific learning management system (LMS). These authors suggest that the quantitative data can be used to evaluate learning and teaching practices through the tracking of behavioural changes at various levels within the institution. Merging the CCS data with student online communication interactions yields an indication of how teaching practices are influencing community development. This method does not profess to provide a thorough analysis of sense of community in an education environment. However, the identification of a relationship between student online communication interactions and the CCS does provide practitioners with a method that can be used to proactively monitor the impact of designed learning activities on the development of community. While this approach lacks the level of interrogation and detail that a qualitative methodology produces, the approach does afford the development of potential lead and lag indicators that are both scaleable and ongoing in nature.

This study aimed to investigate the relationship between asynchronous forum contributions and the degree of sense of community established among the student population within a large Australian metropolitan university utilising a quantitative approach. Specifically, the study addresses the following research questions:

- Does the quantity of forum contributions influence the degree of sense of community experienced among the student cohort?
- Does the percentage of learner to learner (student to student) postings deriving from a unit discussion forum influence the degree of sense of community experienced among the student cohort?

Methodology

Study overview

This study forms a component of a larger investigation aiming to examine the relationship between student communication and sense of community within the education faculty of a large metropolitan university. Study participants were enrolled in either undergraduate or postgraduate units within the Faculty of Education. All teaching units ($N = 21$) selected for the study contained additional supplementary online learning and teaching resources such as lecture notes and presentation materials, as well as asynchronous, computer mediated communication software. Units that did not possess online discussion forum activities were excluded from the study. The sampled units were available for internal, blended or external modes of enrolment. Internal mode of enrolment is defined as all students undertaking on campus study, such as face to face lectures and tutorials. However, while internal students are participating in an on campus mode of study, attendance is often not mandatory. Blended modality refers to a hybrid of online learning resources and traditional face to face teaching practices. Students may elect to attend offline classes or attendance may only be required for a small portion of the teaching semester. The external mode of enrolment refers to study undertaken off campus, utilising the online environment.

Initial data were collected from an online survey. In addition, information on unit discussion forum contributions derived from student participation over the course of one semester of study was

collated by the institution's in house learning management system. The percentages of forum interaction types occurring at a unit level were then correlated with student perceived sense of community as measured by the online survey. From the pool of 2017 students enrolled in the identified units, 22% completed the online survey ($N = 441$). All teaching units involved in the study ($N = 21$) were represented in the returned student online survey responses. Delimiting the sample population into gender and mode of enrolment revealed that 84% of the respondents were female, 16% male, 81% were enrolled via the internal modality and 19% undertaking an external mode of study. The participant demographics observed in this study are consistent with the general education faculty student population.

The discussion forum data

Student contributions to the unit discussion forum were analysed and reported using the institution's in house learning management system (LMS). The in house developed evaluation system associated with the LMS provides detailed summaries of the discussion interaction data, such as new threads versus replies to existing threads, and the quantity of posts and replies by staff versus students. The unit discussion forum contributions ($N = 2179$) were recorded and classified by the evaluation system into the modes of discussion forum interactions as defined by Burr and Dawson (2003). The authors define the interaction types as:

1. Learner-learner: includes all postings involving direct interaction between peers (e.g. a student posts a contribution to the discussion forum and a fellow student replies to the initial thread);
2. Learner-content: refers to all postings between teaching staff and students;
3. System: includes all orphaned postings, i.e. no discussion is associated with the original contribution.

The Classroom Community Scale

An online survey was utilised to ascertain the level of sense of community experienced by the sampled student cohort. Sense of community was calculated using Rovai's (2002b) Classroom Connectedness Scale (CCS). The online survey consisted of 20 self reported items such as "I feel that students in this unit care about each other" and "I feel that I am encouraged to ask questions". Students were requested to rank each item according to a five point Likert scale (strongly agree, agree, neutral, disagree and strongly disagree). Item rankings were then converted to a quantitative score ranging from 0-4. Overall sense of community is then calculated by computing the cumulative scores, with community scores potentially ranging from a minimum of 0 to a maximum of 80. The CCS comprises two sub-scales termed connectedness and learning community (Rovai, 2002b). Rovai (2002b) relates the sub-scale connectedness to the degree of belonging and membership experienced by the student. Rovai and Wighting (2005) have more recently referred to the term connectedness as social community. The sub-scale learning community is described as the "extent to which learning goals are being satisfied" (p. 202).

Validation of the Classroom Community Scale

To ensure robustness of the implemented CCS, validation proceeded in three discrete phases. As the CCS was designed within a North American context, a preliminary student focus group was employed to locate any items of ambiguity or potential misunderstanding. Based on the student feedback the CCS was revised to address the cultural differences in terminology and definitions. For example the CCS utilises the term 'course'. In the Australian context a 'course' is commonly defined as a series of linked units of study in contrast to the North American interpretation of 'course' as an individual unit. The next phase of validation involved the implementation of a pilot study ($N = 160$). The pilot study data were assessed for factorial validity using exploratory factor analysis (EFA). The resulting constructs deriving from the EFA were comparable to those established by Rovai (2002b).

Strijbos, Martens, Prins and Jochems (2006) stress the importance of implementing measures of reliability for studies utilising a quantitative methodology to ensure subsequent interpretations are based on potentially replicable data. To ascertain the degree of reliability, this study employed statistical measures such as Cronbach's alpha and Guttman split half coefficients. The analyses demonstrated excellent reliability and consistency with Cronbach alpha and Guttman split half coefficients of 0.90 and 0.89 respectively for the CCS. More refined analysis of the CCS sub-scales also revealed excellent reliability and consistency. The sub-scale social community resulted in a 0.86 Cronbach alpha and 0.85 Guttman split half coefficient. Similarly, for learning community excellent reliability was observed with a 0.84, Cronbach alpha and 0.76, Guttman split half coefficient. As the survey demonstrated acceptable factorial validity and reliability as demonstrated by EFA, Cronbach's alpha and Guttman split half coefficient, the remaining stage involved the marketing of the survey to the intended broader sample population.

Correlations

Statistical analyses were conducted to investigate the relationship between forum contribution interactions and student sense of community. Specifically, a simple parametric correlation was employed to ascertain the degree of relationship between the variables.

Results

Descriptive analyses

Descriptive statistics were conducted to ascertain the overall student sense of community and the degree of discussion forum interactions occurring within the Education units sampled (Table 1). The mean sense of community established among the units sampled was calculated from individual student responses ($N = 441$) to the CCS survey. The mean student age for all study participants ($N = 441$) was 28.3 years ($SD = 3.6$) with an average employment workload of 20.3 ($SD = 9.5$) hours per week. Table 1 summarises the general descriptive statistics for student sense of community and the specific codified discussion forum interactions.

Table 1: Means and standard deviations for: a. community and the associated sub-scales; and b. number of posted messages per unit for the specific codified forum interaction type.

a. Student sense of community	Community*	Social community	Learning community
Mean ($N = 21$)	46.2 ($SD = 6.5$)	20.2 ($SD = 4.2$)	26.0 ($SD = 3.3$)
b. Forum interactions	Learner-learner	Learner-content	System
Mean ($N = 2179$)	39.3 ($SD = 62.5$)	15.9 ($SD = 23.1$)	48.5 ($SD = 77.1$)
* Community is equal to the sum of the 2 constructs social community and learning. Community scores range from a maximum of 80 to a minimum of 0.			

Community and forum interactions

Examination of the relationship between the quantity of discussion forum contributions and sense of community revealed no significant correlation (Table 2). In order to investigate the relationship between specific categories of forum interaction and community, student and staff contributions were codified into three interaction types (learner-learner; learner-content; and system). Each forum interaction category was then correlated with data deriving from the student responses to the CCS using Pearson's correlation coefficient (r). Significant correlations were observed between sense of community and the specific discussion forum interactions (Table 3). The analyses indicate a moderate relationship ($r = 0.479$) between the degree of learner-learner interactions and student

perceived sense of community.

Harasim (1987) endorses the categorisation of forum interactions and suggests that the most important forum interactions for enhancing the learning process are student to student (learner-learner) and staff to student (learner-content). Building upon the methodology of codifying forum interactions, Schire (2006) differentiates between participation and interaction. The author argues that contributions that are not responded to, in this case system interactions, do not contribute to the knowledge building process. Similarly, Garrison, Anderson and Archer (2001) maintain that an active teacher presence (learner-content) is required to support students in developing higher order cognitive skills. Hence, the aggregation of learner-learner and learner-content interactions (cumulative learner interactions) provides an indication of the degree of social and learning interactions occurring among the teaching staff and student cohort, in contrast to measuring levels of mere participation. Examination of the relationship occurring between the cumulative learner interactions and community indicates a significant correlation ($r = 0.504$). A significant correlation was also observed between the sub-scale social community and the percentage of cumulative learner interactions ($r = 0.576$). In contrast, no significant relationship was observed between the sub-scale learning community and the percentage of cumulative learner interactions. Table 3 summarises the correlations observed between the codified forum interactions and community for the sampled population.

Table 2: Correlation between quantity of discussion forum contribution and community ($N = 2179$)

	Community	Social community	Learning community
Total forum contributions	$r = 0.351$	$r = 0.381$	$r = 0.213$

Table 3: Correlations between discussion forum interactions and community

Interaction type (1)	Community	Social community	Learning community
System	$r = - 0.504^*$	$r = - 0.576^{**}$	$r = - 0.267$
Learner-content	$r = 0.127$	$r = 0.216$	$r = - 0.024$
Learner-learner	$r = 0.479^*$	$r = 0.460^*$	$r = 0.365$
Cumulative learner interactions (a)	$r = 0.504^*$	$r = 0.576^{**}$	$r = 0.267$

1. Specific interaction is calculated as a percentage of the total contributions occurring within the unit discussion forum.
 ** Correlation is significant at the 0.01 level (2-tailed).
 * Correlation is significant at the 0.05 level (2-tailed).
 a. Cumulative score calculated from the percentage of learner-learner and learner-content interactions occurring within the Unit discussion forum.

Discussion

This paper reports on a study investigating the relationship between student forum contributions and sense of community. The findings demonstrate that a significant relationship exists between the quantity of learner to learner contributions undertaken in a unit discussion forum, and the student reported level of sense of community. Additionally, a negative correlation was observed between student sense of community and the number of system posts (contributions that were not replied to) that emerged within the discussion forum.

Quantity or quality?

Numerous researchers have suggested that there is a necessity for student participation within online asynchronous CMC in order to foster a community of learners (e.g. Hiltz, 1994; Palloff & Pratt, 1999; Rafaeli, Ravid & Soroka, 2004; Wood & Smith, 2005). Despite this assertion, there has been little large scale empirical research conducted to substantiate this claim. The results of this study demonstrate that the quantity of forum postings alone is not an adequate indicator of community development. Forums exhibiting a high volume of communication traffic do not necessarily equate to the establishment of a strong sense of community. However, the data deriving from this investigation do illustrate that the degree of social interplay between students, and students and teaching staff, is an influencing factor in facilitating community development. Essentially, forums exhibiting a greater percentage of learner interactions (learner-learner and learner-content) demonstrate a stronger sense of community (Table 3).

Vonderwell (2003), in her study examining student and staff perspectives of online communication, noted that students contributing to the forum experience a degree of frustration when their messages are unrequited. Similar conclusions can be drawn from this study, as units exhibiting high levels of system posts (orphaned contributions) demonstrate a lower reported level of student sense of community. The lack of social interplay among students provides teaching staff with an indication of the degree of community development, and the potentially high level of student frustration and dissatisfaction. The monitoring of the quantity and type of student postings provides a snapshot of the potential level of community evolving among the student cohort. Therefore, educators have the capacity to implement and then monitor learning intervention episodes to encourage greater learner-learner interaction.

Social presence online

This study demonstrates the existence of a correlation between student sense of community and the degree of specific discussion interaction types occurring within a unit forum. The correlation was observed between the overall student sense of community and the sub-scale social community. No significant relationship was observed between the sub-scale learning community and discussion interaction types. One possible explanation for the lack of correlation with the learning sub-scale is that discussions manifesting within the unit forums are more associated with aspects of socialisation in contrast to discussions relating to shared learning goals and outcomes. However, the development of an online social presence is a necessary initial phase in order to foster sense of community. Tu (2002) maintains that the implementation of online introductory socialisation activities affords the development of a "trust relationship" among the participants. This relationship then becomes the foundational layer for further community development.

The lack of correlation observed with the sub-scale learning community may be an indication of the time required for developing an online social presence, particularly given that with the discussion forum medium a textual interface is the sole mechanism for creating an identity online. Within the offline environments, non-verbal communication cues provide a source of information to interpret an individual's social identity. For example, Donath (1999) states: "...the body provides a compelling and convenient definition of identity" (p. 29). However, within the online domain the absence of visual and auditory cues results in an emphasis on the textual artefacts of communication in order to establish an identity. Consequently, developing the foundational layer of social community through establishing an identity and moving through online socialisation may absorb the greater part of the semester, and may therefore limit the opportunity for students to engage in a more learning oriented discourse.

A study undertaken by Gunawardena (1995) illustrates that the rapidity and level of social presence formed online is influenced by the instructors' ability to generate discussion. Hence, the period of socialisation may be reduced through the implementation of effective instructor led social activities

and thus, provide increased opportunity for a more learning oriented discourse to emerge among the forum participants.

Conclusion

The current education climate emphasises the requirement for embedding both community and online technologies in unit curricula, in order to enhance the overall student learning experience. While this drive has an economic imperative (Dawson, Burnett & O'Donohue, 2006), researchers have also demonstrated the pedagogical value of fostering a strong sense of community enacted via the implementation of collaboration and communication centred online technologies (Brook & Oliver, 2003a; Dawson, Winslett & Burr, 2004; Palloff & Pratt, 1999; Salmon, 2000; Scadarmalia & Bereiter, 1994; Wellman & Gulia, 1999). This study has demonstrated that a relationship exists between the level of community experienced among a student cohort and the discussion interaction types occurring within an asynchronous CMC. Deriving from this relationship is the capacity to ascertain levels of student sense of community in a just in time environment. Lecturers and instructors can track student discussion online (via the institution's adopted LMS) to obtain an indication of the level of community emerging among the student populace. As monitoring student online behaviour is an organic process, practitioners have the capacity to develop intervention activities designed to promote further peer to peer discussion and therefore, facilitate the development of a strong sense of community.

Potential sources of Australian government funding are increasingly dependent upon student satisfaction ratings, garnered from post-graduation surveys. Consequently the ability to monitor student satisfaction prior to graduation provides a potential lead indicator to preliminarily assess future student ratings and therefore the degree of possible funding secured. The quantitative approach adopted in this study is scaleable in nature and therefore may be extrapolated to the broader institution to ascertain levels of student sense of community. While this study has addressed one domain of student satisfaction, Williams (2002) maintains that satisfaction is influenced by both the learning environment and learning process. Hence while the evaluation of community within units may provide a framework for assessing sense of community and thereby levels of student satisfaction, the incorporation of parameters relating to the learning process would result in a more holistic and accurate representation of student satisfaction.

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Please cite as: Dawson, S. (2006). Online forum discussion interactions as an indicator of student community. *Australasian Journal of Educational Technology*, 22(4), 495-510.
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Created 8 Nov 2006. Last revised 8 Nov 2006.