Comparing the Social Interaction Pattern of Online One-on-one Peer and Small Group Collaboration Activities

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Abstract

This paper investigates how students' experience in an online learning environment varies across small group and one-on-one peer activities. Particular attention is paid to measures of sense of community and social ability. A multiple data analyses, including statistical analysis and social network analysis (SNA), are used to triangulate findings. The statistical findings show differences in perceived sense of community and social ability between different group compositions. The findings are confirmed by interaction patterns found in SNA.

1. Introduction

Since learning is a social activity [1], a common element for learning in a typical classroom environment is the social and communicative interaction between students and a teacher, and students and other students. However, interactions that occur in a typical classroom cannot be directly translated to online learning. Online learning requires new behaviors on the part of students and teachers to include social interaction in ways that support learning with and from others. Following [2] articulation of situated learning as a function of the activity, context and culture in which it occurs, the teacher's ability to structure learning tasks so as to foster social interaction is recognized to be a critical component of online learning. Some approaches have shown promise. For example, carefully designed types of activities involving group projects or discussion [3] can enhance interactions among students and incorporating small group activities in the online learning process has been shown to increase both interaction among students and sense of community experienced[4]. As a result, there has been an increased emphasis placed on implementing educational practices that foster online learning as a social and interactive activity [5-6]. However, low levels of social interaction among students continue to be reported in online learning environments [7-9].

The importance of social interaction to learning, combined with the low levels of such interaction fostered by current online learning technologies and pedagogies, motivates the research team to focus on the fringe of online learning experiences – Those cases where social interaction actually occurs – in a search for patterns. New knowledge is needed about the mechanisms and structures that impact online social interaction in order to help instructors create online learning environments that take advantage of the social nature of learning.

We seek to understand the social interactions of students in an online course through social network analysis, and then relate that analysis to the social constructs of online learning. Thus, the purpose of this study is to explore how students comparatively experience the social nature of online learning and act when learning in different types of scaffolded social conditions. For this study, the two conditions are small group activity and peer to peer (buddy) activity. The research questions for this study are: (1) How do users experience course interaction across different group compositions, and (2) How does group composition influence sense of community and social ability in online learning?

2. Theoretical Perspectives

2.1. Sense of Community & Social Ability

How interaction supports the learning process follows from the recognition of the situatedness of learning. Situated learning [10] is a framework for understanding learning and cognition that articulates the role of social interaction. Learning is considered an integral and inseparable aspect of the social practice within a classroom community [11]. Interaction in online learning can be classified as: learner-content,

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learner-instructor, learner-learner, learner-interface/technology [12-13], and learner-self interaction [14]. According to [15], sense of community is a result of interaction and deliberation by people brought together by similar interests and common goals. Learner-instructor and learner-learner interactions seem to have impacts on building and sustaining a sense of community among members in online learning environments. [16] indicated that a key for building and sustaining a sense of community is to facilitate social interaction among students who reported feeling higher levels of interaction make them feel better sense of community in class.

Research shows that sense of community enhances persistence in online courses and increases the flow of information and cooperation among learners, commitment to group goals, and satisfaction with group efforts [17].

Social ability describes how able members are to use the resources of the social context to achieve important goals [18]. Social ability is a relationship between people, tools, and activities in the online learning environment [18]. Research to date has identified two primary characteristics of social ability in online courses: social presence and social navigation [18]. Social presence is defined as "an attribute of computer-mediated activity, derived from media studies about how effectively media (TV, etc.) convey the sense that mediated participants were really present [19]". Social navigation is understood as "a construct representing being aware of what others are doing as a primary guide for one's own action" [18, p.166]. [20] divided social presence into social presence with peers and social presence with the instructor because they found students perceived peer and instructor presence differently. Additionally, [21] showed that social ability has predictive power for students' online learning satisfaction. Further, [22] examined relationships among students' social ability, sense of community, and learning satisfaction and discovered that social ability directly contributes to explaining the variability of sense of community and impacts students' learning satisfaction indirectly because the relationship is mediated by sense of community.

2.2. Social Network Analysis (SNA)

Social network analysis [23] is a method that incorporates mathematics and a visualization map to represent information about patterns of ties among social actors in a network. SNA focuses on the study of the interrelationships among individuals and introduces structural variables to measure them. There are two approaches to study SNA – an egocentric approach and a sociocentric approach. The egocentric approach focuses on networks of relations surrounding individuals rather than focusing on the whole society while the sociocentric approach focuses on measuring the structural patterns of those interactions and how those patterns explain outcomes. We focus on the sociocentric approach in this study.

The following measures are used as SNA indexes to provide basic information about the activity of actors in the network and about the network structure.

2.2.1. Network Density. This is the proportion of ties in a network relative to the total number possible (sparse versus dense networks). A fully dense network has a network density value of 1 (above one when data contain edge weights), which indicates that all nodes are connected to each other. A network with a density value near 0 indicates that it is a sparsely-knit network. For an undirected graph with N nodes and M ties the density D is defined as $D= 2M / N (N-1)$. This measure implies proximity of actors in the network.

2.2.2. Centrality Degree. The count of the number of ties to other actors in the network. It reports the centrality of actors and the overall centralization of the group. This can be computed in forms of in-degree (incoming tie to an actor) and out-degree (outgoing ties from an actor). If an actor receives many ties, they are often said to be prominent, or to have high prestige because many other actors seek to direct ties to them. Actors who have unusually high out-degree are actors who are able to exchange with many others, or make many others aware of their views. Actors who display high out-degree centrality are often said to be influential actors.

2.2.3. Network Centralization. It is a difference between the number of links for each node divided by maximum possible sum of differences. A centralized network will have most of its links dispersed around one or a few nodes, while a decentralized network is one in which there is little variation between the number of links each node possesses.

2.2.4. Reciprocity. This measure represents if the relationship of a pair of actors is one-way or two-way. Reciprocity can be regarded as an important indicator of the stability and institutionalization of an actor's position in the social network.

3. Methodology & Results

3.1. Context & Procedure

The data were gathered from an eight-week online graduate course at a large midwestern university in the U.S. during the Summer semester 2006. The course was delivered fully online using the Sakai 2.0 course management system. The course modules which made up the course all included collaborative learning, but were organized as either small group (3-4 members) or one-on-one peer activities. In each module, the instructor assigned students to work as groups or as pairs in order to complete certain learning tasks. For small group activities, assigned members worked together as a team to design a CSCL lesson with the objective of implementing the lesson for 2 other teams in next module. For peer activity, students posted their individual work in discussion boards for others to review. Each student was required to serve as a reviewer of peers by providing feedback in the discussion board for their assigned buddy. During these activities, students were free to use the discussion board, chat room, and other resources available in Sakai to accomplish the task. The research team recognizes that a number of interactions in the small group activity may take place outside of the course tool (e.g. email). However, the tools of the course site were the primary tools for students to use.

Surveys were administered electronically at the end of the module. All 21 students were invited to participate in this research project, and a total of 17 students completed the consent form. Additionally, student activity within the online course was recorded automatically in log files of the Context-aware Activity Notification System (CANS) [24] during the eight-week course.

3.2. Participants

A total of 17 students completed both group and peer activity surveys, while all 21 students' log file entries were collected in CANS. Table 1 presents the demographic information for these participants.

3.3. Instruments

3.3.1. Sense of Community. To measure students' perception of sense of community within a learning activity, six items were adapted from the 20 items of Classroom Community Scale [17]. Students were asked to rate their level of agreement on a 7-point Likert scale where "1" represented strongly disagree and "7" represented strongly agree.

3.3.2. Social ability. To measure students' perception of social ability, 11 items were adapted from an Online Learning Experience Study Questionnaire [20]. Items from the original instrument used to measure three subscales of social ability were included: social presence with peers (3 items, α =.865), social presence with instructor (3 items, α = .764), and social navigation (5 items, α = .859), were included in the survey items for this study. The Cronbach α reliability estimates from our data were .895 for social ability. Below are some sample items asked in the survey. For example, "my interaction with the instructor are sociable and friendly" is a question for (social presence with instructor", while "my interactions with other students are sociable and friendly" is asked for social presence with peers. "Knowing that other students in the course are aware of my work usually influences how hard I work and the quality of my work" is one of the items for social navigation.

Table 1. Demographic information

Demographic Information		Number of Participants	Percentage (%)	Total
Gender	Male	11	64.71	17
	Female	6	36.29	
Language	Native Speaker	15	88.24	17
	Non-native Speaker	2	11.76	
Academic Status	Undergraduate	0	0.00	17
	Graduate	17	100.00	
Previous Online Courses	0-1 courses	1	5.89	17
	2-5 courses	4	23.53	
	> 6 courses	10	58.82	
	Missing	2	11.76	
Hours Login (weekly)	< 5 hr.	2	11.76	17
	6-10 hr.	9	52.95	
	> 10 hr.	4	23.53	
	Missing	2	11.76	

3.4. Results & Data Analysis

Students' perception of their sense of community and social ability were analyzed with T tests, whereas students' logs file were analyzed by applying social network analysis techniques.

3.4.1. Dependent-samples t-test. Dependent-samples t-tests were employed for comparing students' ratings of sense of community and social ability between group activity and peer activity. The results of dependent-samples t-test are shown in Table 2.

The obtained t value of sense of community shows that students' sense of community in small group activity (M=4.53, SD=.56) was significantly greater than that in peer activity (M=4.21, SD=.94). Additionally, students perceived significantly higher social ability in small group activity (M=5.95, SD=.81) than in peer activity (M=5.55, SD=.80). When examining the sub components of social ability both social presence with instructor and social navigation showed statistically significant differences across

activity types. The results show that students experience group work at least in the context of the course activities studied as more social than peer work.

Table 2. Dependent-samples t-test results

Constructs	Small Group Activity		One-on-one Peer Activity		T-test 95% C.I.		t
	M	SD	M	SD	Lower	Upper	
Sense of Community (SOC)	4.53	.56	4.21	.94	.00	.63	2.15*
Social Ability (SA)	5.95	.81	5.55	.80	.11	.68	2.96**
Social Presence with Peer (SPP)	5.93	1.09	6.02	.72	-.56	3.75	-.425
Social Presence with Instructor (SPI)	5.78	.92	4.99	1.12	.33	1.26	3.60**
Social Navigation (SN)	6.06	.91	5.60	.93	.03	.89	2.26**

Note: N=17, t_{cv} (16)= 2.12 (*, α = .05), t_{cv} (16)= 2.58 (**, α = .01)

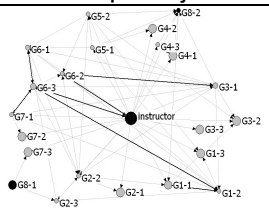
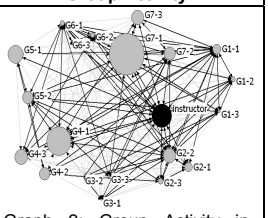
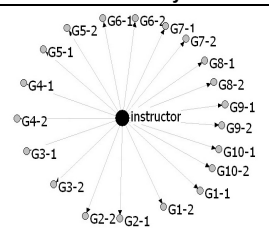
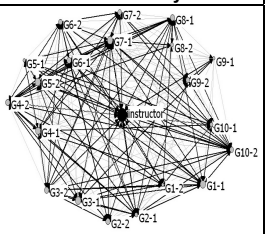
3.4.2. Social network analysis. In this section, SNA graphs and results derived from SNA are presented. NetDraw was employed for representing the social network among members, and UCINET6 was utilized for deeper examination of the relationships among members through quantitative analysis. The following types of interactions were included in the study:

- Addition of documents or other artifacts to a shared repository. These acts are noted by a Resources.new event.
- Reading of documents or other artifacts present in a shared repository. These acts are noted by a Resources.read event.
- Creating new posting to new or existing discussion threads. These acts are noted by a Discussion.new event.
- Reading of existing discussion threads. These acts are noted by a Discussion.read event.

In this study, students and the instructor are the actors (represented as nodes) and links between a pair of actors represent interaction (communication and information exchange) between them. For example, an outgoing tie from an instructor node to a student node means there is a flow of information from the instructor to the student.

Table 3 shows that for both small group and peer activities, students interact more through discussion boards than resources. This might be explained by the nature of the tasks students were asked to perform in the discussion board to accomplish the work. More specifically, in group activities, students debated, reviewed, discussed, and exchanged their ideas through the discussion board and the final products were then uploaded to the resources space. By contrast, in peer activity students were asked to review their buddy's work, which was available in the resources area, and to post feedback in the discussion board.

Table 3. SNA graphs for each activity type

Resources	Discussion Board
Group Activity	**Group Activity**
	
Graph 1: Group Activity in Resources (including the instructor)	Graph 2: Group Activity in Discussion Board (including the instructor)
Peer Activity	**Peer Activity**
	
Graph 3: Peer Activity in Resources (including the instructor)	Graph 4: Peer Activity in Discussion Board (including the instructor)

Note: 1) Black line represents reciprocal interaction. Gray line represents uni-direction; 2)Size of a node represents amount of information created by students and an instructor; 3) Node with the same initial code indicated that students were assigned to the same group. For example, node 'G1-1' represents member 1 of group1 and node 'G1-2' represents member 2 of group1.

The graphs of discussion board activity (see Table 3, Graph 2 and 4) show the difference in the amount of total information created (e.g. Resources.new and Discussion.new events) for each person by varying the size of the nodes in proportion with the amount of participation from the represented individual. The size of the nodes in the small group activity is diverse, while the size of nodes in peer activity is close to equal. On average, the proportion of the nodes in small group activity is larger than that in peer activity, which indicates that students working as small groups tend to post and reply more for accomplishing the collaborative learning task than students in pairs. Additionally, the number of lines between nodes varies. The graphs clearly illustrate that students in peer activity had more reading activities than posting activity. They read others' work but did not give feedback if they were not assigned to be the buddy of the authors. In addition, students in both small group activity and peer activity tend to interact beyond assigned groups or buddies. As the graphs show that there are arrow links among different groups of nodes (same first-two node characters represents same group). The clear inference from this data is that the amount and type of social activity in the studied environment varies based on the nature of the activity

and instructions provided by the instructor. While this finding is not surprising, the SNA technique allowed us to see how the group activity influenced students to be expansive in their social interaction while the peer activity elicited only the activity prescribed by the instructor.

Table 4. The network density of the interaction for each activity type

	Network Density		Standard Deviation	
	Resources	Discussion Board	Resources	Discussion Board
Small Group Activity	0.6415	2.6169	2.9606	4.7689
Peer Activity	0.3276	2.3656	2.0102	2.9176

Network density in small group activity indicates that students more frequently interact with each other and with the instructor in group activity than in peer activity. This suggests that the level of cohesion is high and there is more linkage among students in this activity type. For both activity types, students have more interaction through discussion boards than in the shared resource space.

The network centralization index (Table 5) shows ,on average, students working in small groups tend to have more information sharing and file exchange in resources (outdegree: 46.679% > 35.490%; indegree: 2.921% > 2.448%), additionally they also have more information sharing in the discussion board (outdegree: 27.738% > 19.292%). The results for the peer activity showed students tend to read instead of post, the indegree value for the discussion board indicates a higher value for the peer activity than for the small group activity (indegree: 12.332% < 24.341%).

Table 5. Network centralization

	Resources		Discussion Board	
	Out-degree	In-degree	Out-degree	In-degree
Small Group Activity	46.679%	2.921%	27.738%	12.332%
Peer Activity	35.490%	2.448%	19.292%	24.341%

3.5. Discussion

In conclusion, this research has demonstrated that social network analysis can be a tool for articulating interaction in online learning environments by enabling descriptive and comparative views across activities. The results of social network analysis complement the findings from t-tests by visualizing the relationships among members and the complexity of social interaction. The t-tests show that students perceived different levels of sense of community and social ability when working in small group and peer activities; however, understanding what is different about student social interaction in the different learning activity types is not described by the t-tests. The graphs and numerical data from the social network analysis help us see the differences between the ways students interact when working in small group activity compared to peer activity.

The findings of t-tests indicate that students perceived higher sense of community and social ability in small group activity than in peer activity. The results from SNA also showed there is higher interaction in small group activity than in peer activity in both mediums. The higher number of reciprocal ties in group activity might explain why students perceived higher levels of sense of community than in peer activity since reciprocal ties imply that students continuously exchange information and play both roles of providers and receivers. Through frequent interaction among students, sense of community in online learning is enhanced [4]. The results confirm what has been found in [17-18], which concluded that with higher interaction students tend to have higher sense of community and social ability.

Designing tasks to engage group work and discussion can be a challenge in online learning environments, but our study shows that the social interaction within group work creates social ability and sense of community above that which was created by a peer activity.

In addition, the instructor's role in different learning tasks impact how students perceived social presence with peers and with instructor. The instructor was more active in giving feedback and guidance by posting his suggestions in small group discussion board, but tended to leave students to interact by themselves in the peer discussion forum. This role-taking significantly shifted triggering and response power distribution from the instructor to the students [25].

There is still much to learn about supporting and understanding social interaction and social learning online, but the triangulation of statistical methods with SNA appears to be a promising approach for explicating how students experience instructional tasks online and the social nature of these tasks.

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