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Stream Differences in Asynchronous Online Discussions: Analysing Student Cohesion and Roles in Technology-Mediated Project Work Classrooms

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Abstract. This study aims to investigate stream[1] differences in asynchronous online discussions in the context of Project Work. Empirical evidence from literature shows that knowledge construction in asynchronous online discussions is strongly associated with cohesion and role structure in online networks. We analysed the social networks in two eighth grade classes from two different streams for cohesion and role structures. A total of 80 students in 16 project groups were involved in this study. All groups were facilitated by the same teacher. The findings revealed no significant stream difference for cohesion. It was found that groups which are more cohesive had high correlation values of structural role equivalence while less cohesive groups had lower correlation values of structural role equivalence, indicating the strong presence of dominating and lurking members. The findings provide evidence that asynchronous online discussions in Project Work classrooms provide possibilities for equal participatory activities and cohesive structures in groups of different learning abilities (express and normal stream).

Keywords: Asynchronous Learning Networks, Project Work, Social Network Analysis

1. Introduction

During the past decade, there has been a growing interest in the use of technology to mediate and support collaborative activities in teaching and learning through Asynchronous Learning Networks (ALNs). According to Hiltz [1], "An Asynchronous Learning Network is a teaching and learning environment located within a Computer-Mediated Communication (CMC) system designed for anytime/anyplace use through computer networks". An ALN makes the collaboration process more transparent, because a transcript of conference messages can be used to assess both the collaborative process itself, and individual roles and contributions to the process [2]. Previous research on ALNs has called for a greater research focus on how *social relations* among members determine learning outcomes [3, 4]. Such social relations which bring value to both the individual and the network as a whole are referred to as *social capital* [7]. Research done by Aviv, Erlich, Ravid & Geva [8] found a significant statistical difference in the level of cognitive activity in ALNs based on the cohesiveness and role structures of social networks. It was

[1]Two streams were investigated: Express and Normal. Express stream students sit for the GCE 'O' levels after 4 years of secondary education while Normal stream students take an additional year of study, 5 years, before they sit for the GCE 'O' levels.

found that networks which were highly connected and had structured roles had higher levels of knowledge construction. These findings were similar to that of Burt [9] which argued that cohesion is a primary network structure that contributes to the creation of knowledge, shared beliefs and behaviour. Based on this premise, we are interested to find out the social capital structures of ALNs from two different streams, express and normal. In the Singapore education system, primary school students are allocated into the different secondary school streams (express or normal) based on their Primary School Leaving Examination (PSLE) scores. The difference in the two streams is that Express-streamed students will sit for their Cambridge GCE O level examinations in four years while students in the Normal stream take five years. According to Roschelle & Pea [10] differences in students' learning abilities might restrict the activity and quality of their participation in asynchronous online discussions. We are thus interested to see if there are any significant differences in terms of activity and patterns of participations in ALNs between express and normal stream students. We can then leverage on these findings to scaffold students from both streams to higher levels of knowledge construction.

2. Methodology

We analysed the discussion transcripts from two classes of different streams. Each class had 40 students of average age of 14. There were eight groups in each class with each group having an average of four to six members per group. All students worked on the same project task - "Horrors of the Japanese Occupation" where they were expected to select a role from the Japanese Occupation and create a story for that role. The two classes were facilitated by the same teacher. The transcripts for analysis were obtained after 12 weeks of students' online discussions. To obtain the structure of social capital relations, we used Social Network Analysis [11] which provides an insight into the patterns of social *relationships* between *members* in ALNs. In an ALN, the students were viewed as nodes and links between nodes (who is communicating with whom) are known as lines. The Social Network Analysis (SNA) was performed using UCINET – a software tool for exploratory network data analysis and visualization [12].

To uncover the cohesiveness of the ALNs, we used cohesion analysis to describe the overall linkage or how knitted the members are in the network. A density analysis was conducted to describe the overall linkage between the participants. Density of a network is defined as the number of lines in a network divided by the maximum number of all possible lines [13]. Density value varies between 0 and 1 with 0 denoting a network with no linkage and 1 denoting a network with maximised links. Density may be useful in determining how well a group of people "mixed" or connected, but some caveats apply to its interpretation [14]. First, high values for density can result from the efforts of a small number of "connectors" reaching out to others in the network, playing a central structural role in the network. If this were to occur, density values would be inflated, while the average number of connections of all network members (the *degree* of the network, a measure of how "equivalent" interaction was) would be low [14]. To investigate for inflations in density values, we analysed the role structures of express stream and normal stream students in ALNs by investigating the structural equivalence of nodes in the ALNs using Pearson's correlation. Two nodes are said to be exactly structurally equivalent if they have the same relationships to all other nodes, meaning they are "identical" or "substitutable" [15]. This is to say that if there exists two group members who are structural equivalent, then we can substitute one with the other as they are identical in terms of the role they play in the group communication structure. Pearson correlations for structural equivalence range from -1.00 (meaning that the two nodes have exact opposite ties to each other) to +1.00 (meaning that the two nodes have exact same tie to each other - perfect structural equivalence).

3. Findings and Discussions

3.1 Students' Participation and Cohesion

Over the course of 12 weeks, a total of 554 notes were posted and 745 notes were read in the normal stream ALNs. In the express stream ALNs, 745 notes were posted while 855 notes were read. The normal stream ALNs had density values which ranged from 0.33 to 0.57 while the density values of the express stream ALNs ranged from 0.20 to 0.77. Tables 1 and 2 show the intensity of participation of the normal stream and express stream ALNs respectively. The density range of ALNs in the normal stream (0.24) is smaller than that of the express stream (0.57). An independent sample T-test for the two streams revealed that there is a significant within group difference for the express stream ($p<0.05$). This implies that the cohesiveness of ALNs in normal stream PW classrooms is relatively more homogeneous as compared to that of express stream ALNs.

Table 1 Participation Analysis for Normal Stream ALNs

ALN	Notes Posted	Notes Read	Density	Standard Deviation
N1	57	73	0.4000	0.4899
N2	82	114	0.4667	0.4989
N3	108	162	0.5714	0.4949
N4	75	102	0.5667	0.4955
N5	47	78	0.4667	0.4989
N6	61	93	0.3333	0.4714
N7	72	51	0.4000	0.4899
N8	52	72	0.5333	0.4989

N=40

An analysis of variance (ANOVA) revealed that there was no significant difference in terms of participation and density across streams. E8 from the express stream had a very low density value of 0.20 although the number of notes posted in E8 was the same as that of the lowest ALN in the normal stream (N6).

Table 2 Participation Analysis for Express Stream ALNs

ALN	Notes Posted	Notes Read	Density	Standard Deviation
E1	63	99	0.3571	0.4792
E2	184	179	0.7667	0.4230
E3	89	113	0.4333	0.4955
E4	69	68	0.5500	0.4975
E5	129	113	0.5000	0.5000
E6	78	87	0.5000	0.5000
E7	72	89	0.4333	0.4955
E8	61	107	0.2000	0.4000

N=40

Investigating the role structures of such ALNs will provide an explanation for the high disparity of density values in the express stream. Put briefly, these results appear to indicate that regardless of the educational difference between express and normal stream students; their patterns of participation do not differ significantly across streams. One reason for this could be that the same teacher facilitated both the express and normal stream ALNs. These preliminary findings provide evidence that asynchronous online discussions in Project Work classrooms provide possibilities for equal participatory activities and cohesive structures in groups of different learning abilities.

3.2 Students' Roles in ALNs

It was observed that in the express stream ALNs, networks with highest (184) and lowest number of notes (61) posted had correspondingly highest (0.77) and lowest density values (0.20). However, in the normal stream ALNs, the network with lowest number (47) of notes posted, N5, had the fifth highest density value (0.47). A further investigation of the structural equivalence of these ALNs revealed high Pearson correlation values for the high density-valued ALNs. This implies that the roles of members in cohesive groups are somewhat equivalent; no one member has a dominating or isolated position in the group, across the two streams. In groups which are less cohesive such as N5, the correlation values range of 0.778 to -0.007. This indicated the strong presence of dominating members and lurkers in the group. In Figure 1, we see that members C and E correlate positively with a high Pearson correlation of 0.778. This means that they have somewhat equivalent roles in the network and are the most active partners as compared to the rest. Members A and D also correlate positively with a high Pearson correlation of 0.764. These four members play somewhat central positions in the network. This is contrasted by Member F who correlates negatively at -0.007 with the rest of the members. This imply that the role F plays is somewhat inactive and more of a lurker and a peripheral participant. As a result of this, only 47% of total possible network links occurred as indicated by N5's density value (Table 1). The findings reveal the contrasting positions members of a network hold. Although not everyone can be expected to be the central figure in a network, ALNs that contain isolated members need to be concerned that these individuals are neither hearing from, nor contributing to the network exchanges. They do not benefit from the community, nor does the community benefit from what they might know. By gathering data on who is communicating with whom, and viewing the network, we can see if some communicating intervention is necessary to increase participation by peripheral (non) participants.

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              B A D C E F

Level         2 1 4 3 5 6
------        - - - - - -
 0.778        . . . XXX .
 0.764        . XXX XXX .
 0.673        . XXXXXXX .
 0.528        XXXXXXXXX .
-0.007        XXXXXXXXXXX
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Figure 1 Hierarchical Clustering Of Structural Equivalence for N5

4. Conclusion

The findings provide evidence that asynchronous online discussions in Project Work classrooms provide possibilities for equal participatory activities and cohesive structures in groups of different learning abilities (express and normal stream). The study has provided insights into the participation patterns in these two streams that might be mediating conditions for better collaboration and learning in the PW classroom. A further qualitative study is conducted to analyse the levels of knowledge construction in ALNs of different streams based on these quantitative findings. The implications of this study can be viewed from three perspectives. From the teacher-facilitator perspective, the uncovered participatory patterns from express and normal ALNs can be leveraged upon to scaffold students to higher, if not equal, levels of knowledge construction between the two streams. Role structure analyses of ALNs can also provide information of key communicators and lurkers in an ALN, providing teacher-facilitator an insight into the flow of information within the network, level of group collaboration and group communication. Teacher-facilitators are better able to incorporate Just-in-time activities to foster better group interactivity. From the student-participant perspective, uncovered social network patterns will provide knowledge in relating to other members in the group. Key communicators or central network members can leverage on their prominence in the network to reach out to lurking members. From the researchers' perspective, the findings can be useful for further research in analyzing the processes involved in successful and perhaps more importantly, unsuccessful, peer interactions that shape collaborative learning behaviours and outcomes.

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