Networks of Information Sharing among Computer-Supported Distance Learners

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Abstract: Collaborative learning requires interaction and exchange among learners as they share experiences and solve problems cooperatively. In computer-supported distance learning classes it is often difficult to know to what extent individuals are interacting and how much they communicate with other class members. To explore intra-class interaction, social network data were gathered on the exchange of information and advice about class work among members of four distance learning classes, and the use of media for this exchange. Results present a preliminary evaluation of characteristics of the "typical" student's network in these classes, including the size of the network, the frequency of exchanges, and the media used, and its relation to students sense of belonging to the class.

Keywords: computer-mediated communication, distance learners, social networks

Introduction

Computer Supported Collaborative Learning (CSCL) represents a meeting of two trends: the penetration of computer technology throughout society, and a new approach to learning known as collaborative learning (Bannon, 1989; Crook, 1989; Kaye, 1995; Koschmann, 1996). As telecommuncation infrastructures and the Internet grow, they continue to open up new avenues for delivering education, reaching students who do not meet face-to-face, but instead meet synchronously and asynchronously via computer media. At the same time, what is normal and what constitutes best practice for education delivery via this medium is still in the formative stage.

Unlike the distance programs of the past, the success of new Internet-based programs is more than just a matter of delivering the information from the instructor to the students. The emphasis is on providing an environment for CSCL. One of the key elements for successful collaborative learning is peer-to-peer sharing of experiences. Free-flow of information, ideas, and advice from many participants is important for increasing exposure to different problem-solving approaches, different viewpoints, and different spheres of knowledge, each of which enhances an individual's learning, adaptiveness, and ability to recognize opportunities (Cohen & Levinthal, 1990; Dede, 1990; Granovetter, 1973; Harasim et al, 1995; Haythornthwaite, 1996). Extended contact "outside class" achieved through computer media also allows for more sustained interaction and the creation of closer interpersonal bonds that further support the CSCL

environment (Harasim et al, 1995; Kaye, 1995). Sharing of experiences, informal communication, socialization, and the group bonding that results are important for the creation of a community of learners, who share resources in pursuit of their learning goal (Bruffee, 1993; Kaye, 1995). For individuals this provides a sense of belonging, a sense of feeling part of the class. For the group as a whole, this provides wider sharing of information, increasing the likelihood that information will reach each member of the class.

While the values of peer-to-peer communication are extolled, few studies have examined the way in which information circulates in a CSCL environment, or how this contributes to a sense of belonging to the class. One way of examining interactions is to look at the social networks of communication among members of CSCL classes, asking: Who talks to whom and about what? Such data reveal patterns of interaction among class members that show how information circulates between individuals, and among all members of the class (Wasserman & Faust, 1994; Haythornthwaite, 1996; Wellman & Berkowitz, 1998.). It also shows the range of others with whom each class member maintains contact, and what types of interaction they engage in – from instrumental exchanges of information to exchanges of emotional support. Extending the "who talks to whom" question to include "... and via which media" then allows exploration of the way in which computer media support exchanges and the learning community.

To explore peer-to-peer communication in this way, social network data were gathered on interactions among members of four computer-supported distance classes. Four types of exchanges were examined: collaborative work, exchange of information or advice about class work, socializing, and exchange of emotional support. It is beyond the scope of this paper to report on all these exchanges. This paper focuses only on the exchange of information and advice about class work. The emphasis here is on exploring what the social network of a "typical" class member looks like, e.g., How many others do they communicate with, how often, and via which media? — and how this is associated with.their feelings of belonging to the class. (For in-depth examination of the networks of one of these classes, see Haythornthwaite 1999a, 1999b, in press).

The Study

Data were collected from members of four classes of Internet-based, distance learners enrolled in the distance option (LEEP) of the Master of Science in Library and Information Science at the Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign (http://alexia.lis.uiuc.edu/gslis/leep3/). This program started in 1996 with 31 students and in January 1999 had enrollment of approximately 90 students.

LEEP classes are conducted using combinations of "live" (synchronous) online sessions and asynchronous computer-mediated communication. During live sessions, instructors use RealAudio and PowerPoint slides to present classes over the Internet and students use Internet Relay Chat (IRC) to submit questions. IRC is also used for break-out discussion

groups during class time, and for online office hours. Live sessions may be held as frequently as weekly or as infrequently as monthly.

Asychronous, class-wide discussion is carried out via the Webboard, usually in association with assigned weekly exercises and readings. All students have Email accounts and use them to communicate with each other and with the instructors. All students also have access to their own telephones, and a toll-free 800 number is available for them to call instructors or other members of GSLIS. Students meet face-to-face when they come to campus for a two-week on-campus introductory course at the beginning of their program. They also meet once per course during short on-campus sessions held each term for each class (usually 1 day per course). Student grading is usually based on combinations of individual projects, group projects, and class participation, with work generally "handed in" via the Web or as email attachments.

Data Collection

Students were interviewed by phone and asked how often they had given or received information or advice about class work, with each other member of the class, and via each of the available media. (For three of the classes, data on *receiving* information or advice, and on *giving* it, were collected separately. In earlier work these relations were found to be highly correlated and have been averaged into one relation.) Follow-up questions asked students about the extent to which (1) the class worked together, (2) the class included social interation, and (3) they felt part of the class (answered on a 5 point scale from "never" to "throughout the whole course").

Reports of interaction were used rather than monitoring actual transactions because the questions required the student to judge the nature of the interaction. Reports also provide a consistent measure between means of communication that could be logged and those that could not, e.g., between Email and face-to-face. The use of reports of interaction is consistent with standard survey research practice (Bernard, Johnsen, Killworth, McCarty, Shelley & Robinson, 1990). Response rates are given in Table 1.
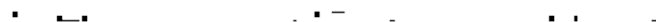
Table 1: Response Rates

Information and Advice Networks

Using a social network perspective it is possible to build a picture of a students' "typical" circle of contacts, i.e., their *ego-centric network* including: how many others they exchange information and advice with, known as their *degree*; the proportion of all others with whom they communicate, i.e., the *density* of the network; how frequently they

communicate with others, an indication of the *strength* of the tie; and which *media* they use.

Degree and density provide an indication of activity in the network, i.e., the extent to which class members are engaged in exchanging information or advice. The more connections maintained, and the more frequently, the more exposure there is to information circulating the network, and the more likely an individual will receive it in a timely manner. Maximum exposure to information and ideas is achieved when there is complete connectivity among all members of a group (a density of 1.0). However, with large group or class sizes, such wide-spread exchange may only lead to information overload. At present we do not know what is an "optimal" density, nor even what is a "normal" density for a manageable collaborative learning environment. Results are presented here as a first look at these network measures.

Across the four classes average densities range from .56 to .93., even though class members at both ends of that range reported contact with 12 others (see Table 2). These differences suggest that a constant factor across classes may be the number, rather than the proportion, of others with whom an individual maintains contact (i.e., degree rather density).

Students' networks contained 9.5 to 13 others with whom they communicate at least once during the term, including 2-7 others with whom they maintained a stronger tie, communicating weekly or greater. Classes that stressed group work (A97, C98, D98) show larger networks of frequently maintained ties (5.5 to 7) than the class which gave less emphasis to group work (B98, 2.3 ties; see Table 2). Group projects require more interaction, and this appears to have encouraged pairs to interact frequently to share information and advice.
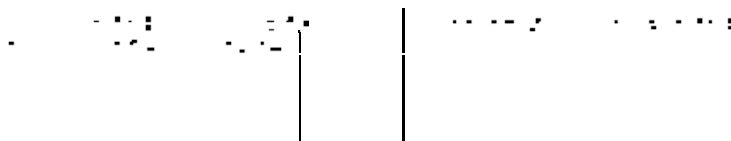
**Table 2: Network Size by Frequency of Communication**

Frequent: weekly or greater; *Moderate*: at least monthly and less than weekly; *Infrequent*: at least once and less than monthly.

Larger networks of frequent contacts may also account for differences in judgements of intra-class community. Responses to each of the follow-up questions were much more favorable for the C98 and D98 classes and more neutral for the other classes (see Table 3). However, across all respondents, the number of frequent contacts is significantly associated only with responses regarding whether the class included social interaction (R-square=0.13, p=.009), although it may also play some part in whether individuals felt "part of the class" (R-square=.05, p=0.13).

Table 3: Response to Follow Up Questions

Media Use

Each class appears to have relied on one major medium for class-wide communication connecting most members of the network. For three classes this medium was the Webboard, used in each of these classes to a greater or lesser extent for weekly asynchronous discussion. The other class (B98) relied mostly on IRC, using the weekly live sessions to discuss exercises that individuals completed on their own or in consultation with others during the week (see Figure 1).

Of the remaining media, Email was used more frequently and with more others. Email was also used more among members of classes that stress group work (A97, C98, D98) than for B98 where work was not completed by groups. A more in-depth analysis of A97 has shown that email was used predominantly to maintain contact with group project members (see Haythornthwaite, 1999, under review).

The number of media used also increases with increasing frequency of communication. Those with infrequent or only moderately frequent ties used only one medium (range from 1.0 to 1.2 across the four classes), mostly the Webboard or IRC according to the class norm. Those who communicated frequently used more media, with averages of 1.2 (D98), 1.5 (C98), 1.8 (B98), and 2.7 (A97) across the classes.

Figure 1: Mean Number of Correspondents and Frequency of Communication by Medium and by Class
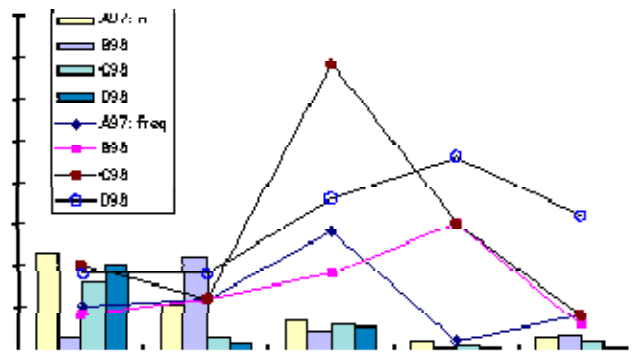
Ego-Centric Networks

These data allow us to draw a picture of the "typical" distance student's ego-centric network for information exchange. Students maintain more frequent contacts with more others in classes that stressed group work, and they maintained these ties through multiple media (Webboard and/or IRC, plus Email).Weaker ties were maintained less frequently and through fewer media, relying mainly on class-wide contact via Webboard or IRC.

While the number of cases here is still relatively small, the results suggest some trends worth further examination. Group work appears to promote the maintenance of larger circles of stronger ties, and the size of this circle is associated with socializing, an element necessary for interpersonal bonding and the promotion of feelings of belonging to a community. This suggests that group work may serve an important role in CSCL classes in promoting community by having the intermediary effect of increasing the size of close social circles. Moreover, frequent communicators are also users of more media. This suggests the utility, if not the necessity, of having multiple means of communication available to encourage frequent, peer-to-peer exchanges, that in turn may foster a sense of belonging to a community.

References

Bannon, L. (1989). Issues in computer supported collaborative learning. In C. O'Malley (Ed.) *Computer Supported Collaborative Learning* (pp. 267-282). Berlin: Springer-Verlag.

Bernard, H.R., Hohnsen, E.C., Killworth, P.D. McCarty, C., Shelley, G.A., & Robinson, S. (1990). Comparing four different methods for measuring personal social networks. *Social Networks*, *12*, 179-215.

Bruffee, K. A. (1993). *Collaborative Learning: Higher Education, Interdependence, and the Authority of Knowledge*. Baltimore: John Hopkins University Press.

Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*, 128-152.

Crook, C. (1989). Educational practice within two local computer networks. In C. O'Malley (Ed.) *Computer Supported Collaborative Learning* (pp.165-182). Berlin: Springer-Verlag.

Dede, C. (1990). The evolution of distance learning: technology-mediated interactive learning. *Journal of Research on Computing in Education, 22,* 247-264.

Granovetter, M.S. (1973). The strength of weak ties. *American Journal of Sociology, 78*, 1360-1380.

Harasim, L., Hiltz, S.R., Teles, L., & Turoff, M. (1995). *Learning Networks: A Field Guide to Teaching and Learning Online.* Cambridge, MA: The MIT Press.

Haythornthwaite, C. & Wellman, B. (1998).Work, friendship and media use for information exchange in a networked organization. *Journal of the American Society for Information Science*, *46(12),* 1101-1114.

Haythornthwaite, C. (1996). Social network analysis: An approach and technique for the study of information exchange. *Library and Information Science Research, 18 (4),* 323-342.

Haythornthwaite, C. (Jan., 1999a). Collaborative work networks among distributed learners. *Proceedings of the 32nd Hawaii International Conference on System Sciences*, Maui, Hawaii.

Haythornthwaite, C. (Jan., 1999b). *Network structures among computer-supported distance learners: Multiple relations, multiple media, and time*. Paper presented at the ALISE conference, Philadelphia, PA.

Kaye, A. (1995). Computer supported collaborative learning. In N. Heap, R. Thomas, G. Einon, R. Mason, & H. MacKay (Eds.), *Information Technology and Society* (pp. 192-210). London: Sage.

Koschmann, T. (Ed.) (1996). *CSCL: Theory and Practice of an Emerging Paradigm*. Mahwah, NJ: Lawrence Erlbaum.

Wasserman, S., & Faust, K. (1994*). Social Network Analysis*. Cambridge, MA: Cambridge University Press.

Wellman, B., & Berkowitz, S.D. (Eds.) (1998). *Social Structures: A Network Approach*, 2nd Ed. Greenwich, CT: JAI Press.

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