Social Network Methods and Measures for Examining E-learning

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Abstract

Learning is a social network relation: it is a transaction, an exchange between people as one person teaches and another learns; it is a shared experience as colleagues explore a new area together, define terms and create common ground; and it is a common experience as students attend classes and lectures together gaining a similar view of subject areas. A social network approach provides methods and measures to allow examination of what is exchanged, shared, delivered and received among members of a network, and to examine outcomes such as interpersonal ties, common knowledge, and community. Social network studies provide insight into what kinds of exchanges comprise learning relationships (e.g., learning how to carry out a procedure, use a new technology, operate within a profession), what balance of learning and production takes place (exposure to new ideas versus completing tasks or assignments), and what balance of people and associations within a network make for a good learning combination (e.g., of people with whom we are strongly and/or weakly tied). This paper presents a look at the exciting new kinds of phenomena open to examination by using a social network approach to e-learning. Social network approaches inform e-learning by demonstrating and legitimizing the creation of network outcomes without face-to-face structures, outcomes that include collaboration, innovation, shared purpose, and above all, learning – by individuals and groups – in learning communities and communities of practice supported through the supposedly lean communication channels of text-based computer-mediated communication, among participants distributed in time and space.

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Social Networks and E-learning

Learning is a social network relation: it is a transaction, an exchange between people as one person teaches and another learns; it is a shared experience as colleagues explore a new area, define terms, and create common ground; and it is a common experience as students attend classes and lectures together gaining a similar view of the subject and profession. Learning involves the transfer of information from one person to another, but it also involves feedback, questioning, and collaborative inquiry. It involves information, but also includes transfer of academic and professional norms, and teaching and acquisition of skills in writing, using equipment, carrying out procedures, and learning to learn. Learning may stand as the only connector between two people, or it may be combined with friendship, social support, and more general advice. Learning jointly around a common interest can foster a sense of community, with benefits to individuals to their personal well-being, and to the community in advancing joint knowledge, sustaining participation, and promoting continued existence.

In these characteristics, we see demonstrated the underpinnings of social networks: *actors* who interact and maintain relationships with each other and with the group as a whole; *relations*, specific kinds of exchanges and interactions that form the base of connections between actors; *ties* between actors based on the specific kinds of relations that characterize a pair's connection; and *networks* that describe the combined set of ties among a set of actors.

Why SNA, Why Now?

Social network analysis (SNA) has become an increasingly popular way to approach research problems and describe social processes. Large scale analyses, primarily from the field of physics, have spurred interest in the general applicability of network characteristics to physical phenomena (e.g., the work of Duncan Watts, and Albert-Laszlo Barabasi). While such analyses are new, there are decades of examination of social phenomena, spurred since the 1980s by the

availability of computing resources to individual researchers and the creation and standardization of software analysis packages (e.g., UCINET by Everett & Borgatti; MultiNet by Bill Richards), and more recently by graphical packages that visualize networks (e.g., NetDraw by Everett & Borgatti, and Pajek by Vladimir Batagelj and Andrej Mrvar).

With its foundation on relations, i.e., interactions, exchanges and relationships between actors, social network analysis is ideally suited for the examination of most general phenomena where some action or association connects actors – whether those actors are people, computers, websites, concepts, or institutions, whether the action is one of teaching and learning, social support, instrumental exchange, collaboration, commercial barter, kinship or common interest, and whether the platform on which such exchanges take place are information and communication technologies, or face-to-face public or private venues. SNA can be used to examine the intricacies of relations and ties between individuals and their personal network members (Wellman, 1997), to monitor and model communication habits and patterns among members of groups (Monge & Contractor, 2001, 2003), and to make sense of large emerging phenomena such as the structure of the Internet (Park, 2003; Thelwall, Vaughn & Björneborn, 2004).

The usefulness of a social network approach is the way it leads us to look at interactions between people – defining and articulating them, then looking at the patterns of interconnection they create, and coming to understand what such patterns mean for the group under study. It promotes an empirical, unbundling of social phenomena. As such it resonates with the way contemporary information and communication technologies also unbundle aspects of social, educational, and commercial endeavors. As these enterprises are freed from the constraints of face-to-face contact and place-specific locations of exchange (the university, the shopping mall), we increasingly become aware of what was bound up in such environments. Thus, we discover that e-learning is not just about learning objects, it is also about student interaction, teaching about process as well as transferring information, building and belonging to a community, a profession, an academic home; it is about making lifelong friends, sharing frustrations, creating and reliving stories and experiences. It is about maintaining relations with others, forming ties, and creating and living in social networks.

As we implement e-learning programs, we come to discover – often by trial and error – that the structures of traditional teaching come with myriad side activities, ones that might have

been referred to as ‘process losses’ if we took a narrow view of learning being an efficiency task. On the side, so to speak, are such things as: visible others in class, public exchange of questions and answers, turn-taking in discussions, informal meetings in coffee shops and other public areas, libraries stocked with resources, auxiliary personnel such as administrators, loans officers, faculty you are not taking a class from, senior students not in your year, etc., etc. Some of these we are discovering were unacknowledged benefits that we have lost – e.g., being about to meet spontaneously on common ground develops a general sense of belonging, reducing the strangeness of a new environment. Others we find it is a benefit to lose: the public nature of questions and answers, and the turn-taking of face-to-face discussion groups both decrease the ability for everyone to feel safe enough to ask questions and participate in class.

Although new technologies free us from face-to-face constraints, that does not mean we are now without constraints. How and with whom we learn, socialize, and work is both bound up and inseparable from the technologies through which we meet, whether this is the classroom, chat room or discussion list. Different sets of contacts are available when we meet face-to-face versus online; different patterns of participation can be expected from a turn-taking face-to-face class than in an asynchronous discussion, or from an asynchronous bulletin board and a synchronous chat room. Each delivery technology comes with its different configurations of features, each of which have the capacity to facilitate or constrain participation and interaction in different ways.

The network approach helps in several ways in examining these new online social phenomena such as e-learning. First, by drawing our attention to relations and the patterns they engender, a social network approach provides a method and measures of basic interact ional units that separate the delivery mechanism from the interaction between people that underpins the educational endeavor. Second, by articulating what is or was happening in older educational models, we can anticipate, plan for, and design systems (both social and technical systems) with better insight into important features that promote e-learning and e-learning environments. Third, we can look for the unexpected: as we assess new environments empirically, we can discover new patterns of behavior, new social uses, and unexpected outcomes emerging from the new structures we have put in place.

Actors, Relations, Ties and Networks in an E-Learning Context

To ground the discussion of social networks, we start with a brief overview of the building blocks of networks, i.e., actors, relations, ties and networks, using e-learning examples. As we decide on the actors to study, we also decide what kind of network approach we want to use. We can examine a whole network of actors, e.g., all students in a class, but we can also examine personal networks, e.g., looking at how many others students discuss class work with during a week, and ego-centric networks that look at not only how many ties an individual maintains, but also the network of interconnections among the members of their network. We will discuss here personal and whole networks.

Actors

Actors are the nodes in the networks, and in e-learning setting they can be teachers, students or administrators. E-learning in work settings can also involve co-workers, collaborators who may learn in online communities of practice. Actors can also be institutions, e.g., as we map inter-institutional cooperations. For teachers, we might be interested in what kinds of relations they maintain with their personal network of students. In this case, we consider the teacher as the focal actor, and ask questions about their exchanges and interactions with each student. As an e-learning environment, we also should be asking about how they use the media and technologies to engage in these interactions. After such an analysis we can build a picture of how teachers are communicating with their class: examining both what kinds of *relations* are maintained, and what media are used. We might also be interested in how students communicate with one another. But now we do not know who is a key informant. Unlike the role of teacher, we cannot know who to ask to get a good picture of overall communication. Thus, we may choose instead to ask all students, getting a complete set of relations maintained within the class, perhaps also the media used, and a view of the whole network of in-class relations.

Actors have *attributes*, i.e., characteristics that define them. These are typical data such as age, gender, socioeconomic status, or organizational status.– any kind of data that is associated with the individual rather than their relation with others. These data can be used to see if network positions or outcomes are associated with characteristics of the actors that they hold independent

of the network connections. Thus, we can separate network effects from pre-existing attribute effects.

Relations

Relations are connectors between nodes; when such a connection is found, a pair of actors is considered to maintain a social network *tie*. Typically, as we focus on the relations between pairs, the person who reports on the relation is called *ego*, and the person they maintain the tie with is called the *alter*. Thus, an ego-centric analysis looks at the world from the ego's relations with others.

We can talk of relations as having *content*, i.e., what is exchanged or shared, *direction*, i.e., from whom and to whom resources flow, and *strength*, i.e., how much is exchanged, or how often exchange occur. A relation can be instrumental, such as working on an assignment or exchanging information, or it can be socio-emotional, such as providing help during a crisis, giving social support, or going to a party together. Many ties, particularly as the tie increases in importance to actors (i.e., as ties become stronger; see below), are found to contain both instrumental and social or emotional relations.

Sometimes social network analysts are interested in whether <u>any contact</u> occurs between actors, regardless of its content, direction or strength. The presence of any contact, at any frequency or intensity, and maintained at any time, is sufficient to indicate a connection worthy of note. In other cases, analysts are interested in a <u>specific kind of connection</u>. For example, here is a social network question from the 1985 U.S. census (known as the General Social Survey (GSS)):

> "From time to time, most people discuss *important matters* with other people. Looking back over the last six months – who are the *people* with whom you discussed matters important to you?" (Burt, 1985, p.119).

In such cases, the analyst is interested in drawing conclusions about the network of people with whom the focal individual discusses important matters, limiting this to relations maintained only in a restricted timeframe such as the recent past.

Yet other analyses are conducted to find out <u>what kinds of relations</u> support ties in particular groups or are important for particular kinds of outcomes. Analysts may ask about many kinds of connections, and use statistical methods (factor analyses, correlations) to find out

which relations are held in common by pairs. In my own research, in a study of relations in a computer science research setting, a factor analysis of 24 different work and social relationships reduced to six dimensions of work and social interaction: Receiving Work, Giving Work, Collaborative Writing, Sociability, Major Emotional Support, and Computer Programming (Haythornthwaite, Wellman, & Mantei, 1995; Haythornthwaite & Wellman, 1998). I have since used these results as input for designing questions asked of members of e-learning classes, where I asked about these relations: collaboration on class work, receiving or giving information or advice about class work, socializing, and exchanging emotional support (described as support during a minor or major upset).

More recently, in a more explorative study of three collaborative research teams, I analyzed answers to questions about what they learned from others, and what they thought others learned from them. This qualitative analysis revealed nine relations important to group members, including exchange of factual knowledge, learning the process of doing something, finding out about research methods, working jointly on research, learning about how to use a technology, generating ideas, socialization into the profession, access to a network of contacts, and administrative work (Haythornthwaite, 2005).

Ties

Given the set of relations, and the data on who is connected to whom by these relations, we are ready to look at ties. *Ties*, as nearly everyone is now aware, can range from weak to strong, with each end of that continuum having its own particular advantages. *Weak ties* are maintained with those we barely know, and talk to rarely. These ties include little exchange of personal information. We are unlikely to seek out our weak tie contacts for advice or help. It turns out that we also use fewer channels to communicate with them, depending on contact mechanisms set up by local authorities (e.g., regular class meetings, broadcasts to group bulletin boards; Haythornthwaite, 2002a). These contacts are less likely to be like us (*heterophilous*), and we are less likely to know the people they know because they travel in different social circles from us. It is these latter attributes that gives the *strength of weak ties* (Granovetter, 1973). Their different-ness from us means they have access to information and other resources different from our own, and contacts different from those in our social circle. We are more likely to become aware of

new ideas, information, jobs and career opportunities through them (Granovetter, 1973; Lin & Bian, 1991; Rogers, 1995).

At the other end of the continuum lie the *strong ties*. Strongly tied pairs typically maintain many kinds of relations, including relations of intimacy and self-disclosure (*relational multiplexity*), communicate frequently with each other, and use a number of channels to communicate (*media multiplexity*; Haythornthwaite & Wellman, 1998). Pairs in strong ties are likely to be similar in attitudes, socioeconomic characteristics, etc. (*homophilous*). In times of crisis these are the people we call on, and they are motivated to help wherever they can. But, as they travel in the same circles as we do, they tend to be constrained only to the same resources to which we have access.

In e-learning, weak ties are important for gaining exposure to new information, opinions and ideas different from our own, and new approaches to problem-solving, elements that go hand in hand with notions of collaborative learning, and computer-supported collaborative learning (CSCL; Bruffee, 1993; Dede, 1990; Koschmann, 1996; Harasim et al, 1995). Strong ties are important for social support, friendship, and work partnerships. Where e-learning initiatives spend all their time creating the best learning environment, the best way to deliver information, they can fall short of considering the need to support weak tie contact, as well as providing for the non-learning exchanges important for strong tie relationships. Overall, it is important to recognize that e-learning environments need to address both kinds of ties, and relations based on other than learning exchanges (for a longer discussion of this point, see Haythornthwaite, 2002b).

There is one more kind of tie to discuss. In my work I have identified and been describing the role of what I have termed *latent ties*, i.e., ties that are technically possible, but not yet activated into weak ties (Haythornthwaite, 2002a, 2002b, in press). These might be ties between people you know of at work, or in a neighborhood, but whom you have not actually talked to. They may also be ties based on electronic connections, such as co-membership in a listserv, or enrollment in a proprietary email system. In an e-learning setting, initial membership in an online class creates latent ties, which can then be activated into weak and/or strong ties by things that happen over the course of the class. The kinds of media, and what they are used for in online and e-learning groups turns out to be an important aspect of latent ties. In the groups I have researched, those who do not actively engage with each other yet are still part of the group tend

to keep up with group activities through communications managed through a group-wide contact medium, such as one-to-many bulletin board postings in an e-learning setting, and many-to-many face-to-face meetings in a co-located group. Email and other private means of communication (chat whispering, phone) sustain stronger ties for both distant and co-located pairs. These pairs add the use of these media onto the more widely-used group media. As I have argued elsewhere, the important point for an e-learning setting is that the technical *and* social implementation of the group-wide contact medium is something that cannot be initiated by pairs who do not even know each other. It is instead the responsibility of authorities beyond the group members to lay this foundation, authorities such as e-learning administrators and instructors (Haythornthwaite, 2002a, 2002b).

Networks

With ties defined, we can see how these build into *networks*. As noted above, we can analyze personal networks across a set of selected actors, or we can analyze whole networks. In looking at personal networks, we can analyze in ways familiar from other kinds of approaches, e.g., regression analyses may be performed to explore how actor attributes are associated with network measures such as number of ties to others. However, if all actors are drawn from the same network, there are problems with the non-independence of data. In such cases, statistical procedures such as p* (p-star) models, specifically designed for the analysis of network data are needed (models devised by Stanley Wasserman and colleagues). Network analysis software packages such as UCINET and MULTINET (among others, for a full list of available software, see www.insna.org) provide a suite of analysis techniques and graphing facilities specifically designed for networks. Here we will discuss briefly some of the main network measures.

Asking Network Questions

Perhaps the first step in understanding how to apply a social network perspective is understanding how to ask network questions. While other research approaches might look at aggregated behavior across classes, a social network study looks at what is exchanged, communicated, and shared by pairs of individuals. For example, we could study online classes in an aggregate way, e.g., comparing participation rates across classes, between online and offline sections, or across programs.

This can be useful information, but we can go further with a network perspective to explore who is talking to whom and about what, whether discussions are typically dominated by one or more individuals, whether classes become structured into cliques, or dense are the work interconnections among class members. Thus, instead of asking "how often did you participate in class?" we ask:

- For each member of the class, how often did you talk to them about class work?

or, if we are interested in the direction of information transfer, we might ask:

- How often did you receive information from them important to class work?
- How often did you give information to them important to class work?

Knowing that socializing helps in supporting work relationships, we might also ask:

- How often did you socialize with each member of the class?

Then we can examine how often information exchange relations match up with socializing relations.

The general characteristic of these questions is that they examine *who maintains what relations whom*. In my own work examining the role of computer media in supporting networks, I add on to this, *and via which media*. Thus, I have extended questions above to include assessment of media use in a question like this one:

- How often did you collaborate on class work with {each member of the class} face-to-face, via email, class bulletin board, or chat?

Answers then provide a network of data indicating who in the class collaborated on class work with whom, and how often they managed this through each of the available media.

The resulting data are typically formed into a matrix of who talks to whom, with cells containing data of how frequently the relation was maintained. The data are then input to computer programs for further analysis and assessment of network structures via measures such as those discussed next.

Measures

The following provides an introduction to the very basics of network measures. For more on social network analysis methods, measures and statistics, see the further reading section at the end of this paper.

Number of Ties

A very basic measure of a network is the number of ties maintained, by an individual with others, and across the network as a whole. The number of ties maintained by an individual can show the communication and contact load for an individual. However, because networks differ in size, a more standardized statistic is necessary for comparing across networks.

Density

Density is perhaps the most commonly used measure of network connectivity. It is simple to calculate and yet says a lot about network connections. It is calculated as the proportion of the number of actual ties to the number of possible ties. Because connections can go both ways (to and from ego), for undirected relations (e.g., sharing, collaborating) network density is calculated as:

Density = n / (N x (N-1) / 2)

where n is the number of actual ties, and N the number of actors in the network

Density shows the interconnectivity of the network, with consequences for things such as the rate of information exchange and extent of common knowledge.

Centrality and Centralization

Another commonly used measure is that of centrality. Applied at the individual level, it identifies how central an actor is in the network, and at the network level it shows the extent to which the network is organized around key actors. One way to calculate this position is to identify the person with the most ties (*degree centrality*). The direction of the tie becomes important in interpreting the role of this person. A high *in-degree* indicates a lot of others choose to relate to this individual. They are said to have high *prestige*. A high *out-degree* indicates a person who relates a lot to others. They may have high *influence* on others. Individuals with low degree centrality may be peripheral players in the network, but degree is not the only way to wield power in a network. Strategic positions also place an individual in a position to control the circulation of resources. Other measures of centrality calculate how an actor sits between others in the network (*betweenness*), and how they are positioned in the network as a whole to be on the path of information or resources circulating the network (*information centrality*; Stephenson & Zelen, 1989). By whatever measure, actors who occupy central positions play important roles in

networks: network *stars*, i.e., the person most central in the network, and network *brokers* or *bridges* who sits between different parts of the network, each control the way resources enter and circulate the network.

Non-central players are also important to identify. *Isolates*, and other *peripheral* actors are left out of the mainstream of activity. They may receive resources late, perhaps after their usefulness has expired. They have fewer others to call on for help, and thus are less likely to find what they need. Such actors are less satisfied with their role in the network, and may be more likely to leave. In e-learning settings, these may represent the vulnerable and failing students, and are an important set to be aware of.

Cliques

Another measure important to networks is the extent to which the network members form internal cliques, clusters or components. Again, basic configurations of ties can reveal who is connected to whom in subgroups in the network. As a member of the group, this may be obvious, but associations may appear that are unexpected, based on unexpected criteria. Again, these features are useful for understanding how a network is operating, and we can then go on to try to understand why such configurations are in place.

Example

Figures 1 and 2 are included as examples of e-learning networks. Figure 1 shows the collaborative work network of 14 members of a distance class. The *sociogram* shows ties that were maintained over the 15 week semester at a frequency of more than twice a week. This frequency was chosen to capture stronger work ties. As can be seen, the network is somewhat sparse, with a density of .24 (22/((14x13)/2, ignoring the direction of the connection[1]), i.e., only 24% of connections are present (at this frequency and for this relation). One thing we don't know is whether this is a 'good' density or not. We have no data yet on what constitutes an optimal in-class work density, and it may differ by class, subject, and teaching approach. One thing that does seem evident from examining this and other classes, is that the upper bound on connectivity may be more driven by personal network size, e.g. as the number of others an individual can maintain contact with reaches a limit. Across four moderately sized classes examined, the

average personal network size seemed to reach a limit of around 13 others (class size 14, 17, 19, and 23; average personal network size 12.1, 9.5, 13.3, and 12.3; Haythornthwaite, 1999).

A primary feature to note in this figure is the clique formation, here created around group projects. This shows how constrained collaborative ties became, and how centered on class projects. As argued elsewhere (Haythornthwaite, 2002a), this configuration shows the influence that class organization can have on who works with whom, and thus also who exchanges ideas, opinions and knowledge with whom.

Also important in this figure is how two central players emerge: one is clearly identifiable from the network diagram – this individual displays centrally in the diagram, and has a high degree centrality; the other is less obvious and appears centrally from a calculation of information centrality. Using this measure on data of the frequency of interaction, both these individuals emerge as positioned in such a way that they are on the route of most information circulating the network and thus are central in the network.

Figure 2 shows the network of collaborative work relations during the last month of the semester for the same class as shown in figure 1. This figure shows the Email network and the IRC network. Most notable in these figures is the difference in density. Email is used primarily between network members who maintain more frequent connections, which in this particular class meant the co-workers on projects as well as a few connections across teams. IRC, by contrast, connects very widely. Not evident, however, from these diagrams is that the frequency of communication is much higher between those with the Email connection than with the IRC connection.

Sociograms are a wonderful way to display networks, but, as noted in the ways that not all information is revealed in these networks, it is important not to misinterpret them. This can particularly be an issue if higher administrators or other authorities are looking for some kind of ‘proof’ of the effectiveness of e-learning evident in these pictures. They should be approached with caution and with an understanding of how they may be perceived and used. For more on this, see Haythornthwaite and Shoemaker (forthcoming).

Let us move on now to look at overall social network aspects of e-learning environments.

E-learning Environments and Social Networks

When students enter the E-learning environment they face a number of challenges that show the diversity of interactions and relationships that we are called on to support when we work and learn together. First, they must build relationships around *learning*: interpersonal ties with the instructor (and teaching assistant), relations with library staff and bookstores for delivery of course and research materials, in-class relationships with all others taking the class, out-of-class work ties with students for collaborative projects, and more generalized ties with all members of the program and the educational institute offering the E-learning program. Second, they build relationships with those who *support* them in the program. These include *technical support relations* with personnel associated with the program, and with their own local technical support (spouses, siblings, parents, children; co-workers); *social support relations* locally from family (spouses, children, and parents) and the workplace (employers, bosses, and co-workers), and online from and with fellow students; and *friendship ties* with fellow students. Third, many build *administrative ties* with student loan officers on campus, and with administrators and other office staff they interact with as they negotiate their way into the program, and as they have questions over the course of their program.

While many of these ties are instrumental, e.g., asking for and receiving research materials, many take on a social support role as students find a real person at the other end of the line. Moreover, their contact with others is almost always around areas of uncertainty – what to do for an assignment, how to write papers, how to act in the online environment, how to succeed in class and in their chosen profession – coloring every encounter with emotion. Students form strong emotional bonds with other classmates who experience and understand their world (Haythornthwaite et al, 2000). Such ties may come to an end as they leave the program, leaving students to negotiate a social and emotional exit from their online lives (Kazmer, 2002, forthcoming). Since e-learning programs are new, we know little at this time about how such ties will be maintained after leaving such venues, and whether the online connection makes it easier to continue professional contacts after graduation.

In the rush to support ties and relationships with the program, and among members of online classes and programs, it is often forgotten that, unlike on-campus students, these individuals are still engaged with and embedded in their local ties. In a way, as we bring them into the program, we also set them the task of breaking – or putting on hold – their existing ties.

Just as students going away to college must leave family behind, online students also leave people behind, and they do so even as they may continue to occupy the same physical space. We ask them to set themselves apart from others in the home or workplace to concentrate on the distant instructor. We also ask them to take on a new area of knowledge, delivered through a brand new mode, one that no one they meet locally has ever experienced. And, we ask them to adopt a new set of colleagues and friends using new ways of 'speaking,' participating in class, and presenting themselves to others (Bregman & Haythornthwaite, 2003). Thus, we ask them to drop (or at least put on hold) not only existing ties to friends, family and co-worker, but also existing ways of making ties. We have radically changed the way ties are built, and with whom they are built and sustained.

Taking on e-learning, including new learning and new technologies often requires a lot of local social support. But, not all of those called on to provide social support actually do. Spouses often only barely tolerate the disruption to their home life as the student spends dinner time at the computer taking class, evenings studying, and weekends working on projects. Bosses err in being unsupportive and too supportive: they may not support the endeavor and thus work and school are maintained as strictly separate endeavors; and they may be too supportive, living vicariously through the students' work, asking to see what's being done. Parents may question why the student is pursuing a degree, why this degree, and why an online program. With the student 'at school' at home, children are often unable to tell that Mom or Dad is unavailable. Consciously or unconsciously, young children can disrupt time for class or study by demanding time with the parent or by creating distractions that must be dealt with at that time. Older children just want the parent off the computer! The shared technical resource as well as the physical home office space can become disputed or partitioned territory (Kazmer & Haythornthwaite, 2002; for similar descriptions for teleworkers, see Salaff, 2002). Finally, local friends and colleagues may ask just one too many times about the online environment, failing yet again to understand or accept the role of new online friends in the students' life.

Thus, not only must we be aware of the different personal networks e-learning students are embedded in, and how each is different, we also need to understand that while many do have support for their endeavor, not all students have local communities that can or do help them through the program.

Discussing the "E" in E-Learning

Since e-learning is bound up with the use of new technologies, particularly CMC, one key question is how online and offline environments differ for maintaining relations and ties. Early discussion of CMC suggested that the lean, text-based communication typically available via CMC was insufficient to sustain the kinds of social and emotional relations characteristic of offline settings, hence that CMC was unable to maintain social network ties of any but the most instrumental type. This argument is repeated more recently against online community: again, how can community be maintained via online, text-based communication with no corresponding physical location for people to identify with. Of course, the same arguments are leveled against e-learning. How can an online class deliver the same kind of experience as on-campus education? Aren't learners being cheated out of close interaction with faculty and other students? How can they learn without coming together in lectures, and discussion groups? How can you maintain a learning community without co-location and on-campus activities? These arguments against online ties have not gone away, despite many testimonials, research studies, and the presence of many long-standing online social relationships and communities (for a summary of these arguments, see Haythornthwaite, 2002b; Haythornthwaite & Wellman, 2002). How can we reconcile this debate?

For CMC, we find that communicators have worked around the limitations of CMC to re-implement social communication. We find language use has evolved to convey emotion through the use of emoticons and acronyms, information about the sender is revealed in writing style and email domain address, and signatures are added that convey identifiers of nationality and status as well as often containing sign-off quotations that give an indication of a sender's world view. Online communities show many characteristics of offline communities, such as conformity to social norms, definition and policing of group behavior, creation of roles, and sharing of communal histories (Baym, 2000, 2002; Haythornthwaite, Kazmer, Robins & Shoemaker, 2000; Kendall, 2002; McLaughlin et al, 1995; Hearne & Nielsen, 2004).

In e-learning we find that online students can feel closer to their instructors from a distance than up close, with email and chat exchanges perceived as personal[2], no one fighting for time in the discussion, and strong social and communal bonds created among participants (Haythornthwaite & Kazmer, 2004; Renninger & Shumar, 2002). Indeed communal processes are so strongly emergent, that researchers Barab, Kling and Gray (2004) write that in

implementing e-learning communities they came to view their task as designing “for virtual communities” rather than designing communities.

As for online social ties, and online community, these arguments against e-learning are built on two assumptions: (a) that physical co-location is the key factor making the educational experience, and (b) that on-campus experience *is* the one best way to interact, teach, and learn. While considering learning to be bound up with the physical setting (the campus as the delivery technology), there is little recognition that it is only a delivery mechanism, and thus learning relations may be separated from the location and re-bound to other technologies in new, different, and potentially better ways.

In making the (temporary) separation of technology and learning, we find again the utility of a social network perspective. With its focus on what is happening between people, within collectives, and across boundaries, social network analysis lets us examine what relations sustain ties and networks without depending on one delivery mechanism. Geography, co-location, face-to-face meetings, and home bases can be unbundled from communication, information exchange, knowledge sharing, and provision of advice, social support, goods and services. Thus, we can open up the possibility of choosing the best ways to pursue e-learning, for young and adult learners, students and lifelong learners, through interactions maintained solely offline or online, or through combinations of computer-mediated and face-to-face communication.

Tasks ahead

There are many avenues for exploration of e-learning from a social network perspective, and much research still to be done. The following is a brief list of areas of possible investigation:

***In-class dynamics*:** Finding out what network configurations exist, what they mean, and what we then want to encourage. What does it mean to have high density in a learning network? How common are network stars in e-learning classes, and how does their presence affect class dynamics?

Discovering relations: What relations make up a teaching-learning relationship, a collaborative work and learning relationship, a peer-to-peer network? How do we support and provide for that online?

Bootstrapping online relationships: How do you get e-learning interactions up and running? How do you bootstrap network ties?

Building e-learning communities: How do you foster interpersonal ties and community that support learning, being together at a distance, and provide benefits such as satisfaction with the e-learning experience, and personal well-being? How does feeling part of a community relate to pedagogical outcomes, program completion rates, and long term professional associations?

This is a very short list, but one that I hope will encourage others to consider a social network approach to e-learning, and encourage you to find networks everywhere.

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Further Reading on Social Networks

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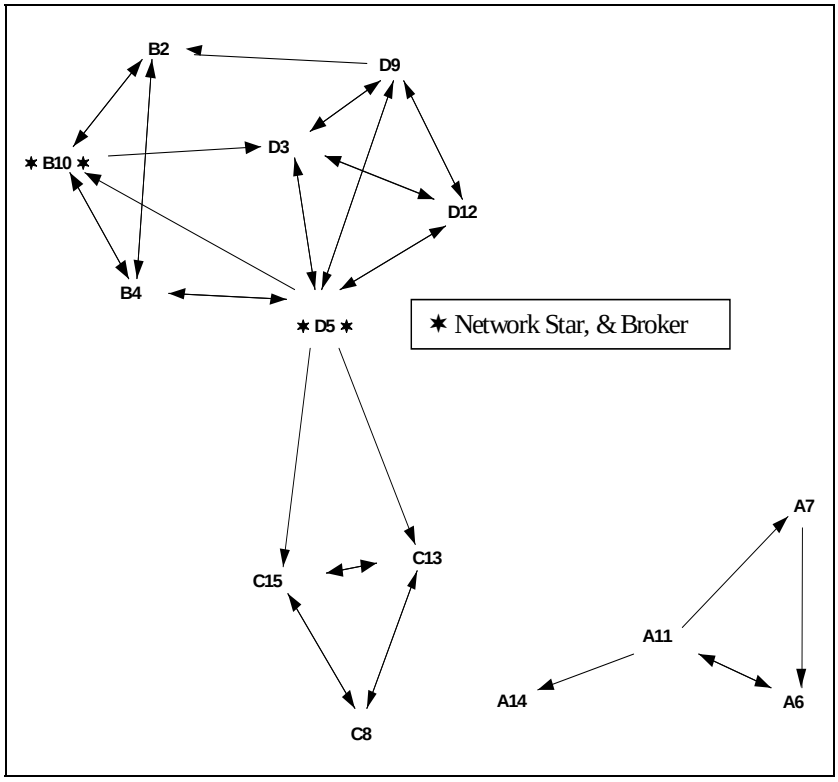
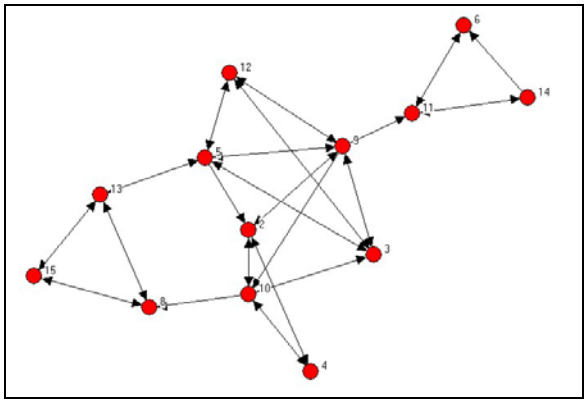
Figure 1: Sociogram of Distance Learners' Collaborative Work Network : Ties maintained more than twice a week over the entire semester



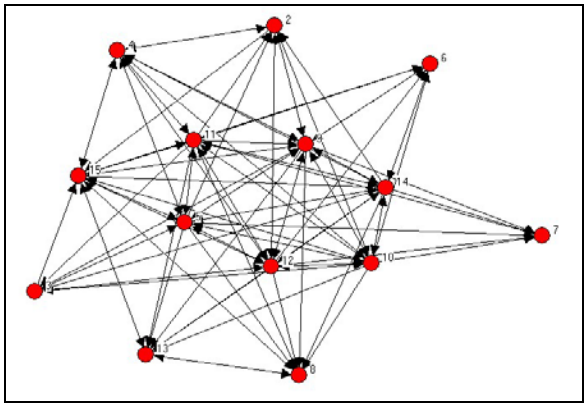
* Centrality calculated using Stephenson & Zelen's (1989) information centrality measure, which calculates centrality based on all possible paths. This measure is able to accommodate the frequency of interactions.

Figure 2: Total Email and IRC communication during the last month of the semester

Email



Internet Relay Chat (primarily in-class interaction)



[1] The data in this case are both *symmetrized*, i.e., made the same in both directions (e.g., by using the minimum, maximum, or average report of the tie frequency; in this case the average was used), and *dichotomized*, i.e., converted to binary based on a logically determined cut-off, here determined as a frequency of greater than twice a week (1) or less (0). These are common procedures in examining networks, and necessary for many network statistics as currently implemented.

[2] Perhaps along the lines of what Walther (1996) has termed 'hyperpersonal.'