

To Learn is To Know: Teaching, Communities, Social Capital and Knowledge Management Technologies

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Abstract

In this paper, I argue that online communities help bring into question what learning and knowing are, and therefore what it means to “teach.” I provide three alternative models of knowledge, and discuss three examples, each involving online communities. First, using the example of teachers and researchers participating in an online portal, show how informational and cultural resource exchange is a goal of teachers, and how one digital library became a tool for building social context for learning. Second, I discuss how learning can take place in knowledge building communities, even without access to expertise, using an example of schoolchildren learning science online without traditional teachers. Third, I discuss the concept of an educational accelerator, or a collaboratory for educational reform, and discuss experiences from our own attempts to build such an accelerator. Finally, I propose some design heuristics for online systems by examining how new models of knowledge in online communities suggests new concerns for teaching and design.

1 Perspectives on Learning and Knowing in Online Communities

Online communities are a growing, and important, phenomenon. Increasingly, all aspects of human interaction are played out not only via face-to-face interaction, but also on a stage that is virtual and technology-mediated. People fall in love online, grieve online, shop online, become famous online, and form communities online (Rheingold, 1994). While the novelty of the early Internet era may have worn off, the kaleidoscope of how humans congregate via technology continues to fascinate, since technological changes (and social innovations) yield a constantly changing set of practices and behaviors.

In studies of online communities, learning often takes a central role. This is most obvious in e-learning applications, distance education, or online communities explicitly founded to support learning and teaching (e.g., Fishman et al., 1999; Hewitt & Scardamalia, 1999; Schlager, Fusco, & Schank, 2003). It is interesting to note that although there have been attempts to conduct computer-mediated learning *without* making it a social affair (for instance, via intelligent tutoring systems like Koedinger, 1998) online discussions often take center stage in computer mediated learning. The label “community” arrives quickly thereafter, in some cases raising the question of how to evaluate what counts as a community (Ke & Hoadley, 2004). Educators are justifiably excited about the possibilities of online learning generally, and hence interested in the question of how to create online communities for learning.

Yet, learning in online communities is not confined to the educational sector. Research on communities of practice (Lave & Wenger, 1991; Wenger, 1998) reinforces the idea that learning is a natural part of the functioning and replication of communities—these groups replenish themselves when people on the fringes of the community, or peripheral participants, learn to belong to the community by adopting its practices. And, while this learning may occur in deliberately constructed communities of practice (including online communities of practice), it also takes place naturally in other contexts, from the apprenticeship of tailors in Liberia to the enculturation of photocopier repair technicians. (Lave & Wenger, 1991; Orr, 1990). There are many incentives motivating learning in these settings, from economic participation to social inclusion to developing a professional identity.

The shift towards a community-driven model of learning such as occurs in online communities puts the role of teaching in question. If learning is a byproduct of communities (including online communities), knowledge itself becomes a property of the whole system. Traditionally, teaching and learning are clear complements to each other. But learning in online communities looks different—it can both be more emergent and more driven by the learners, not explicit teaching (Scardamalia & Bereiter, 1991). Knowledge itself becomes a systemic property, situated in particular configurations of people, tools, and contexts (Barab, Squire, & Dueber, 2000; J. S. Brown, Collins, &

Duguid, 1989). If learning occurs outside formal instruction, what, then, does teaching mean in an online community?

Indeed, teaching begins to look more like HCI design. From human-computer interaction work in CSCW and CSCL, we know that technology designers have a great deal of leverage over the practices that emerge from the use of their tools. Likewise, teachers are designers too, as orchestrators of activities, experiences, and interactions. The term *interaction design* has been proposed as “moving beyond human-computer interaction” to encompass precisely this blending of tool design and activity design (Preece, Rogers, & Sharp, 2002). When discussing new models of teaching in online communities, we need to see teachers as designers of experiences and interaction. In short, the “teachers” are architects of the system that fosters knowledge and permits learning.

In the sections that follow, I examine three models of knowledge in online communities and their implications for learning. Then, I illustrate each perspective with a different online community that provides an image of what “teaching” might mean. Finally, I present a framework that can be used to support teaching in the design of online learning communities.

1.1 Knowledge as information

The first model of knowledge is knowledge as information. Generally, there is a distinction between knowledge and information. Information theory says that information is simply data—a signal that is distinguishable from noise. Books, the web, hard drives: each contains information. On an intuitive level, we can see the difference between information and knowledge by considering the difference between an expert who knows how to repair a car, and someone who has access to books about repairing a car. Access to information can lead to knowledge, but they are not the same thing.¹

Nonetheless, we frequently approximate knowledge as information in online communities. Having access to information resources can make a person seem very knowledgeable. For instance, a manager, given access to the right reports (information), might be able to make a measurably better business decision. And likewise, when a student produces a paper, they are likely to do a better job if they have access to high quality information resources, such as a library or the Web. Early analyses of social computing often focused on how information can support individuals’ knowledge and power. (Kling, 1980) The instructivist model of learning (as opposed to the constructivist model) simplifies learning and teaching to the exchange of information; in this model, the teacher’s goal is a well-designed message conveying information to a learner (Clark & Salomon, 1986; Grabowski & Small, 1997; Kozma, 1991). This model is also used in management information systems; MIS designers are often focused on getting the right information to the right people at the right time, even when the system is “collaborative” (e.g., Foltz & Dumais, 1992).

How can we conceptualize teaching in an online community with knowledge as information? Obviously, a community provides a venue to exchange information between people. In many early descriptions of usenet newsgroups, they were highlighted as a nearly infinitely responsive information resource—post any question, get an answer from somebody who knows. Clearly, not all information is equally relevant or of equal quality. The former is a challenge when dealing with information repositories such as digital libraries, but the latter is a particular challenge of online communities. “Teaching” in this model of knowledge as information means helping connect the right people to each other, locating the right information resources (human or otherwise), and exchanging the right information (Kamiya, Roscheisen, & Winograd, 1996), a perspective sometimes called *knowledge networking* (Hoadley & Pea, 2002; R. D. Pea et al., 1999).

1.2 Knowledge in relationships

Knowledge can also be viewed as inhering in relationships between people. From a semiotic point of view, language and other signs derive their meaning from how they are used and exchanged. Thus, defining meaning is a consensual activity; an individual’s ability to use a word comes from not only the status of the word in the head of the

¹ Strict materialists would argue that the basis of knowledge is indeed information, i.e., special classes of representations at a neurological level, but even in this point of view, there is a distinction of perspective between the information or signal and the “concept” or knowledge it represents. (Pylyshyn, 1984)

individual, but also from the ways the person can use the word to communicate with other individuals or whole communities. This view suggests that tool designers have a great deal of influence on knowledge (see Marcus, 1993, for an overview of the implications of semiotics for interface design). In this perspective, knowledge can be viewed as the functional relationship between what a person knows and how they can use it, either to communicate with other people, or to accomplish tasks in the world. This perspective of knowledge as a functional relationship has an affinity with situated views of cognition, wherein the “knowing” is not a property of states in a person’s mind, but rather the inter-relationship between the person and the context in which their activity is situated (Resnick, Levine, & Teasley, 1991; Roth, 2001).

The online community aligns well with this view of knowledge. Within an online community, one can see people interacting in ways that permits not only individuals but also large groups to negotiate meaning and build knowledge. (Mantovani, 1996; Scardamalia & Bereiter, 1993). An online community may develop its own collective wisdom which members partake of by relating to one another, and evidence of this would be the development of important texts or monologues within the community as well as dialogues that allow knowledge to be created by members as they interact through computational media (Hoadley & Enyedy, 1999). As people develop social connections and converse, they create knowledge that inheres in their relationships (Dixon, Allen, Burgess, Kilner, & Schweitzer, 2005; Goodenow, 1992; Kilner, 2004; Wenger, 1998).

The knowledge-in-relationships perspective suggests an interesting model of teaching, in that the teacher-designer must take into account not only the processes of meaning-making within the community (i.e., the knowledge-building processes) but also how this locally constructed meaning connects to larger, externally constructed sources of meaning (Tabak, 2004). In this view, the teacher can be both a leader who has a relationship with learners and helps them negotiate meaning (think, for instance of a Socratic dialogue), and a facilitator who can support particular kinds of dialogue or relationships among people in the community (Fredericksen & White, 1997; Johansen, 1989).

1.3 Knowledge in the organization

A third perspective on knowledge is a structural one of knowledge as a property of a configuration of people, ideas, and practices in an organization (J. S. Brown & Duguid, 1991; Engeström, 2002; Garratt, 1987). In this view, it may make more sense to ask what an organization knows or remember than what individual people know. (Ackerman & Halverson, 2000; Ackerman & Halverson, 2003). For example, Hutchins does a fine-grained analysis of the navigation of a large ship in the Navy, in which he demonstrates that no single person has all of the relevant knowledge to pilot the ship, but when considered as a system, including multiple people and artefacts, the organization (the crew) does know how (Hutchins, 1995).

The community-of-practice literature has examined how communities, especially online ones, can support the advancement of collective knowledge in professional organizations and companies (Dixon, 2000; Dixon et al., 2005; Saint-Onge, 2004). In this view, an online community’s learning is less dependent on the individual, and more dependent on the group—the collective functioning of the group or organization is the measure of knowledge. Sometimes learning in this view is a result of the need for the organization to produce (in this case, learning is incidental to working), but sometimes learning is the primary aim of the community. Scardamalia and Bereiter (1993) have termed online communities with such a focus *knowledge-building communities*.

Within the perspective of knowledge as an organizational property, teaching is perhaps the least similar to the traditional transmission model. In this view, the organization must be constantly seeking out, creating, and disseminating not only new ideas but new practices that transform the work of the organization (Garratt, 1987; Nonaka, 1998; Rogers, 1995). The “teacher” (now perhaps called a “chief learning officer”) has only slightly more responsibility for ensuring this than other participants in the organization; each knowledge worker becomes responsible for ensuring that knowledge diffuses (and each one can disrupt the transfer of knowledge within the organization, Orlikowski, 1993). In an online learning community, the teacher becomes an organizational leader, inspiring a climate in which the organization as a whole (and thus, its participants) becomes more empowered by knowledge. In addition, the design of information technologies and practices becomes paramount to encourage awareness and diffusion-friendly information sharing (Ackerman & Halverson, 2003).

2 “Teaching” in online communities for learning

In this section, I show, by example, how each model of knowledge can change what it means to be a teacher in an online community. In each case, knowledge is built up and learning takes place, but through a process that differs from traditional teaching.

2.1 Teaching as information exchange: Knowledge networking in the CILTKN digital library

The first example of new forms of teaching aligns with the model of knowledge as information. The Center for Innovative Learning Technologies (CILTKN) was a six year project, funded by the US National Science Foundation, to improve the nation’s capacity to innovate educational technologies by linking researchers, practitioners (primary, secondary, and postsecondary teachers), technology developers, policymakers, and others. CILTKN had a variety of mechanisms for achieving these goals, such as hosting conferences, funding collaborations among different stakeholder groups, and training postdoctoral scholars (Roy Pea & Hoadley, 1999; R. D. Pea et al., 1999). CILTKN also hosted an online community called CILTKN, or the CILTKN Knowledge Network. Initially, CILTKN experimented with discussion boards and other communication tools, but through empirical research discovered that different stakeholder groups didn’t necessarily perceive a need to communicate with each other directly. Rather, people needed access to information about educational technology research and development. CILTKN was created as a digital library, a repository of information that was either difficult to collect or disseminate, such as bibliographic references, course syllabi on educational technology, contact information for people, research projects, and labs or organizations, and so on (Hoadley & Pea, 2002). CILTKN helped foster information interchange through a novel combination of data types, technological infrastructure to lower barriers to contribution and use of the information (Hoadley, 1999a), and an emphasis on linking information resources to social ones. For instance each published data item was associated with a contributor whose contact information was readily available, and special visualization tools allowed users to see a social network diagram of who co-authored papers with whom. In addition, a special posting area allowed users to advertise for collaborators or those with a particular expertise.

Although CILTKN was primarily a digital library, it supported an online community that fostered learning about educational technology. Before CILTKN ended, CILTKN supported over 10,000 users. Despite the fact that the information types selected for the digital library were derived from the information needs of educational technology researchers (Hoadley & Pea, 2002), practitioners (primarily K-12 teachers) formed the bulk of CILTKN’s user base (over 75% of members identified their primary role as “educator,” not researcher, Hoadley, 2003). Surveys and interviews with CILTKN users revealed that teachers, graduate students, consultants, and others who did not (yet) belong to the core educational technology research community were nonetheless interested in the knowledge of that community, and used the information resources in CILTKN to orient and educate themselves (Hoadley & Paryono, 2003). Furthermore, logfile analysis showed that people did seek out social connections via the system; the most commonly viewed page after the initial login screen was the membership directory (Hoadley & Paryono, 2003). Some of the heaviest users of the system (including both researchers and non-researchers) described other learning activities the system helped foster, ranging from staying aware of recent developments in the field to helping them write papers, review literature, and prepare courses. Based on these self-reports, it certainly would appear that the users were learning about research in the field.

In general, the teaching and learning in the CILTKN were a result not of any traditional direct instruction, but rather an innovative access to informational resources about research. These resources were not limited to research reports, but included a rich mix of social context information too. Though members of the community did not use the site for chat or discussion, it supported a rich mix of social practices for information sharing, by lowering barriers to publishing and use of important information about the research community.

2.2 Teaching as relationship: Peer learning in SpeakEasy

The second example of new forms of teaching aligns with the model of knowledge in relationships. The *SpeakEasy* software was one of the first two Web-based threaded discussion tools (Hoadley, Hsi, & Berman, 1995a). This tool was studied in a variety of contexts, including science education for middle school students in the Knowledge Integration Environment (KIE) project (Bell, Davis, & Linn, 1995; Hoadley & Bell, 1996). In typical use, the *SpeakEasy* was provided as a curricular adjunct, allowing peer discussion among students with no teacher intervention (except when students posted vulgar or otherwise inappropriate comments.) The tool and surrounding

activities were designed and tested against a model of productive discussion (Hoadley, 2002; Hoadley, Hsi, & Berman, 1995b; Hsi, 1997; Hsi & Hoadley, 1997). Typically, a topic would be presented that asked students to explain some scientific phenomenon, and the students were graded on participation and effort, not correctness of their opinions. Students talked online in groups of 12-15, and typically interacted with other students whom they did not know offline.

In one study, students conducted online discussion with no prior curricular exposure to the topic, the relationship between light and color. The discussion was seeded with comments that recreated a historical debate between the theories of Newton and Kepler, whether light carried color to objects, or that white light was composed of a spectrum of colors. Despite the fact that students had no curricular exposure, and nearly no students had any idea about the relationship between light and color, students significantly improved in their conceptions. Furthermore, the learning was not attributable to which of the discussions included students with correct preconceptions, but rather the participation of students in discourse (Hoadley & Linn, 2000). While one might imagine that uninformed students, presented with two competing scientific explanations, might be characterized as the blind leading the blind, the research showed that through the process of talking online the students could generate explanations, weigh evidence, and come to a more correct understanding, both individually and collectively. (Hoadley, 1999b; Hoadley & Linn, 2000).

Here again, there is no traditional teacher in this online community. Instead, through relationships with each other in the online community, the students were able to construct meaning and learn science. Students communicating in these types of online discussions were often able to, for the first time ever, engage peers in a learning discussion about science (Hsi, 1997). The discussion groups came to varying degrees of consensual understanding of a topic, and were able to make progress teaching themselves (Hoadley, 1999b). The technology in this case was an important component of scaffolding particular kinds of productive discussion that enabled the knowledge in relationships to come to fruition (Hoadley, 1999b; Hoadley, 2002).

2.3 Teaching as organizational knowledge-building: The TELS education accelerator

The third example of new forms of teaching in online communities aligns with the organizational model of learning. The TELS (Technology Enhanced Learning in Science) project was proposed as an “educational accelerator” for science education research and development. The term is a double entendre; on the one hand it recalls particle accelerators in physics, a mechanism for large numbers of scientists to collaborate on large, high impact breakthroughs. On the other hand, it refers to the possibility of radically accelerating the progress of research and development through an organizational approach. When such scientific endeavors are supported by technology, they are often called *collaboratories* (National Research Council, 1993; Olson et al., 1998; Rosenberg, 1991). TELS includes universities, a non-profit organization, and school districts in the US and Israel—all told, the participants span nine time zones.

TELS is a relatively new example (a little over a year old) so data is sparse. However, TELS has focused on deliberately encouraging knowledge-building as an organizational endeavour through the use of online community technology. One strategy has been to make heavy use of a wiki, a collaboratively editable website, as a repository for planning documents. TELS encompasses two technology teams in Massachusetts and in California; through the wiki these teams have been able to construct requirements and specification documents that represent the organizational consensus for the programming agenda. Non-programmer stakeholders use these documents to stay aware of the current activities, and to comment on or change plans as appropriate. Rather than a traditional hierarchical communication structure in which site principal investigators would cull opinions from their site, take them to leadership team meetings, and then bring decisions back to their teams, the participants, ranging from graduate students to K-12 schoolteachers at pilot sites can have direct input into the technology development process, meaning that TELS as a whole learns how to meet the needs of a wide variety of stakeholders, and produces an enduring record in the process that will hopefully be useful for communicating with outsiders. This and other aspects of the partnership model in TELS are being explicitly considered (and empirically validated) as ways to build practical and theoretical knowledge about science education. Additionally, TELS creates and circulates written summaries of research, teaching strategies, or technologies called “TELS Perspectives.” These documents are reviewed and edited by researchers and teachers from a variety of TELS sites, and not only help TELS members communicate with each other, but also provide a written record of the collective wisdom of the group for newcomers to the organization. Finally, TELS uses distance education technologies to offer professional development to

graduate students and K-12 practitioners. Courses are co-taught by individuals at different institutions to help maximize cross-institutional knowledge transfer.

Although the organization is collectively learning how to engineer effective technology-enhanced science curriculum, again, there is no traditional teacher providing this knowledge. Instead, TEELS fosters its own organizational learning by combining a research-driven knowledge-building process with a wide, participatory engagement with stakeholder groups, organizational flexibility to take advantage of knowledge wherever it exists within TEELS, and technologies that support construction of group artefacts and boundary objects (Hoadley, 2005). The wiki, the online course environments, and the online perspectives each help the organization as a whole function and learn.

I have presented three examples of teaching and learning in online communities that reflect the three different models of knowledge: knowledge as information, knowledge in relationships, and knowledge in organizations. The CILTKN showed how improving information flow can help individuals get knowledge from a community they may not belong to. The SpeakEasy example showed how knowledge can grow from relationships among peers by using discussion to elicit and refine ideas. The TEELS example shows how a focus on organizational knowledge-building can help disparate stakeholder groups synthesize new knowledge. Each of these examples lacks a clear “teacher” but helps show how strategic use of activities and technologies can foster learning in online communities.

3 The social life of knowing and teaching: a systemic view

As we have seen, online communities challenge the standard view of teaching and learning as a transaction between two individuals. As we consider online communities and their informational, relational, and organizational dimensions, a more systemic view of knowledge arises, and hence a more systemic view of how teaching and learning might take place. The teacher or designer in such an environment must worry about how knowledge is created and diffused across the entire community, and to a much greater extent, the learner must take responsibility for knowledge as well. I propose three features of online communities that help highlight and explain teaching in this new model: information capital, social capital, and processes of learning.

3.1 Information capital

Information capital refers to the informational resources people can bring to bear to solve problems. In the knowledge as information view, information capital is the primary focus for learning: how to get information to those that need it. But information is important in the relational and organizational models of knowledge too. In the relational view, information capital is held by people who co-construct meaning through dialogue. And in the organizational view, information capital is one of the resources that define the continuity of the organization. Important design questions for teachers in online communities concern the information capital. Where is the information capital? Who holds or controls it? How is it produced, and how is it transferred? Can systems such as information technologies allow more frictionless movement of this capital? And so forth.

3.2 Social capital

Social capital refers to both the relationships between people and the ability to which those relationships allow access to other forms of capital. (Portes, 1998; Putnam, 2000) Thus, if I borrow \$5 from a friend, I am using the relationship and my social capital to gain access to (monetary) capital. In an informational view, social capital might simply be seen as a way to route “knowledge.” From a relational view of knowledge, social capital becomes important as the basis for the construction of dialogues and meaning; it is the basis for the relations that permit knowledge to be generated. In an organizational view, social capital is particularly important for the diffusion of innovations and for organizational flexibility (Winograd & Flores, 1986). Increasing social capital does not necessarily mean that everyone must have a strong social bond to everyone else in the community; indeed, weaker bonds may actually be more productive (Granovetter, 1973). However, a general atmosphere of trust and community-mindedness is an important precondition for the types of knowledge production and learning that we might hope for, contributing to a “tipping point” effect for learning (Gladwell, 2000; Glance & Huberman, 1994; Huberman & Hogg, 1995).

3.3 Processes of learning

The processes of learning within an online community may be defined as those processes by which information and social capital are transformed into knowledge. In an informational view of knowledge, this includes routing, awareness, comprehension, and so on (Heath, Svensson, Hindmarsh, Luff, & Vom Lehn, 2002; Schmidt, 2002). In a relational view of knowledge, these processes primarily include discourse and other sensemaking activities. Much has been written about how technologies may be structured in such a way as to support or optimize these learning discourses (A. L. Brown et al., 1993; Cavalli-Sforza, 1991; Duranti, 1986; Hoadley & Hsi, 1993; R. Pea, 1992; Pontecorvo, 1993). Finally, in an organizational view of knowledge, the processes of learning include organizational knowledge management and the diffusion of innovations, and again, technology is likely to play a role in supporting these processes (J. S. Brown & Duguid, 1991; Davenport & Prusak, 1998; Engeström, 2002; Greer, McCalla, Kumar, Collins, & Meagher, 1997; Orr, 1990; Saint-Onge, 2004).

These three phenomena—information capital, social capital, and processes of learning—are the levers that would-be teachers can pull to help ensure learning in online communities. As a design heuristic, teachers in online communities should consider how to enhance each of these phenomena as they relate to the community and learning.

3.4 Conclusion

Although online communities are both popular and frequently successful in education, they are still poorly understood as a venue for teaching and learning. By focusing on different models of knowledge and alternative views of what learning is, we can expand our idea of what it means to teach (i.e., how to foster learning). Although a theory of learning does not necessarily imply a theory of instruction (Bruner, 1968), identifying ways to think about teaching is vital if we wish to take full advantage of the opportunities provided by online communities.

I have described and exemplified three models of knowledge that each has implications for how we view teaching and learning. The three different models of knowledge in online communities include knowledge as information, knowledge in relationships, and knowledge in organizations. These three models each help support a more systemic view of learning in an online community in which the teacher or designer can foster learning through attention to each of three aspects of the online community: information capital, social capital, and the processes of learning. From these three models of knowledge derives an idea of what “teaching” might mean in an online community.

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