Technology-Supported Systemic Reform: An Initial Evaluation and Reassessment

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Abstract: This paper reports and reflects on the use of information technology to support a systemic reform effort in rural, geographically distributed schools. An evaluation conducted after a year and a half of effort indicated limited use of the technology outside of face-to-face events. We reassess the potential roles of technology in systemic reform in terms of the communities and practices to be supported and the tension between supporting and changing practice.

Introduction

As new information technologies are invented they are often associated with efforts to improve education. Applications of information technology include attempts to more effectively convey information to students, to empower students' own agency in accessing information and constructing knowledge, and to aid teachers' classroom management, lesson preparation, and assessment. Information technology can also support *systemic reform* processes in several ways. Technology can act as a change agent: teachers will need to change their practices in order to teach about technologies designed for doing authentic inquiry and communicating or collaborating with others. Information technology can also support professional development through access to online courses, and enable participation in distributed communities of practice.

Because today's school systems operate in an environment of constant change, professional development for survival and success in such a setting requires a paradigm shift from a scripted training approach to a more fluid approach that encourages the incorporation of networks, coalitions, and partnerships. The capacity to network with other professionals is embedded in the notion of communities of practice. McLaughlin and Mitra (2001) argue that sustaining large-scale theory-based reform efforts "requires a community of practice to provide support, deflect challenges from the broader environment, and furnish the feedback and encouragement essential to going deeper" (p. 10). Barab (2003) defines a community that advances ongoing and open-ended professional development as a "persistent, sustained network of individuals who share and develop an overlapping knowledge base, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise" (p. 198). These communities change the relationships among teachers, breaking the isolation that most teachers have found so confining. Members of a community learn new patterns of behavior primarily through their interactions with others, not through front-end training designs (Fullan, 1993).

A natural extension of such communities of practice involves the use of the Internet to grow and sustain these enterprises. Yet, Barab (2003) maintains, "attracting to the forum a group of people who will form a community is a considerable accomplishment" (p. 197). An emerging body of literature confirms Barab's observation and documents the challenges faced by design teams. Marx and associates (1998) reveal the importance of building systems and tools that allow for cycles of collaboration, trial, reflection, and modification over time. The researchers emphasize that these online innovations *supplement* not *supplant* face-to-face professional development. Working with the Inquiry Learning Forum (ILF), Barab, MaKinster, & Scheckler (2003) find that a web-supported community must focus on issues of *sociability* more than *usability*, i.e., how the design links to and supports people's social interactions, focusing on issues of trust, time, value, and collaboration. Kling and Courtright (2003) contend that it is easier to foster technology *supported* community development than to nurture technology *initiated* communities. They note that if teachers have not engaged in reflective discussion even in face-to-face settings, it is unrealistic to expect this behavior in an online environment. In addition, the researchers attribute low usage of ILF to participants' fear of "exposing themselves" (p. 227). Trust building is an essential feature of online engagement. Working with TappedIn, Schlager and Fusco (2003) find that certain communication, database, and search tools are necessary components of a community of practice infrastructure (e.g., stronger tools for content-specific authoring and reflective inquiry to support local practice). They identify certain significant characteristics of communities and

their implications for building infrastructure support. Learning occurs primarily in the context of work: formal training supplements informal learning with more experienced members taking the lead while new members are initiated by participating peripherally. Groups within the community are fluid: participants, objectives, tools, and divisions of labor change over time. To support community evolution and reproduction, the online technology must build its capacity for resource-intensive informal professional development activities such as mentoring and coaching. Based on her case study research of nine schools implementing technology as part of educational reform, Means (1998) associates the following factors with successful use of technology: teacher input into school decision making, broad teacher ownership for a school reform agenda, teacher belief in a rationale linking technology use to the school's vision, provision of supported time for teacher interaction and feedback around the use of technology, distribution of technology to classrooms, interaction with an external partner, and easily accessible, nonjudgmental technical support. She maintains that these factors are crucial conditions that impact not only community building within a school but also within an extended community of professionals.

Thus, technology can serve systemic reform in a variety of ways. A reform effort must choose from among these and address the issues raised above. If the goal is assimilation into the practice of community members, designers must seriously consider how and when new tools and artifacts are introduced. Issues of compatibility, interoperability, and overlap with existing infrastructure, as well as user readiness, must be carefully addressed. We will return to these critical issues in the concluding section of this paper. First, we describe our own systemic initiative and the technology (hnlc.org) that was created to support its work. We report the results of an internal evaluation of educators' use of hnlc.org, and then return to this discussion, informed by that experience.

Hawai`i Networked Learning Communities

The goal of Hawai`i Networked Learning Communities (HNLC) is to empower educators to prepare students in economically disadvantaged rural schools for life and careers in today's complex and dynamic technological world by enabling them to attain high standards in science, mathematics, and technology (SMT). HNLC is the result of collaboration between the Department of Information and Computer Sciences (ICS) of the University of Hawai`i at Manoa (UHM) and the Advanced Technologies Research Branch (ATRB) of the Hawai`i Department of Education (HIDOE). Hawai`i is unique in having a single public school district, which is also a state agency.

HNLC is funded by the National Science Foundation's Rural Systemic Initiative (RSIs). NSF created the RSIs in 1994 to support educational reform of SMT programs in economically disadvantaged, rural regions of the United States. The goals of the RSIs are to improve SMT education, increase student achievement, strengthen schools through partnerships with institutions of higher education, and enhance scientific understanding and appreciation among students and the general community (National Science Foundation, 2000). As well as facing typical reform issues, such as standards alignment and professional and leadership development, the RSIs face unique challenges. Rural schools serve small, isolated, and poor communities that are often ambivalent toward education (Inverness Research Associates, 2001).

Organization and Activities

Presently 20 schools on six Hawaiian Islands participate in HNLC, having joined the initiative in two cohorts: Cohort I (starting in 2002) and Cohort II (2003). Schools were selected according to criteria that include a rural or small town location, at least 30% of students receiving free or reduced lunches, and a preference for high percentages of under-served populations, especially of Hawaiian/Part Hawaiian ancestry. Benefits to schools include leadership development activities, mentoring by state-level resource teachers, training on instructional use of technologies, and access to HNLC's online resources (described below). Each school's HNLC leadership team includes an administrator, a half-time HNLC-funded teacher partner, and two additional teachers and/or support services personnel (e.g., technology coordinator, librarian). SMT expertise must be reflected in the team. HNLC requirements are aligned with those of HIDOE: a school-wide Standards Implementation Design that aligns SMT curricula with state standards and reflects inquiry-centered instruction, elimination of tracking, increased teacher participation in the standards implementation, and building community support for SMT education. Development of an assessment-driven reflective practice is of particular concern.

To ground leadership development in practice, HNLC requires that each school develop a *unit plan* that provides a concrete example of standards-based inquiry learning and serves as a model that can be replicated to

accomplish full implementation of the school's Standards Implementation Design. The unit planning process is intended to expose barriers in practices, policy, and infrastructure that inhibit the best practices exemplified by the units. HNLC units have emphasized environmental and cultural themes as a strategy for increasing the relevance of SMT curricula to Hawaii's students. HNLC has provided leadership development activities for the unit planning process in its summer institutes, presenting exemplary units that combine exciting hands-on learning with an orientation towards standards and assessment, and providing training in the use of technologies. School teams brainstorm potential unit plans at the institute and then continue the planning process throughout the year, encouraged to share their work in our online workspaces. The completed unit then provides an example within the school and for subsequent cohort schools.

Technology

Our working assumption at the outset was that if teachers experienced the use of technology in their learning they would better understand how to use it for their students' learning. Based on this concept as well as feedback from state educational leaders and findings of a needs assessment survey, we planned to use networked computer technology to make statewide resources available to the rural schools through: (1) a searchable resource database with a web-based interface (Suthers, Johnson & Tillinghast, 2002); (2) telementoring to provide critical access to people; and (3) workspaces to support the collaboration that is so vital for learning and professional development. The website, hnlc.org, was developed to provide access to these tools. All of the components of the website have been developed using *open source software packages* that are inexpensive and easily reproducible on a range of computing equipment (Linux, Apache, MySQL, PHP, PHPMyAdmin, Qmail, and EZMLM).

The first generation of hnlc.org consisted of *static HTML pages* that stated the goals of HNLC and announced upcoming events, with a link to a prototype *online discussion tool* (Suthers & Xu, 2002). This tool was designed to support *artifact-centered discourse*, allowing discussants to simultaneously view and comment on a webpage, containing for example unit plans in progress or student work. A new version of the discussion tool is now being used on hnlc.org.

Our early experiences indicated that educators needed guidance on instructional planning aimed at reform objectives. We conceived a simple guide, an online *unit plan template*, for designing the units and facilitating access to completed units via the resource database. The template consists of eleven web-based forms, covering unit description, designers, grade level and curriculum areas, standards, assessment, samples of student work, overview of goals, learning outcomes, resources, unit flow, and reflection. Though these sections can be completed in any order, they are sequenced to prompt authors to first identify learning objectives in terms of state standards and how these objectives will be assessed. This was the first tool designed specifically for our systemic reform effort.

In keeping with our community building focus, we made a significant change to hnlc.org in August 2002. To promote active online involvement and participant "ownership," the hnlc.org homepage was replaced with a dynamically generated, story-based page modeled on Slashdot.org. Users who log into the site can submit stories for the front page, and project staff can use this *community forum* to publish information for the HNLC community. Members are notified by email when a new story is posted, with a link to the story.

In June 2003 we introduced a *resource database* with a focus on SMT resources in Hawai'i. The database is searchable by keyword in simple mode, and in advanced mode on specified fields – audience, title, creator, contributor, subject, coverage, description and resource type. The database also has fields for identifier, date, standards, format, language, learning time, publisher, rights, source, and relation (enabling relations to other resources to be constructed). The fields were derived in part from the Learning Object Metadata (http://ltsc.ieee.org/wg12/) and the keywords from the GEM (Gateway to Educational Materials) controlled vocabularies (http://www.geminfo.org/Workbench/Workbench_vocabularies.html).

Evaluation

An evaluation of the use of hnlc.org and its interactive tools was conducted by the third author as his master's thesis, with assistance from the first two authors. The objective was to understand how, why, and under what circumstances hnlc.org is used, as well as how well the interactive tools are meeting the needs of participants. This descriptive study included a survey, analysis of server logs and online content, and a focus group.

A *survey* was distributed at the 2003 HNLC Summer Institute, to which all 47 attendees of the Institute responded voluntarily and anonymously. Respondents were asked to: (1) provide basic biographical information and information concerning the technology capacity of their school; (2) report frequency of use of several common networking technologies (email, discussion boards, instant messaging, etc.); (3) report frequency of use of hnlc.org, as well as any benefits they perceive hnlc.org as providing; and (4) assess their attitudes toward technology used for teaching, learning by students, and for professional development.

Web server *access logs* for the period of August 2002 to August 2003 inclusive and participant *login logs* for the period of January 2003 to August 2003 inclusive were analyzed to determine usage patterns for the site, using the Webalizer server log analysis tool (http://www.webalizer.com/). These logs were pre-processed to eliminate HNLC staff use, demonstrations, development/testing of the site, and search engine "spidering." We also examined the content of online stories and discussions.

A *focus group* was convened for one day in April 2003. Participants were asked to discuss their current practices, perceived challenges, and possible improvements with regard to three key topics: alignment of curriculum to state standards; use of technology to support and improve SMT education; and integration of inquiry-based learning into the curriculum. They also reviewed the tools available on hnlc.org and discussed how the tools could be used to improve their teaching practice, the relevance of the tools to their existing practice, and what improvements they could imagine for the tools.

Results

The *profile of survey respondents* suggests that they are motivated, seasoned professionals who are largely new to the HNLC initiative. The 47 respondents included classroom teachers (40%), teacher partners (6%), technology coordinators (11%), library media specialists (6%), administrators (19%), and "other" (17%). About 76% had served 10 or more years as professional educators (65% in Hawai'i). Few had been with HNLC for the full two years of the initiative (4%), while 30% have been with HNLC approximately one year, and 66% for less than six months. A majority of respondents said that the purpose of hnlc.org was clear to them and that hnlc.org was relevant to the success of their students. However, when asked about the *effectiveness and appropriateness of hnlc.org*, at least half were "neutral" on whether hnlc.org had a positive impact on their professional activities or a positive impact on SMT programs in their schools, or whether hnlc.org provided services unavailable to them elsewhere. Neutrality may be consistent with the large number of new members surveyed. Responses to an open-ended question indicated that the most valuable services provided were "current info on technology," "networking with other schools on problem based learning," "resource listings," "ideas for units," and "the unit plan template." "The discussion area" was identified as least valuable.

Many of the respondents reported frequent *use of computers* in the classroom. Respondents felt strongly that computers were relevant to their teaching, assisted them in planning, and helped them integrate innovative methods. They also felt that computers enabled them to focus on individual students' needs better. About 58% felt that they had sufficient training to incorporate technology successfully into their teaching. Respondents also reported a high frequency of use of computers in-class by students, although not as high a rate of use as for "in-class instruction."

In contrast, most respondents reported that their *use of ICT for professional development* was limited to the use of online resources and email. Many have never used online discussion boards (50%), online chat rooms, or instant messaging (85%) for professional development. HNLC participants have only limited exposure to and understanding of the online communication and collaboration tools we offer. Despite this, over 75% felt that online communication and active collaboration were important to their professional development. While over 60% reported that they found inspiration for *new uses of computers* from their students, only 39% felt that students were inspired by respondents' use of computers.

The *web-server log analysis* distinguished between site visits (not requiring login) and login logs. A unique *site visit* occurs when a new Internet address visits the website, or when the same Internet address visits the site after making no requests for 30 minutes or longer. The monthly number of unique visits to the website increases from about 600 in August 2002 to about 1800 in August 2003; fluctuations do not show an obvious relationship to HNLC-sponsored events. The *login logs* provide an estimate of use of specialized tools such as the unit plan template, discussion forums, posting stories, and submitting resources. Login rates are low (below 100/month)

except in months in which HNLC-sponsored workshops were held. After filtering out logins generated from the ATRB network (since those can be attributed to use during HNLC sponsored workshops or to HNLC staff doing their work), we obtain the best picture of participant adoption of hnlc.org tools by educators for their own, spontaneous use outside of workshops sponsored at ATRB. In general, from January to August 2003 there were an average of 21 logins per month outside of ATRB, although this includes a spike of 56 in June 2003, suggesting that some Cohort I participants logged in around the time of the summer institute to work on their assigned unit plans.

The record of *online stories* provides further usage data. For the period covered by the server log data (8/2002-8/2003), 43 postings (54%) were contributed by HNLC staff, including 17 from ATRB and 26 from the UH team. The remaining 36 postings (46%) were by others, with 33 by teachers and 3 by other organizations who were offering resources. Of the 33 postings by teachers, 18 were by school teams introducing their schools at our request during a sponsored workshop; the other 15 posts were by teachers on their own initiative, with many of these posts provided by one teacher known for his innovation.

Asynchronous participation in *web-based discussion forums* has been particularly low. Our first proposed topic, discussion of an indicator of successful systemic reform (National Science Foundation, 2000), fell flat. Responses to informal queries attributed this to the abstract nature of the topic (too far removed from practice), lack of time, and forgetting to check the web site (email notification of activity had not yet been implemented). Most use took place when ATRB staff used the discussion forums as meeting-support tools. Discussion spaces are now also created automatically for each unit plan, and school teams were asked to comment on each other's units. More recently we have been trying to use the discussion forums as a bridge between meetings and subsequent asynchronous work by asking participants to seed a discussion with action items identified during their face-to-face sessions, and asking ATRB resource teachers to use the workspaces to mentor school planning. These conversations have just begun and are not reflected in the data reported.

Five HNLC participants volunteered to attend a *focus group discussion*, joined by seven HNLC staff members. Issues raised included their broad concern that the goals of the HNLC initiative might be critically different from their own goals and that HIDOE expectations of them were unreasonable, given the stage of development of their reform efforts. Also, participants recognized that HNLC was an evolving initiative and that Cohort 2 schools (and, by implication, HNLC staff) could learn from the mistakes made with Cohort 1. Attendees were re-introduced to the existing hnlc.org tool set. While they liked the tools, they reported that they had little or no experience using such tools online. Finally, they were asked to suggest new tools. Without exception, they suggested tools for use by students. Also, during discussions of the resource database, attendees primarily suggested the addition of websites that students would use as part of lessons. The prevailing view of "technology in education" appears to be "technology for use by students," not "technology for use by educators."

Discussion

Overall, respondents seem to have positive attitudes about the use of technology for a range of purposes, but as of Summer 2003 had not made significant use of hnlc.org outside of sponsored events, with the exceptions of school teams preparing for those events and the initiative of a few individuals. The results of this study raise theoretical and design concerns about our efforts to use technology in support of systemic reform. We have considered four interpretations of these facts. These are discussed below, beginning with the most pessimistic and the most optimistic interpretations, and concluding with the complex middle ground where truth probably lies.

Can Technology Help?

First, there is the possibility that technology support for systemic reform is too difficult to be worthwhile, or is not a solution to the most fundamental problems faced. Clearly, we feel that, despite the challenges, technology *can* and *should* help some aspects of education reform efforts. In the conditions of isolation of rural schools in Hawai'i, we would be irresponsible not to make every effort to take advantage of the powerful possibilities offered by technology to connect people and ideas into communities of practice. We are committed to furthering and supporting the desires for reform these communities hold for themselves. Yet we acknowledge that, along with the need for new teacher competencies and practices that might possibly be addressed with technology support, what educators also need is more time and better funding for their schools. The public educational system faces great challenges in shrinking resources that often are accompanied with underfunded mandates for greater accountability with punitive consequences.

An Optimistic View

Second, at meetings and school visits, participants have indicated positive attitudes about the resources database and the unit plan template as a prompt to organize work. The server logs suggest that HNLC staff and participants are logging in to prepare for and supplementing HNLC sponsored events (Marx et al, 1998). Therefore, the hnlc.org tools may be serving a useful purpose in providing resources for and organizing HNLC sponsored activities. Also, the data reported cannot capture all use of hnlc.org, particularly the dissemination of information via the community forum. When a new story is posted, email goes out to all members with a URL to the story. Members can view the story without logging in; our present logging mechanism cannot identify such use, which may well be the most frequently used service. One school has reported that they sought and obtained a grant as a result of a story posted on hnlc.org. Although only a few educators have taken the initiative to share information, these innovators have been given a voice and hnlc.org is providing an important service to educators as consumers. However, we cannot ignore the fact that tools that have been the focus of much of HNLC's development efforts have not been made an integral part of participants' professional practice.

Patience Is Required

Third, it may be that the basic approach is right, but more time is required to realize the benefits and some adjustments are required. We note that 66% of school team members have been with HNLC less than six months; participants reported low prior use of the kinds of tools we offer; and they are neutral about whether the benefits of HNLC match their own goals. It is clear that the majority of school participants need more time and guidance to understand the demands of HIDOE's systemic reform program and to become familiar with and adopt the inquiry-based, reflective practices we are advocating as well as the tools we provide to help them meet those demands. Many educators have little experience with reflective and evaluative practice, so use of the discussion forum for that purpose requires more than a technical understanding of the tool.

We are also learning to better coordinate efforts of the technology team at UH and other HNLC staff at ATRB. The current ATRB team – which has the most direct contact with school teams – has been in place only for the last five months of the period reported on in this study. Recently both teams have developed a strong sense of the urgency of closer coordination of our work, and are working together to examine the appropriate use of technology support. New activities have recently been added under the initiative of a new project director. School visits to all schools were conducted by representatives of the ATRB and UH teams to provide further clarification of the program, technology training, and time for work on the unit plans. An online course for professional development credit is being developed.

Looking more specifically at the technology, there are reasons to expect that incentive for use will increase and barriers will decrease in the coming year. Usability issues are being resolved and new features added that may increase use, such as email notification of new discussion activity. Also, telementoring (mentoring of school teams by disciplinary experts, master teachers at other schools, and state curricular specialists) is a frequently requested service that we will provide once our infrastructure is capable of supporting it.

Supporting and Changing Practices of Multiple Communities and Teams

Fourth, we have seriously considered the possibility that our approach is misguided and fails to meet the needs of the community of practice that we target. This conclusion receives support from the low participant login numbers and from comments made in the focus group suggesting, for example, that teachers want software for their students, not themselves. It is this conclusion that has generated the most reflection and debate within our group.

<u>What Community?</u>

Questioning what community of practice we are trying to support, we first reaffirmed that it is necessary that we support educators. Although our ultimate goal is increased *student* performance and participation in SMT, we are working with those responsible for this outcome rather than directly with students. Considering communities of practice within our partner schools, we realize that we have not deliberately identified existing communities (Kling & Courtright, 2003); rather we are working with teams constituted for the purpose of representing the school to HNLC that may or may not (yet) constitute a community of practice. We also recognize that relevant communities of practice can extend beyond the schools. Teachers specializing in a given subject or grade level may want to network with each other across schools. There are also groups (if not communities) defined by

administrative structures such as the HIDOE complexes (high schools and their primary and intermediate feeder schools). Educators at different grade levels are interested in working with each other towards continuity in the students' learning experience. We also considered whether our HNLC colleagues within the HIDOE should be the primary targets of our technology support. The ATRB team members plan the leadership development program and carry it out in scheduled events, school visits, and (soon) online instruction. Although ATRB staff suggest that we focus on teachers, we recognize the need to work closely with the ATRB staff to ensure that the affordances of our technologies mesh well with their plans. Because participants will most likely try new tools and practices at face-to-face meetings, we need to design for transitions between face-to-face and online use. Also of interest for our systemic reform agenda is the statewide community of SMT educators within HIDOE, and the even broader community of stakeholders and interested parties that includes parents, employers, and representatives of other federally funded programs that have an educational outreach component.

As a result of this discussion, we now explicitly acknowledge that hnlc.org must support *nested* and *overlapping* communities of practice (c.f., "nested learning communities," Resnick & Hall, 1998; and "double-knit organizations," Wenger, McDermott & Snyder, 2002) that extend beyond the schools and into the community. We need to focus on teachers as those primarily responsible for student achievement, but not neglect the larger community context of education. Our primary focus in the design of hnlc.org remains on the school teams and on inter-team collaborations (communities of practice) in which educators and ATRB staff share ideas and advice. Our secondary focus remains on the larger community that forms the environment of resources and expectations within which our primary communities grow. It is *essential* for the sustainability of systemic reform that we not only address the needs of the practitioners, whose work immediately impacts upon student performance, but also initiate change in the broader community that places expectations on the school system as well as provides the resources to meet those expectations.

What Practice?

Having clarified the overlapping and nested spheres of communities of practice that we intend to support, we are still faced with the question, "What practice?" Specifically, we considered whether there is a conflict between the view that tools for communities of practice should meet practitioners' immediate needs and systemic reform's objective of *changing* practice. We also considered the request for technology for students in terms of pathways by which technology is adopted into practice.

For its primary target community of cohort teachers, HNLC aims to guide them toward utilizing *best practices* in inquiry-based learning in their classrooms. Technology should be incorporated as an integral part of inquiry activities. Although we began under the assumption that educators could learn to teach with technology by learning to learn with technology, we found that HNLC educators tend to view technology as resources for use with their students, and are more likely to be inspired by their students' use of technology. Yet they also acknowledge that technology is an important resource for their own professional development. Perhaps the resolution to this apparent tension between teacher-first versus student-first use is to shape professional and leadership development so that participants use the tools in the way students would be asked to use them in inquiry-based learning. They would thereby gain simultaneous training in the practice of inquiry-based learning and the use of technologies as specifically applied to the inquiry activities of themselves *and* their students.

Practice can also refer to best practices for achieving systemic reform, which involves leadership development and coordination specifically for *changing* practice. Central to our systemic reform effort is practice informed by inquiry and reflection. Teachers are asked to examine the effects of their instruction on student performance in SMT, and adjust their practice to improve performance based on their knowledge of best practices. School administrators and HIDOE leaders at all levels of our nested communities are asked to question, reflect upon, and reassess their effectiveness in promoting a vision of high quality teaching and learning, creating a climate for school reform, providing professional and leadership development opportunities, and fostering collaborative, inquiring communities based on trust and respect. If *these* were the prevalent practices of our user communities, then the tools they needed and indeed demanded might be different. Can we offer technology, integrated with leadership development, that meets the demands of this imagined community of practice of the future? Strategically, we should build tools to support current practice, gain acceptance of these tools, and then build on this base to change practice with and through the tools. The process of learning how to become better professionals and leaders may then involve face-to-face, school-based communities of practice in addition to inter-school communities of practice that evolve from formal, distance learning groups or informal curriculum collaborations. This process could be supported by

technology serving as a collaborative workspace with functions to enable socialization and interpersonal connection (Barab et al., 2003).

<u>What do we build?</u>

We have so far considered what we can do to support multiple communities and teams. A deeper issue arises if many of these communities of practice do not already exist. Then the question becomes, "What do we build – the community, the practice, the tools?" As indicated by the earlier review of experiences in educational reform, professional development, and web-supported communities, communities of practice need to be built from a complex array of factors and in a manner that is timely and unique to each group. A community design cannot simply be proffered to a group. Communities evolve within groups around their particular needs and for purposes that they value. As we have noted before, fostering trusting and respectful relationships is paramount. This is the basis for community building, and, once established, each community of practice then directs the development, adoption, and use of technology for its specific needs. The process combines both bottom-up and top-down efforts to answer the questions we pose here. When multiple, nested communities of practice are involved, our responsibilities for attentiveness and technological responsiveness are correspondingly increased and should be clearly prioritized.

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