

# Designing and Building an On-line Community: The Struggle to Support Sociability in the Inquiry Learning Forum

□ Sasha A. Barab  
James G. MaKinster  
Julie A. Moore  
Donald J. Cunningham  
The ILF Design Team

*In this paper we describe the sociotechnical structures of the Inquiry Learning Forum (ILF), a Web-based professional development tool designed to support a community of inservice and preservice mathematics and science teachers creating, sharing, and improving inquiry-based pedagogical practices. Founded in our previous research and consistent with our pedagogical commitment, the technical structures of the ILF have been designed around a “visiting-the-classroom” metaphor. This decision was based on our belief that teachers need to be full participants in, and owners of, their virtual space for meaningful interaction to occur. The hallmark of this environment is that teachers with a broad range of experience and expertise can come together in an on-line environment to observe, discuss, and reflect on pedagogical theory and practice anchored to actual teaching vignettes. The goal of this paper is to share how we instantiated our pedagogical commitments and to describe the challenges we faced during the design, development, implementation, and analysis of the ILF. Toward this end, we walk the reader through our design and implementation process, highlighting our change in focus from usability to sociability issues, and movement from conceiving the ILF as an electronic structure to a sociotechnical interaction network.*

□ Research, theory, and the teaching standards of the professions (e.g., American Association for the Advancement of Science, 1993; National Council of Teachers of Mathematics, 1989; in press; National Research Council, 1996) have firmly established the importance of active learning environments in which learners engage in conversations and inquiry that authentically establish the relevance and meaning of mathematics and science concepts. Consistent with this belief, a number of writers have called for new pedagogical models that move from a didactic approach to a learner-centered approach (Barab, Hay, Barnett, & Keating, 2000; Duffy & Jonnasen, 1992; Land & Hannafin, 1996) as well as for tools and structures that provide ongoing support needed for change. However, an examination of mathematics and science teaching practices in the K–12 schools provides little evidence of such a shift in practice (Cuban, 1993; Ruopp, Gal, Drayton, & Pfister, 1993). In fact, much of the classroom research has found a disconnect between calls for reform and actual classroom practice (Huinker, 1996; Huinker, Coan, & Posnanski 1999; Niederhauser, Salem, & Fields, 1999; Richardson, 1996; Stofflett & Stoddart, 1994; Tobin & Gallagher, 1987). Secondary classroom interactions are still dominated by whole-class noninteractive activities and individual seatwork, where “instruction remains primarily didactic, dominated by lecture, demonstration, textbook readings, and

memorization" (Stofflett & Stoddart, 1994, p. 32).

Why has the change that so many have advocated been so slow to occur? Perhaps one answer lies in the way teachers are being trained for this shift in teaching. We believe that new pedagogical models for professional development that move us from a traditional didactic approach to a learner- or community-centered one are needed (Barab & Duffy, 2000; Duffy, 1997; Duffy & Jonnasen, 1992; McCombs & Whisler, 1997). As of yet, however, there are few demonstrably effective models that provide ongoing support for change. One reason for this is that models cannot simply be imposed; rather, we must create environments that provide teachers with ongoing supports for change that are situated in and address their everyday pedagogical needs (Smylie & Conyers, 1991). Most critically, perhaps, change efforts have often been unsuccessful due in large part to the lack of a culture of sharing among teachers (Chism, 1985). Teachers do not have the opportunities to participate in discussions that promote change such as discussing, sharing, and thinking about their practice (Darling-Hammond, 1997). While stating it somewhat strongly, Miles (1995) put it directly.

Let's frame the issue in extreme terms. A good deal of what passes for "professional development" in schools is a joke—one we'd laugh at if we weren't trying to keep from crying. It's everything that a learning environment shouldn't be: radically under resourced, brief, not sustained, designed for "one size fits all," imposed rather than owned, lacking any intellectual coherence, treated as a special add-on event rather than as part of a natural process, and trapped in the constraints of the bureaucratic system we have come to call "school." In short, it's pedagogically naive, a demeaning exercise that often leaves its participants more cynical and no more knowledgeable, skilled, or committed than before. (Miles, 1995, p. vii)

Finally, and most critically, change has been slow simply because the culture of teachers sharing pedagogical strategies is not well established.

We believe that new models for professional development are needed, models that foster a culture of sharing, and provide sustained support (i.e., knowledge networks) for teachers as

they evaluate both their beliefs and practices (Guskey & Huberman, 1995; Richardson, 1990). Our research and instructional design efforts revolve around the creation of a Web-based professional development system, a system that is based on "learning" and "community" models rather than "instructional" models of professional development (Barab & Duffy, 2000). Our situated perspective is consistent with the current theory and practice in teacher professional development, indicating that change is more likely to be effective and long-lasting if the teachers are allowed to build vital relationships with each other (Mevarech, 1995; Richardson, 1990).

In this paper we initially focus on the electronic portion of the Inquiry Learning Forum (E-ILF), a Website designed to support a virtual community of inservice and preservice mathematics and science teachers sharing, improving, and creating inquiry-based pedagogical practices. We use the notation *E-ILF* to distinguish the Internet site from the broader ILF community, which includes people as well as other social relations and entities. It is also important to note that this Website was initially named the Internet Learning Forum, but, as presented below, a series of events resulted in a name change to the Inquiry Learning Forum.

While our initial development focus was on the E-ILF, a full appreciation of the context of ILF use requires us to broaden our discussion to include those decisions also, resulting in a focus on the technical and more social structures that influence and facilitate member participation in the ILF community. As such, both our recent design process and the latter half of this paper move from a focus on design and usability issues toward examining relevant sociability issues. *Sociability* refers to those social policies and technical structures that support the community's shared purpose and social interactions among group members (Preece, 2000). It is one challenge to develop usable technical structures to support human-computer interactions and another to develop technical structures that support human-human interactions as mediated through technology (Barab, in press).

The ILF is designed to support teachers with diverse experience and expertise coming

together in a virtual space to observe, discuss, and reflect on pedagogical theory and practice anchored to actual teaching vignettes. The design centers around the vision of a community in which teachers can virtually visit each other's classrooms to observe and discuss approaches to teaching mathematics and science topics. The ILF Website is meant to support a distributed group of teachers in making the tacit knowledge involved in their teaching explicit so that it can be shared with others and, in turn, aiding other teachers in making that explicit knowledge a tacit part of their practice. While some designers may opt to support this process through electronic performance support systems (Levin, Riel, Miyake, & Cohen, 1987; Schwen, Kalman, Hara, & Kisling, 1998), our design was predicated on a different set of theoretical commitments.

We begin this paper with a description of the foundational design commitments that have guided the conception, design, and building of our professional development environment. Then we lay out the design trajectory of the ILF, tracing the evolution of the design through a series of decisions, usability tests, and revisions. We use a series of screen shots to illustrate our design trajectory. After discussing the initial analysis, design, and development, we then focus on this process of supporting sociability. The current ILF, what we came to view as a sociotechnical interaction network—a STIN (Kling, McKim, Fortuna, & King, 2000)—is described and contextualized through descriptions of ILF members' experiences. We use the term *sociotechnical interaction network* to capture the complex sociotechnical arrangements involved in a technology-intensive project, emphasizing the reciprocal character of the interaction among people, among people and equipment, and even among sets of technical structures and political climates. Lastly, we provide user cases of three ILF members and reflect on the relationship of our design commitments and the current design, and offer our recommendations for using the Internet to foster teacher professional development.

## GUIDING DESIGN COMMITMENTS

In this section we present the three design commitments that have guided the development of the E-ILF. The E-ILF was developed around a "visiting-the-classroom" metaphor and with the belief that teachers need to be full participants in and owners of their virtual space. It also focuses on supporting knowledge networking as the creation and use of knowledge among teacher practitioners, that is, a dynamic, open process that arises from the synergy and interaction of the members of the teaching community. With this in mind, we will examine the three design commitments that guided the design and revisions of the E-ILF: (a) visiting the classroom, (b) knowledge networking, and (c) building community. Underlying all three of these design commitments is a philosophical commitment to situated cognition.

A central assumption to many of the interpretations of situated cognition is the mutual relation of content and context, of individual and environment, and of knowing and doing, and the conviction that learning is always situated and progressively developed through activity (Barab et al., 1999; Brown, Collins, & Duguid, 1989; Lave, 1988; Lave & Wenger, 1991; Young, 1993). Many situativity cognitivists have argued that concepts and practices are tools, not self-contained entities, that can only be fully understood through an appreciation of the contexts in which they are used and applied. Therefore, understanding the practice of teaching or the notion of inquiry-based teaching involves more than acquiring information, but actually involves building an increasingly rich implicit understanding of the practices as well as context in which teachers engage in these practices. However, some situativity theorists emphasize the reciprocal character of the interaction in which individuals, in addition to cognition and meaning, are considered socially and culturally constructed (Lave, 1988, 1993; Roth, 1996).

In these latter situative theories, interactions with the world are viewed as not only producing meanings about the social world, but also as producing identities; that is, individuals are fundamentally constituted through their relations with the world (Barab & Duffy, 2000; Lave, 1993;

Lemke, 1997; Walkerdine, 1997; Wenger, 1998). These anthropological accounts of situatedness focus on communities and what it means to learn as a function of being a member of a community. This shift in the unit of analysis from the individual context to the community context leads to a shift in focus from the learning of skills or developing understandings to one in which, "developing an identity as a member of a community and becoming knowledgeably skillful are part of the same process, with the former motivating, shaping, and giving meaning to the latter, which it subsumes" (Lave, 1993, p. 65). More generally, our belief in the reciprocal relations of individuals, content, and context and the situatedness of meaning provide an important framework for our three design commitments (and the E-ILF) presented below.

#### Visit-the-Classroom Metaphor

It is our conviction that professional development models should be targeted toward fostering a culture of sharing, and providing sustained support for teachers (i.e., knowledge networks) as they evaluate both their beliefs and practices (Heaton & Lampert, 1993). As such, a crucial design challenge is to develop participant structures that represent and facilitate the sharing of tacit knowledge, a process that is central to effective knowledge networking (Brown & Duguid, 1998; Nonaka & Takeuchi, 1995). However, as pointed out by Lampert (1998), the actual practice of teachers sharing what happens in their classrooms with other teachers is not common.

More common in teaching is the individual practitioner who reasons privately about what is good, right, and true often while fending off the barrage of pedagogical solutions that are promoted by teacher educators, policy makers, curriculum developers, researchers, and administrators. (p. 54)

Traditional models of professional development tend to tell teachers what is "good, right, and true," presenting best practices of teaching as clearly defined and minimizing the situated complexities of everyday practice (Clark & Lampert, 1986; Greeno & Goldman, 1998). How-

ever, when one enters the classroom and looks at the complexity and disorderliness of practice, especially inquiry-based classrooms, another story unfolds (Barab, Hay, Barnett, & Squire, 2001; Lampert, 1990). The complexities inherent to inquiry-based classrooms arise precisely because students are engaged in learning the subject matter by *doing* as opposed to simply being told about it. It is how to function in the context of complex classrooms, not some orderly delivery of "best practices," that teachers need to observe, discuss, and evolve if professional development is going to stimulate the use of teaching methods that promote student engagement and inquiry.

Observing and reflecting on actual classroom experiences provides powerful learning opportunities. Teacher discussions and relationships should be anchored to their actual teaching practice. In particular, the craft of teaching consists, in large part, of tacit skills and knowledge that are not easily shared in words alone. Hence, an important starting point for sharing practices in a community of teacher practitioners is through visiting each other's classrooms to observe the craft of teaching as a basis for analysis, discussion and reflection. Live visits, however, are fleeting, one-time experiences that are difficult to manage. This limitation can be addressed, in part, by using video to capture and share teacher classroom experiences.

We acknowledge that video-based classroom observations are significantly impoverished compared to the experience of actually visiting a classroom. In addition, video-based lessons are often misinterpreted because the viewers may not know the teacher, the classroom culture, the needs and issues of individual students, and the cultural norms of the community (Hatano & Inagaki, 1998). A video of a classroom also lacks the interactivity and a certain amount of investment that one experiences during a live visit. However, video cases also have their advantages, providing a jumping-off point for discussion, allowing the same user multiple viewings of the same episode, supporting multiple perspectives all reflecting on the same video. Evaluation of one video-based teacher preparation program, Strategic Teaching Framework, demonstrated its effectiveness in promoting

meaningful teacher reflection for both preservice (Lambdin, Duffy, & Moore, 1997) and inservice instruction (Chaney-Cullen & Duffy, 1998).

#### Knowledge

##### Creation-Management-Networking

Traditional teacher professional development is based on a hierarchical model of expertise and on a transmission model of teaching; that is, one either goes to an expert information resource or "receives" professional development from experts (Asayesh, 1993; Smylie & Conyers, 1991). Effective instruction in this traditional paradigm is that which is well organized, prepared, and presented to the learner in a context where clear communication is the goal. Lakoff and Johnson (1980) have labeled this model as the conduit-container model. Basically, knowledge contained in the head (container) of the teacher-instructional designer is moved to another container through words or graphics or video and sent along a conduit (reading, listening, etc.) to the learner who takes the information out of the words or graphics or video and stores them in his or her head. Many programs of teacher professional development operate on exactly this model. Teachers come to workshops, attend classes, or go on-line in order to capture the expert knowledge contained therein. Armed with this new knowledge, they can then change the way they teach.

There are numerous efforts to develop information resources for teachers to use to add to their knowledge base. The Concord Consortium (Tinker, 1998), Pathways to School Improvement (North Central Regional Educational Laboratory, 1999), and Link2Learn (Link2Learn & Commonwealth of Pennsylvania, 1997), are among the better of these environments, but still are based on providing information rather than fostering the development of a knowledge network among a community of teachers. The University of Maryland and Baltimore Schools (Rose, Ding, Marchionini, Beale, & Nolet, 1997) have been focusing on the development of a library of videos that teachers can access; that is, a library model of information. The SRI International project, Tapped-In (Schlager & Schank,

1997), is more interactive than the previous examples, and provides synchronous spaces where professional developers can work with and support collaboration among their teachers. While this prior work certainly informs our own design and research agenda (e.g., video access and indexing, teacher goals and what teachers find useful in the environments, organizational structures, social support structures, etc), our emphasis is on knowledge networking among teachers and on fostering and supporting a community of practitioners through virtually visiting each other's classrooms. Additionally, the ILF is based on a quite different view of knowledge.

Fahey and Prusak (1998) make a distinction between knowledge and information. According to them, knowledge is not an object put in a drawer and pulled out when necessary situations occur. Instead, knowledge is "in constant flux and change. It is central to day-to-day doing and being. Individuals create it and it is largely self-generating" (p. 266). Put succinctly, knowledge is effective action in situ (Brown & Duguid, 1998; Duffy & Cunningham, 1996; Maturana & Varela, 1992; Nonaka & Takeuchi, 1995; Orr, 1990). For example, we consider a skilled reader as one who participates effectively in the literate community, rather than one who has acquired a large vocabulary and comprehension skills. Likewise, an effective teacher is one who participates in a community of teachers by using the tools and other mediational means to accomplish outcomes that are recognized as effective within that community. Moreover, knowledge connects, binds, and involves individual users. Therefore, knowledge is inseparable from the individuals who build, transmit, and leverage it, and knowing is a process of connecting, not acquiring. The creation and sharing of knowledge is not putting bits in a box, but involves creating a flow of "value-added" information among individuals.

An important part of a professional development structure like the ILF is to offer tools that allow participants to better connect with the community and construct knowledge. Video-based episodes provide access to teachers acting effectively (and sometimes ineffectively) in the instructional context. Artifacts such as lesson

plans, examples of students work, and classroom resources are additional tools. One of the most powerful tools for professional development is discussion and reflection. However, these processes are not simply a matter of translating tacit knowledge into explicit knowledge, but rather constructing additional or complementary knowledge. In other words, creating a dialogic form of something previously constructed through observations. The Web forum, like the video and artifact, is an archive that can be visited and revisited as a springboard for further knowledge construction.

#### Commitment to Community

Lave and Wenger (1991) used the term *communities of practice* to capture the importance of activity in binding individuals to communities, and in communities legitimizing and developing individual practices. While communities come in many shapes and sizes, in brief, a community of practice involves a collection of individuals sharing mutually defined practices, beliefs, and understandings over an extended time frame in the pursuit of a shared enterprise (Barab, McKinster, & Scheckler, in press; Wenger, 1998). The shared experiences of a community come to constitute a collective repertoire of activities and means of participation (that can include knowledge) that is continually negotiated anew through each interaction. Barab and Duffy (2000) stated that when learning occurs as part of a community of practice, members interacting with this community have access to this history of previous negotiations as well as responsiveness from the current members on the functional value of a particular practice, solution, or finding.

Collaboration among individual community members allows them to view one another as part of a collective whole working toward the joint goals of the community and its members. As such, a community is an interdependent system defined by the collaborative efforts of its members (Barab et al., 1999). Being a member entails being a part of this network. This involvement is what is established in Brown et al.'s (1993) community of learners or Scardamalia

and Bereiter's (1994) knowledge-building communities. Students in these settings work collaboratively on projects that become part of a larger group effort. This community-based and situated perspective is consistent with current theory and practice regarding teacher change and continuing professional development: Change is more likely to be effective and long-lasting if the teachers are allowed to build relationships with each other (e.g., Mevarech, 1995; Richardson, 1992).

Consistent with the belief that learning is a participatory process that involves doing, becoming, and belonging, not simply acquiring, many educators are looking toward the design of communities of practice as environments to support learning (Bielaczyc & Collins, 1999). A key assumption underlying community models for supporting learning is that developing an identity as a member of a community and becoming knowledgeably skillful are both part of the same process, with the former motivating, shaping, and giving meaning to the latter (Barab & Duffy, 2000; Lave, 1993). From this perspective, teacher professional development should involve participatory ownership by teachers, in which the development of identity in the community and becoming knowledgeably skillful are part of the same activity. A strong implication of this is that a culture of learning must become an integral part of the teacher's ongoing practice, with learning being characterized by a process of "change" in the way in which participation in the community is enacted. A second implication is that learning is primarily the development of explicit and tacit knowledge achieved through active participation within the community.

#### THE VISION TAKES SHAPE (FALL 1999)

The ILF was conceived through informal faculty discussions, drawing on previous research and theory (Barab & Duffy, 2000; Chaney-Cullen & Duffy, 1998; McMahan, O'Neill & Cunningham, 1992) and took shape within a unique graduate seminar in the spring of 1999 during which a working prototype was produced. Since this time, the ILF has undergone numerous design iterations as we struggle with the question of

how to build a community of practice in an electronic environment. This section will describe the initial conception and the design of the E-ILF.

Six faculty and 15 graduate students gathered in a seminar to explore what a Web-based professional development system predicated on a community model would look like and to subsequently develop a prototype for such a system (MaKinster, Barab, & Keating, 2001). As a project-based learning experience, the driving question for this class was "How do we design an on-line community that promotes the professional development of preservice and inservice math and science teachers?" The goal for the semester was to design a prototype of a Website that would support such a community. Students engaged first in a review of the literature of on-line communities, knowledge networking, communities of practice, and professional development. Additionally, the students began evaluating on-line structures and designs that promoted the building of community.

Three distinct audiences for the ILF were identified: (a) preservice teachers, (b) novice teachers (1–5 years' experience), and (c) veteran teachers (5+ years experience). A targeted needs analysis was conducted with a small sample (5–10) of teachers from each group. A needs analysis is an essential element of the design process that allows one to identify the problems and concerns of a potential audience (Kaufman, 1986). The preservice teachers, including both undergraduate-level education majors and field-based student teachers, completed a written survey designed to assess their perceived needs and the types of professional development experiences they have found most valuable thus far. The five inservice teachers were interviewed using a similar set of questions.

The needs analysis provided a foundational understanding of the issues and concerns most important to potential future members of the ILF. The findings were similar to the needs and concerns of preservice and inservice teachers discussed in the literature (Adams & Krockover, 1997; Hewson, Tabachnick, Zeichner, & Lemberger, 1999; Simmons, et al., 1999; Strage, & Bol, 1996). Preservice teachers expressed a desire to

obtain more field experience and were usually more concerned about lesson plans and classroom management issues, whereas veteran teachers often wanted to discuss deeper pedagogical and curricular issues with their peers. For example, several inservice teachers expressed concern about and interest in specific teaching strategies, such as inquiry-based learning, rather than the basic classroom management issues emphasized by preservice teachers. Both groups expressed an overwhelming desire to interact with, share, and learn from other teachers. In addition, the inservice teachers stated that teacher training programs and professional development workshops often failed to address many of their curricular and pedagogical concerns. The needs analysis reiterated the strength of using the visit-the-classroom metaphor to address the needs of these teachers.

During the latter half of the course, there were parallel design teams consisting of 3–4 students. Each group used rapid visual prototyping (Tripp & Bichelmeyer, 1990) to develop a prototype environment that would inform our attempts at building a community of practice and supporting teachers in virtually visiting classrooms. The design that was adopted relied heavily on the visiting-the-classroom metaphor and incorporated the navigational use of a school hallway that was eventually to become the home page of the E-ILF prototype (see Figure 1 for screenshot of the initial home page). In addition, we decided to support this metaphor by finding a means of sharing videos of actual classroom practice over the Internet (see Figure 2 for a screenshot of the initial classroom page).

The next step in our development process involved videotaping several science and mathematics teachers in their own classrooms. The teachers were encouraged to teach a lesson with which they were comfortable and that they thought was inquiry-based. When the taping was concluded, the ILF team recorded a debriefing session-discussion with each teacher in a manner that would capture their reflections and thoughts about the implementation and some of the decisions they made during the lesson. These reflections were transcribed and given back to the teachers so they could edit them into

Figure 1 □ First iteration of the ILF home page, consisting of links to the VISIT CLASSROOMS, ILF OFFICE, MY DESK, LOUNGE, LIBRARY, AUDITORIUM, and NEWS.



Figure 2 □ First iteration of a specific CLASSROOM, including links to an overview of the lesson, reflective commentary, descriptions of teaching activity, lesson plans, and connections with both state and national standards (not visible on this screen shot).



Figure 3 □ Second iteration of the ILF home page, consisting of links to the CLASSROOMS, ILF OFFICE, ILF NEWS, MY OFFICE, LOUNGE, AUDITORIUM, and LIBRARY.



a readable format. In addition, copies of the lesson plan, handouts, and student work were also collected. The videos were digitized and edited into 3–10 min segments; they embodied the structure and activity of the lesson, which were then converted into a video format suitable for Web-based access. All of these elements and artifacts would become part of what was shared within each of the ILF classrooms. Our intention was to capture teaching in a variety of settings from teachers who have a variety of strengths and weaknesses. We felt that by attempting to capture the everyday practice of teachers we were most likely to foster a greater amount and quality of discussion both on-line and in-situ.

In September 1999 we received three years of funding from the National Science Foundation (NSF) for the full project, enabling us to flesh out the design, conduct user testing, and formally launch the project. Data from the summer usability testing and new staff, who for the most part did not have background in the project, provided an opportunity to reformulate, refine, and redesign the site. While the initial design had a pseudophysical look and feel of a virtual school, including “floating doors” leading to

areas of the site, we then wished to adopt a more virtual school appearance and the second major iteration of the E-ILF home page took on a much more realistic look and feel. The major push behind this change was the desire to build a sense of community by establishing a concrete place for the community—a place that members would want to return to and explore—and to make the front end interactive and fun. While the site maintained its basic structure and outline, the look and feel were very different from the original prototype in that the main page was a pseudovirtual 3-D hallway with animated doors (see Figure 3). We strove to give the site a feeling of “place” in a manner to which teachers and future teachers would easily relate.

As part of the grant, the Teacher Advisory Board was established consisting of six math and science teachers from our target audience. The purpose of this board was to provide the ILF members a voice in the process of design and development of the E-ILF. These teachers met with us in October 1999 to provide feedback on the current design of the E-ILF. The first thing the teachers told us was that the site needed to include examples of student work in the class-

rooms. The other major comment was that they did not like the current “complex, virtual interface” and wanted to be able to easily navigate to the classrooms and throughout the rest of the site. While our initial needs analysis helped us to identify the important elements to include, the teachers found the interface confusing. They were also concerned that the interactive home page was nonintuitive and would take too much time to download on a computer in a K-12 school. In a nutshell, they wanted it simple, so they could quickly and easily reach the classrooms and other virtual spaces of personal interest. Based on this feedback, our design team again began the process of rapid visual prototyping.

In addition to design suggestions, the Teacher Advisory Board also discussed problems that were less technical and more social and political. For example, the team members unanimously stated that they were concerned with the soundness of the subject matter content and quality of the teaching depicted in the videos—they wanted good pedagogy and accurate content. One teacher stated, “A lot of science teachers out there are just doing bad science and they don’t know it!” Another teacher commented on her busy schedule and stated, “I don’t have time to look through bad teaching.” At this point, consistent with concerns from NSF, we decided to implement a video review board. Later, members of the video review board and of the ILF created a technical document that embodied these concerns (see Appendix A for a copy of the rubric). One comment from an ILF team member was: “This is not simply a rubric, it is a political document that determines who is a good teacher and who is not, and who gets to be peripheral and who gets to be central members of the ILF community.” This document and its application forced us to wrestle with the tensions of gatekeeping versus community ownership, and sharing expert versus everyday practice (Barab et al., in press). Rather than minimize these tensions, we have highlighted these challenges through ILF member discussions and on-line polling, leveraging these tensions as opportunities to build community, not as messy issues to be resolved by the designers.

#### VERSION 1.0: SOLIDIFYING THE E-ILF (SPRING 2000)

The next iteration of the E-ILF, in Spring 2000, consisted of a school floor-plan metaphor (see Figure 4), again trying visually to provide a sense of place and community with iconic representations for each of the distinct areas of the site. The icons incorporated stylized people and were developed in response to a sense that the site, while representing a physical place, looked empty and uninhabited. Consistent with our design experiments, the notion of community is one driving force behind the development of the look and feel of the site.

This iteration of the E-ILF consisted of a variety of participant structures related to virtually visiting the classrooms of other teachers and supporting the sharing and improving of teacher practices. From the home screen (Figure 4), members can quickly access any other part of the E-ILF by clicking on the tabs at the top of the screen. The heart of the E-ILF, renamed the VISIT CLASSROOMS space, is where members can go to see other teachers teach. When ILF members select a specific classroom to enter, they have before them a variety of video clips, reflections, and documents that embody the lesson or unit highlighted in that classroom. The videos act as anchors to these artifacts and discussions. At any time during the playing of a video, members can view an overview of the lesson and its context, teacher’s reflections on the lesson, lesson plans, examples of student work, and connections with both state and national standards (see Figure 5). Also, within each classroom page, there is an asynchronous discussion area where teachers can engage in thoughtful dialogue with each other regarding that particular classroom or pose questions directly to the contributing teacher.

At this point, we distinguished between contributing members and participants; the former actually share intimate public portrayals of their classrooms while the latter simply post comments for other teachers to read.

The contributing teachers’ reflections on their lessons are essential elements of the E-ILF. As briefly described earlier, each ILF contributing teacher is interviewed after teaching the

Figure 4 □ Iteration 1.0 of the ILF home page, consisting of links to the VISIT CLASSROOMS, ILF OFFICE, MY DESK, LOUNGE, LIBRARY, AUDITORIUM, and NEWS.



Figure 5 □ Current iteration of a specific CLASSROOM, including links to an overview of the lesson, reflective commentary, descriptions of teaching activity, lesson plans, students' examples, and connections with both state and national standards.



videotaped lesson. Each teacher and an ILF design team member review the classroom video and discuss the lesson as it unfolds. This experience gives contributing teachers an opportunity to describe what they were trying to accomplish at different times, the challenges faced, why they dealt with students in a particular manner, and anything else relevant to the lesson and classroom. As a result, ILF members visiting an ILF classroom are able to access information that is seldom available in the context of a live visit to a classroom: the detailed thoughts and reflections of the teacher on this particular lesson and a complete collection of supplemental information and artifacts. Being able to see the video, read these reflections, and access the other materials relevant to the lesson (lesson plan, student work, etc.) enables other ILF members to develop a rich appreciation for the lesson, context, teacher, and lesson implementation. Furthermore, ILF members are able to respond to questions posed by the contributing teachers in asynchronous discussion forums, or post their own thoughts or questions about this lesson.

In addition to the VISIT CLASSROOMS spaces, there were also five other virtual spaces designed to address professional development needs of ILF teachers. The AUDITORIUM was designed as a place where special events could occur. Generally, these might involve a "videocast" followed by asynchronous discussion hosted by the individual featured in the talk or workshop. In this way, members could not only "see" the presentation, but also participate in meaningful dialogue with the speaker and other members. After an auditorium event is concluded, both the video of the presentation and the associated discussions remain archived on the site. The LOUNGE hosted general conferences that were not tied to a particular classroom as well as a space for real-time chat to allow members to communicate with others. Any member of the community could hold a workshop, experts could be brought in, or, there could be synchronous discussion of specific issues. Additionally, MY DESK was the teacher's desk (since entry into E-ILF is password protected, MY DESK is the desk of the person who logs in) and was intended to provide a place where the user could store bookmarks to resour-

ces and classrooms that were of personal relevance, and return to those at a later visit. The ILF OFFICE served as the place where new participants could secure a password (the site was password protected), get help with technology, or make suggestions. The NEWS section provided members with updates on E-ILF development progress and listings of new additions to the site. Lastly, the LIBRARY was a place where teachers could go to access reference materials of interest, including references on teaching resource materials (software, other classroom artifacts, such as the graphing calculator, manipulatives, and sensory probes), state and national standards, grants, applied research and theory, relevant state initiatives, and other materials that teachers identify as relevant.

No one was convinced that "if we built it, they would come." In fact, this statement was frequently used to illustrate what the team could *not* rely on happening. In a very real way, the E-ILF was based on a participatory design; we expected the current iteration to continually evolve based on the needs and suggestions of the E-ILF members as codesigners. To promote this process, the site included several different structures and avenues for suggestions, contributions, and feedback. Our goal was to build a structure through which a community could develop, grow, and evolve to meet its needs. The design and use challenges we faced were three-fold: (a) How do we help teachers break down the walls of isolation in which they are so used to working? (b) how do we get teachers to critically reflect on each other's teaching? and (c) how do we do this in an on-line environment? While our usability studies suggested the design was usable from a human-computer interaction standpoint, our other discussions with teachers suggested that we had not developed a space that was encouraging participation or building social relationships among community members. In fact, teachers reported being uncomfortable with criticizing the teaching practice of other teachers. It was at this time that we began to conceive of the ILF, not simply as a technical entity, but as a sociotechnical interaction network. Below, we discuss the design challenges that this appreciation brought to our attention.

VERSION 2.0: DESIGNING FOR  
SOCIABILITY (FALL 2000)

As the initial design and implementation of the E-ILF coalesced into a functional and potentially meaningful entity, we were able to identify technical and sociopolitical aspects of the ILF that could be improved as a means for fostering a sense of social connectedness, personalization, and interactivity. As stated above, it was at this point that we began to see the ILF not simply as an electronic structure but as a sociotechnical interaction network. This conception had important implications for the further design of the electronic structures as well as nontechnical structures discussed further below. Central to the sociotechnical interaction network framework, we did not recognize these as separate activities (simply challenges in implementing the design); these less-technical design decisions became part of what we have come to understand as the design of the ILF. The origin and realization of these ideas grew primarily out of three interwoven entities: the ILF design team, the ILF research team, and the Research Advisory Board.

The ILF design team and the ILF research team each meet once a week and consist of numerous faculty and students who are intimately involved in the design or research of the ILF. A central concern of both teams is how to foster greater participation in the ILF community and how to foster greater interaction among ILF members both on and offline. In addition to these meetings, the grant also supports the annual coming together of the Research Advisory Board, which consists of international scholars and has as its purpose to provide design expertise and help guide the research aspects of the project. A number of design features and improvements have emerged from the design, research, and advisory meetings, as well as more formal and informal conversations among our team. While acknowledging the usability and functionality of the design, a central concern of all these meetings (including the Teacher Advisory Board) was that in version 1.0 of the E-ILF we had not designed for sociability. To restate, sociability refers to those social policies and technical structures that support the community's shared purpose and social interactions among group members (Preece, 2000).

Our major sociability design challenges are increasing connectedness and active participation in the ILF. These are reflected in our two primary design questions at this time: How do we help people connect to the people and artifacts in which they have interest? How do we help support increased participation and ownership of the community? Recently we have designed a variety of ways, in both interface and our process, of attempting to increase the connectedness within the community, and thus, strengthening the community as a whole. From our examination of notes from the above meetings, design team e-mails, interviews with teachers, usability documents, and relevant literature, three major sociability design themes emerged:

1. The need to build structures that supported group collaboration and work.
2. The need to provide structured tasks (goal sets) for engaging with the E-ILF and ILF community.
3. The need to provide more visible connections to people, conversations, and artifacts of interest to each ILF member.

In response to these needs, a number of design steps and resultant structures were implemented—including the name change from Internet Learning Forum to Inquiry Learning Forum. Each of these structures was intended to provide ILF members with a greater sense of connectedness to the ILF community and increased opportunities for participation, investment, and personal engagement. Below, we briefly review these structures:

#### Front-End

A decision was made to make the front entrance to the ILF less static and more dynamic (as opposed to simply a navigational portal that may not have been updated recently), by adding a number of features with the goal of making the ILF look more active. The design team decided to use the right side of the home screen to create a sidebar that would serve as the dynamic portion of the ILF home page (see Figure 6). One of the central new features was a link to a "video trailer" of the classrooms most recently added to

the ILF. These 40–60 sec trailers were designed to provide members with a quick overview of a new ILF classroom and entice members to explore these new additions to the ILF. In addition to the trailers, the side bar has three other sections with links, and content that is changed or updated on a biweekly basis. One section is entitled *HOT TOPICS*, which has links to relevant news articles and related discussion forums. The other sections include links to *TEACHING TIPS* written by ILF members, links to relevant Websites, and links to professional development opportunities within the ILF community. Finally, the current date appears in the upper right-hand corner of the ILF home page in an effort to convey the dynamic and active nature of the E-ILF.

#### Entry Points for Participation

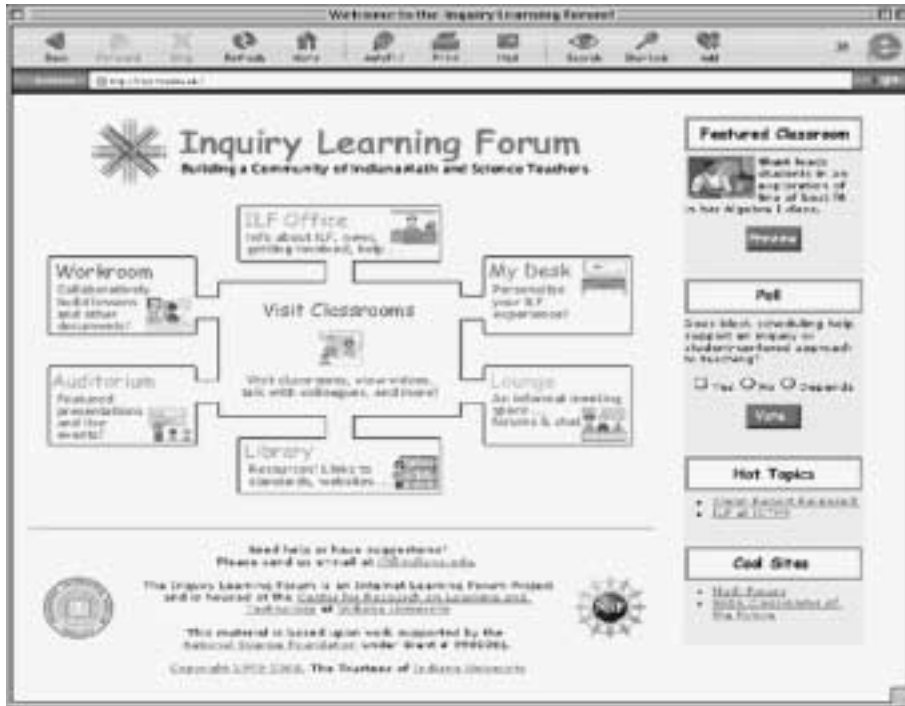
Recognizing that people often need a starting point when entering a new on-line environment, we have developed a variety of strategies to bring people into the ILF community in a more structured manner. We have focused both on building relationships through structured group activity and on providing entry points to individuals who come to the site. We quickly realized that the initial broad categories of discussion topics within ILF classrooms were almost too broad and didn't provide any sort of specific way to initiate discussion. Additionally, the teachers who were putting videos up on-line were interested in receiving critical feedback and were frustrated with the lack of critical conversation. One of the teachers suggested that the ILF teachers could provide questions that they had about their own teaching as a mechanism of providing a jumping off point for discussion. We added these questions to the teachers' reflections about their classes and linked them directly into a discussion thread about that question. We are also in the process of developing a variety of tasks or modules that first timers can utilize as a way of getting oriented to the ILF and involved in discussion. These will be posted in a *FIRST TIMERS* area and provide suggestions for what to look for and questions to ask both themselves and their colleagues as they begin to engage in the community.

#### The Workroom

One of the issues to emerge from the ILF Research Advisory Board meeting in the summer of 2000 was the idea of supporting the collaborative design and creation of lesson or unit plans within the E-ILF environment. Several ILF research projects and university courses expressed interest in using such a system, which quickly began to be referred to as the *WORKROOM*. The idea was to have a new area of the E-ILF in which specific groups could collaboratively develop and discuss document-based artifacts. This would enable the E-ILF to facilitate and encourage on-line collaboration around artifacts that would eventually become an E-ILF resource or part of an E-ILF classroom. Our initial ILF design supported only individuals coming together to create a community. The E-ILF did not have any structure to support group-work or subcommunities working together and creating an artifact. In fact, we initially avoided the creation of private spaces, fearing that the ILF community would fragment and thus never truly materialize. However, artifact building can be an extremely useful way of engaging people in critical reflection and discussion. Drawing from Riel's (1998) notion of "Learning Circles" and Harvard's Teaching for Understanding Collaborative Curriculum Design Tool (Active Learning Practice for Schools, 2000) as models, we have added a space to the E-ILF that we call the *WORKROOM* to support *WORKING CIRCLES*—groups that wish to come together and build an artifact.

The current version of the ILF Workroom entails three levels. Within the Workroom, ILF members can be part of one or more Working Circles. Each Working Circle is facilitated by an ILF member who is using this particular Working Circle for a particular project or course. Within each Working Circle, smaller groups or projects can be organized. For example, a class (a Working Circle) may be broken into a variety of groups (projects) that each work on the design and development of specific documents. The facilitator of a Working Circle controls who has access to the Working Circle, as well as each project. There is a separate asynchronous discussion forum associated with each Working Circle, each of its projects, and each document within

Figure 6 □ Current iteration of the E-ILF home page, consisting of links to the VISIT CLASSROOMS, ILF OFFICE, MY DESK, LOUNGE, LIBRARY, AUDITORIUM, and WORKROOMS. It includes a side bar that highlights new features and classrooms to give the E-ILF a more dynamic feel.



those projects. In addition, project members can choose to share their completed lesson or unit plan with either their Working Circle, or the greater ILF community. A secondary-math early field experience project pilot tested the Working Circles in the fall of 2000. This pilot group generated 10 different projects, 28 documents, and 271 posts within a six-week period.

My Desk

This particular section of the E-ILF was part of the initial conception, but until recently its development was relatively limited. Since the E-ILF is password protected, the MY DESK area contains information specific to the ILF member who is logged in. This personalized space currently informs the user of the recently active discussion forums in which they have posted and describes new ILF events, classrooms, and resources that match their stated interests. This section is designed to provide ILF members with a sense of personal space within this on-line environment. Future iterations will include the

ability to bookmark specific areas or discussions within the ILF, as well as post picture of themselves and favorite links so that it has a more personalized feel.

Professional Development Workshops—Opportunities

We have begun to implement a variety of structured professional development offerings through the ILF. Central to this push is our belief that we need to foster trust and connections among members, often within a face-to-face context, if we are to foster a culture of critical inquiry on-line. Also, we have developed a greater appreciation for the systemic constraints facing teachers and have worked to establish more administrative support so that teachers can receive credits or release time for ILF participation. Structured participation opportunities range from a one- or two-hour demonstration of the E-ILF to a semester-long collaboration with schools and school corporations in which the E-ILF is utilized as a means of continuing conver-

sation about inquiry teaching over an extended period of time.

We also conduct a two-day intensive seminar on inquiry-based teaching, in which teachers utilize the E-ILF to critically reflect on teaching and build their own conceptions of what inquiry-based teaching is. These workshops allow us to first work in face-to-face groups where we can build trust, support teachers in engaging in critical inquiry, and develop a sense of purpose for continued use of the E-ILF. Additionally, we now offer a graduate-level course, conducted almost exclusively in the E-ILF, which explores inquiry-based teaching. Lastly, we are encouraging and working with university courses in using the ILF as a part of their coursework and supporting that work through the creation of discussion forums and working circles. Currently we are only utilizing the E-ILF with Indiana University courses, but hope to expand to other colleges and universities in the state in the coming year.

#### New Roles

Changes in interface design can help with connecting people and ideas, but we are also looking at our own work and process to find ways to promote and strengthen connections. When people first register for the ILF, an ILF staff member sends them a personal welcome message with several suggestions for how they might get started. With conversations and ideas spread out over such a large "space," it can be difficult for those with common interests to actually "find" each other. ILF staff members are now proactively tracking conversations and suggesting discussion forums and conversations to visit as ideas and themes emerge. For the community to succeed, however, ownership for the site cannot be held by the ILF staff—it must be held by each member of the ILF community. Thus, we have established a variety of roles and tasks that community members can take on and provide leadership. These include Discussion Leaders (discussion forum facilitators), Critical Friends (pushing reflection and critique by modeling positive critique of lessons), and Reviewers (review lessons to ensure a minimal level of approach to inquiry and avoid promulgation of misconceptions).

#### Summary

Each of these changes has resulted in new and exciting opportunities for ILF members. Many have been acknowledged as positive and useful additions to the E-ILF by classroom teachers and ILF research, design, and advisory team members. However, the true effectiveness of these changes can only be assessed by examining how ILF members are involved and participate in the ILF community. Below we provide three user cases that begin to illuminate the impact some of these changes have had on these teachers, and some of the most current design, usability, and sociability issues to emerge.

#### USER CASES

From a situated-cognition perspective, we recognize the need for multiple modes of participation in the ILF. Lave and Wenger's (1991) notion of legitimate peripheral participation (that participation on the outer edges of a community is desired and, for many, necessary before immersion into the community as full members can occur), indicates that a community of practice must allow for multiple levels of participation and multiple paths of involvement. The ILF currently has three distinctive levels of membership.

- *Observer*: Registered members who learn by viewing other members' comments and videos, but who do not post their own.
- *Active Community Member*: ILF members who actively participate in viewing other members' comments and videos, as well as engage in discussion with other members. Additionally, there may be more focused roles such as discussion leader or critical friend.
- *Contributing Member*: ILF members who share their classroom with the community. In all instances to date, the ILF team has provided complete support from shooting the video, collecting artifacts, selecting clips, and so forth, to digitizing the video and mounting the classroom on the Website. Eventually we hope that teachers themselves will be able to take over significant portions of this process (e.g., shooting the videos themselves).

ILF members can move through these levels of membership as their situation and interests allow. For example, while a member may initially prefer being an Observer, who looks at the posting of other members, over time, as the Observer comes to recognize how E-ILF members communicate, the individual can begin to post messages and engage in E-ILF discussions (Active Community Member). Eventually, some members will choose to share videos of their own classrooms as Contributing Members. In order to illustrate how the sociotechnical features of the E-ILF translate into use by ILF members, we present three cases that represent possible ways in which an ILF member at these different levels of membership can engage and participate in the ILF community. In addition, these cases illuminate many of the struggles and challenges that the ILF design and research teams are currently facing. We begin with two active community members and then discuss the experience of an ILF contributing teacher.

#### ILF Active Community Members

There are currently several projects or courses that are using or incorporating the ILF in different ways. We have chosen to present member cases of an inservice and a preservice teacher who are involved in different professional development projects and courses. These cases illuminate some of the differences in participation, contribution, expectations, and motivations of ILF Active Community Members. It is important to note that there are currently very few Active Community Members (defined by seven or more posts) who are not involved in some professional development project or associated course. While we had hoped this would occur immediately, this phenomenon is not surprising or unexpected given the early stages of development in this project.

*In-service mathematics teacher.* Glen is a calculus teacher at a large, well-funded, urban high school in south central Indiana. He has been teaching for more than 25 years and carefully balances his teaching, family responsibilities, and professional development activities. Glen teaches four sections of an advanced placement

calculus course that serves more than 100 students. He is currently involved in a variety of professional activities. One of his most demanding responsibilities, as of late, is being the vice president of the local teachers union. In addition, he is the chairperson of his department and is involved in a variety of professional mathematics organizations, including the National Council of Teachers of Mathematics, the Indiana Council of Teachers of Mathematics, and, for the past three years, serving as a portfolio evaluator for INTASC (Interstate New Teacher Assessment and Support Consortium). Most recently, Glen has chosen to become involved in a new federally funded project entitled Collaboration to Enhance Mathematics Instruction (CEMI). CEMI is modeled around the Japanese Lesson Study Groups that bring together K-12 teachers, university educators, and preservice teachers who collaboratively develop, teach, critique, and redesign lessons in their respective area of expertise (Lewis & Tsuchida, 1997; Stevenson & Stigler, 1992). The CEMI project meets in face-to-face settings, but is using the WORKROOM of the E-ILF to facilitate the collaborative construction of lesson critiques, lesson plans, and unit plans during times when they cannot meet on campus.

Glen was introduced to the ILF and the CEMI project through a series of interactions and opportunities within his own school. His first exposure to the ILF was during an inservice day before the beginning of the school year. Glen attended an ILF workshop that gave him a chance to better understand the goals and culture of the ILF community and briefly explore one or more of the classroom episodes. He spent most of this time exploring the ILF classroom of one of his mathematics colleagues, Kevin. Prior to this workshop, Kevin had also approached Glen about participating in the CEMI project at the local university. Glen was apprehensive at first about making an additional time commitment, but after talking with the project director he decided to become involved.

The CEMI project began its work by critiquing and discussing CD-ROM based teaching cases. The project members used the WORKROOM of the ILF to construct and record reactions to and critiques of these cases. After a few weeks, small groups of CEMI members began con-

structing their own lessons and videotaped the teaching of these lessons within the classroom of the inservice teacher. The CEMI members used the WORKROOM to collaboratively write critiques of these lessons. Glen has really enjoyed the chance to work on documents with his group members. Since one of the biggest constraints on his professional development efforts is time, Glen has also appreciated the fact that the members of his group could “meet” and collaborate on-line, rather than traveling to a particular place to get together.

Glen sees a lot of potential value in the CEMI project. He feels frustrated by the fact that there is so little consensus about specific ways to teach particular math concepts. Hence, because he feels very little of what they have done within the project thus far has significantly impacted his teaching, he is looking forward to exploring math concepts, teaching, and related lessons in depth. “I think the potential is there, and I think it will affect me . . . I think I have already reflected a lot, but I want some help, I want somebody to bounce something off of.” Glen stated several times that he wished he had more people that he could talk with about his teaching. There are relatively few teachers who teach calculus and even fewer preservice teachers who are prepared to jump into such a class for their student teaching.

When Glen was asked why he had not spent much time in other areas of the ILF besides the WORKROOM, he stated that time was a significant factor restricting his participation.

I thought about it (visiting the classrooms) . . . well, about a week ago, I thought about it a lot. I said, “I would really like to take some time and get on there and take a look at that.” And then we were crunched in getting our lesson study group material going and my own class. Like this morning, I was here at 7:00 a.m., but I was helping students until 8 o’clock, so I couldn’t get on there [the ILF] to do that.

Glen has recently been contributing in the discussion forum in the lounge of the ILF entitled USELESS MATH, but he has not explored a classroom since his initial exposure to the ILF and does not yet regularly read or participate in the ILF LOUNGE discussion forums.

*Preservice Science Teacher.* Karen is a graduate-level preservice science student who is currently doing her student teaching at a local high school. Karen’s involvement in the ILF has been a result of a particular set of assignments within her secondary science methods course and the seminar that accompanies her student teaching experience. During the first six weeks of the semester, Karen was involved in an intensive secondary science methods course, while at the same time doing an early field experience in the classroom of her student teaching cooperating teacher. Since the sixth week of the semester, she has taken over the class from her cooperating teacher and has been immersed in her student teaching experience.

Science education student teachers in the past have been required to write reflections during their student teaching experience. This is the first semester that Karen’s professor has decided to use on-line discussion forums as the medium for these students to write their reflections and also for them to provide feedback for one another about the reflections of their peers. The students have been divided into groups of four and they take turns either reflecting on a particular problem that they encountered during the week, or giving feedback to the other students in their class whose job it is to reflect that week.

Despite the fact that the assignment was intended to require students to be on-line at least once a week, Karen has managed to get everything completed for the assignment on time, but she only logs in every two weeks. When she goes into the ILF, she posts her reflection for the week that she has written offline in Microsoft Word. Then she will look and see how people responded to her reflection from the past week. Third, she will read the reflections of her peers for that week and respond to them accordingly. Finally, and also as part of the assignment, she finds somewhere outside of the student teaching group discussion forum to make another post within the ILF.

Since the discussion forum that Karen uses for her student teaching reflection is in the ILF LOUNGE, other ILF members are able to read and respond to Karen’s reflections. Two ILF members outside of her student teaching group have

posted responses to her reflections. It is important to note that Karen has not responded to any of the comments that these members have posted in response to her reflections. She stated that she never really thought of this process as a conversation per se, and she was not sure that doing that was part of the assignment. When asked about her participation in the ILF and the nature of her engagement with this assignment, Karen repeatedly stated that she never thought of these activities as anymore than an assignment.

I don't know how you get beyond making it an assignment. I think . . . with us busy as we are, you know, I feel that, whether it is true or not, student teachers don't feel like they have time to do anything else, you know. I think a lot of people saw it as a nuisance or something hanging over their head, oh I have got to post, or I forgot to post.

Karen thought it was a valuable idea to have student teaching reflections posted within the lounge of the ILF: "I think it is especially helpful because you can get responses or thoughts from people who are actually out teaching in the field." However, she did not feel that her teaching was influenced much by the responses she received in the ILF, because the things she had reflected on were in the past and she was continually confronting new problems in her classroom. She stated, "I don't think it [written reflections] really changed my classroom behavior or anything that I did in the classroom." Karen did point out that she thought the rest of the ILF, such as the classrooms, might be interesting and even valuable. However, she never explored any of the classrooms or their related discussion forums, saying, "I didn't know that we could do that as part of the assignment, so I didn't." Karen simply perceived her involvement in the ILF as an assignment. She always completed her assignment for a given week, but she, and almost all of her classmates, did not go beyond what they were required to do for the class, even when ILF members responded directly to their posts.

*ILF Contributing Member.* The last case we present is that of an ILF contributing member, Ben, who is in his fourth year teaching earth

science at a rural high school in central Indiana. Ben has been actively involved in the ILF for about 8 months, first as an Active Community Member, then as a Contributing Member, and during the summer of 2000 as a member of the ILF Teacher Advisory Board. Ben's desire to reflect on his teaching, his abilities as a rather young K-12 faculty member, and his involvement in the ILF are somewhat exceptional; however, based on our conversations with other ILF Contributing Members, many of Ben's needs and concerns are shared by other Contributing Members.

Ben first heard about the ILF from one of the initial members of the development team and approached the project manager of the ILF about becoming more involved at a state teachers' conference. He had videotaped and analyzed his teaching in the past and was fairly comfortable with the idea of sharing his classroom with the ILF community. Ben's desire to become more involved in the ILF was not driven by any need for teaching materials or new ideas. If anything, he feels as if he has lots of ideas and materials, but what Ben has longed for is to be a part of a larger community outside of his own school that could push him to think more critically about his teaching.

Thinking about how he might change or modify a lesson is a regular part of Ben's teaching; however, he has had several opportunities to formally document and analyze his teaching as well. During his first year of teaching, Ben completed a teaching portfolio that included a videotaped lesson for a pilot project of a new licensing and professional development program for teachers. It was this process that then served as a basis for thinking about his teaching from year to year. In addition, Ben recently received a state-sponsored teaching fellowship that enables him to invest time in helping other teachers, both inservice and preservice, to reflect on and think more critically about their teaching. At the same time, Ben has expressed concern about the willingness of the administrators and colleagues within his own school to give him critical feedback on his teaching, suggesting that maybe they do not want to offend him or one another. When he initially found out about the ILF, he really liked the idea of being part of a

larger community that was designed to support teachers in providing constructive feedback to one another about their teaching practices and beliefs. In the ILF, he expected to find the critical feedback on his teaching that he felt had been lacking within his local school community.

Ben had an earth science lesson videotaped for the ILF at the end of the 2000 spring semester. It was a guided-inquiry lesson in which the students used several concepts that they had learned about throughout the year, including Doppler Shift and Hubble's Law, to calculate the age of the universe. In addition, to enable his students to apply what they had learned throughout the semester, this lesson challenged them to think about one of the "big" questions in science, the age of the universe, and discuss how science struggles to answer such questions with a particular amount of certainty. It is important to note that even though Ben's lesson was videotaped in the spring, his classroom did not appear in the ILF until the middle of the fall semester because of restructuring within the ILF development team.

We talked with Ben about three weeks after his classroom went on-line in the ILF. When asked to describe how he uses the E-ILF, Ben described himself as a window junkie. During his day of teaching, he always has several windows open on his computer, including his e-mail, and a Web browser open to the ILF. When he logs on to the ILF, Ben always goes straight to his classroom to check and see if anyone has posted anything in the related discussion forums. If so, he will respond to any comments immediately. Then, if he has time, he might go to the LOUNGE and see if there are any new posts in any of the discussion forums in which he is interested. Ben checks back with the ILF about two more times during the day. If he decides to post something, he usually takes about 30–45 min to read related posts and submit his own post or two on a particular topic.

Ben expresses frustration about the lack of feedback on his teaching thus far and stated that he is not getting much out of his participation in the ILF community itself. He does feel that simply videotaping his teaching and critically analyzing and reflecting on it was a valuable experience, but he continues to wait for critical

feedback from his peers. In addition, he sees most of the reflections in the ILF as rather limited.

Most of the reflections in [the E-ILF] are still, I think, especially from preservice teachers, are documentation kind of things. It does not go beyond just taking note of what occurred . . . I think if you take that and you move to the next step, OK, today this happened, today this happened, I know I need to do something different in light of what happened, I think I'll synthesize a new plan and go ahead and articulate that. That is when reflection becomes very valuable for me.

Through his involvement in the ILF Ben feels as if he has learned about notions of communities and how on-line communities might be useful for teachers; however, he has yet to have his expectations of the ILF met or even approached. He is longing for sustained engagement with his peers and seems to be visibly frustrated with the lack of participation in the ILF in general, and his classroom specifically, to date. He does feel connected with some people in the ILF, but many, if not all, of those connections were established and fostered in offline contexts. "I can't say that my feelings of community have developed within the Web interface. My feelings of community have developed in the times that we've had lunch together and worked together face to face . . . I really don't feel identity with people I haven't met face to face."

When asked what would encourage him to participate more in the ILF, Ben responded simply by stating "feedback on my video." He clearly wants more people to take a critical look at what he is doing in the classroom and give him feedback on his teaching. He does not yet feel that his participation in the ILF has had any significant impact on his classroom practice; however, he does feel some sort of responsibility to continue to be involved. Ben suggested that as one of the initial contributing teachers, one of his adopted roles is to be an advocate for the ILF. He hopes not only to encourage his colleagues to get involved, but to work with preservice teachers at the university, and conduct workshops for inservice teachers outside of his own school district.

## CONCLUSIONS

ILF members can see actual teaching practice, helping them to develop an appreciation for the contributing teacher's perspective (Lampert, 1998), by viewing the lesson overview and the teacher's reflective commentary. These multiple artifacts can allow the viewer to reach a greater understanding of the class itself and of the teachers' motivations for lesson activities than would textual descriptions or isolated videos. However, as stated earlier, there are drawbacks to using videos to illuminate classrooms. As stated earlier, video-based lessons can be misinterpreted by viewers who do not know the teacher, the classroom culture, the needs and issues of individual students, and the cultural norms of the community (Hatano & Inagaki, 1998). Additionally, videos lack interactivity and provide the viewer the vantage point of the camera, not necessarily the significant interactions from the teacher perspective. However, video cases also have their advantages in that they provide a starting point for discussion, and allow the user multiple viewings of the same episode.

For the Contributing Member (teachers who have classrooms in the ILF system), the opportunity to share classroom practice also allows for self-reflection about the nature and practice of one's own teaching. As teachers contribute classrooms to the video library, they engage in a process of thinking about their teaching that encourages making tacit knowledge explicit to others (Brown & Duguid, 1991). Contributing teachers have commented to us that while the process of putting a classroom on the Website does take up valuable time, it encourages them to be thoughtful about their teaching in a way that is energizing. With the capturing and public display of what may have been tacit knowledge, teachers are given the opportunity to create and share their perspectives and expertise among the entire community as well as further develop them as members, engage in dialogue, compare stories, and come to hold taken-as-shared meanings.

In addition to capturing and sharing their own teaching, ILF members can engage in discussion with other teachers about issues of in-

terest. This, better than any theoretical pronouncement, demonstrates our commitment to the support of knowledge as an evolving and changing phenomenon (Maturana & Varela, 1992). The E-ILF is not an expert-driven model in which the university didactically describes to the "ignorant teacher" what are good inquiry-based, teaching practices. Rather, the E-ILF supports teachers in engaging in discussions with each other as they negotiate what constitutes best practice in terms of inquiry-based teaching and learning. This same potential is a two-edged sword in that the dialogue may or may not support the types of discussions and commitments that are consistent with effective inquiry-based teaching practices. Further, what may be effective from a project-based university perspective (Barab et al., 2000), may not be effective from the perspective of facilitating high achievement on standardized tests. We have tried to take some steps that will push the ILF discussions toward innovative practices. For example, one design decision that pushes the community norms toward innovative practice is that a review team of university educators and classroom teachers rate each video in terms of whether it is inquiry-based. This selective process increases the likelihood that at least the classroom videos are examples of best practice. At these initial implementation stages, however, we have not yet witnessed much rich and reform-minded discussions taking place in the E-ILF postings.

Our commitment to community, perhaps more than any other principle, has shaped the design of the E-ILF, and we believe will prove to be the largest hurdle in our work. From an interface design standpoint, we want participants to have a sense of place in which they have ownership. This desire has influenced major interface decisions (the use of a stylized physical look to the entrance of the site) as well as small ones (use of stylized people icons to "populate" the site). However, a much more important aspect of community is that its members take ownership in the community and work to build it and maintain it. To this end, the ILF is not designed to provide instances of exemplary classroom practice, but to provide opportunities to share, reflect on, and discuss actual classroom practice. Throughout the site, multiple structures are in

place for members to engage in dialogue with one another. Additionally, and consistent with Lave and Wenger's (1991) notions of Legitimate Peripheral Participation, members can initially observe other members' participation as observers. A central focus of our research is to understand how to enable ILF members to feel comfortable so they can contribute to ILF discussions and eventually even contribute videos of their own classrooms.

Seven months into implementation, facilitating a community feel and commitment is proving to be extremely challenging. The first challenge is whether community can be designed and the second challenge is to do it, or at least a significant portion, on-line. As discussed above, the most active discussion contributors in the ILF are individuals who are part of some structured commitment—preservice teachers using it for a class or the CEMI project using it as part of their lesson study groups. While we do have teachers like Ben, they in no way yet form a critical mass. In fact, we are extremely concerned that we will never get the critical mass necessary for community development. We have found that it is challenging to get teachers to log on in their free time or, when they do log on, to critique other teachers. Critically reflecting on other teachers' teaching is not common practice in this very isolated profession in which teachers shut their classroom doors when the bell rings (Darling-Hammond, 1997; Grossman, Wineburg, & Woolworth, 2000). If we are to support the development of anything resembling community on-line, it is our belief that we need to spend more time building trust and connections among members (much of which will occur face-to-face), fostering a culture of critical inquiry, and developing additional means for administratively supporting teachers (credits, release time, classroom computer) for their ILF participation. Appreciation of these issues has led us to many of the sociability design decisions discussed above.

#### IMPLICATIONS

A powerful method for creating knowledge is storytelling, where individuals share accounts of particular episodes (Orr, 1990). Technology can

support the sharing of these stories in a manner that is not bound by time or place. Brown and Duguid (1998) stated that technology "supports not merely the diffusion of know-what, but the creation of know-how and that allows for knowledge to be shared rather than marketed" (p. 107). The design of the ILF explicitly exploits the story metaphor by capturing entire class sessions on video and providing narrative tools, such as the teacher commentary, to portray the story of that class. In solitary professions, such as teaching, where most of the practice is done singly, it is difficult for preservice or new members to learn to participate in the community. Even experienced teachers rarely are able to observe and reflect on colleagues' practice. Storytelling is one means that allows members to "lurk," watching and reading what and how skilled practitioners act.

The process of building knowledge is as significantly important as the sharing of the knowledge. Instructional design, under such a view, is a process of providing tools and an open architecture for participants to customize and create the structures that best support their community of practice. Knowledge-building activities encourage educational activities to focus on conceptualizing an in-depth understanding of a situation, promote an open knowledge environment for collective understanding, and facilitate a productive interaction among its community members (Scardamalia & Bereiter, 1994). These types of open knowledge-building and sharing environments allow users to take an active role and ownership for the creation of their community, and share stories that will continue to contribute to their professional development throughout their careers (Barab & Duffy, 2000).

In this paper we have described the sociotechnical structures of our on-line professional development environment designed to support secondary mathematics and science teachers in sharing, discussing, and evolving their practice. The E-ILF, and our more recent sociability decisions, center around the goal of fostering sustained participation and a sense of ownership, rather than supporting occasional visits to the site to gather information. We believe that this mode of participation will assist

teachers in taking charge of their professional development needs. The National Foundation for the Improvement of Education recommends that such action is essential if teachers want to go beyond merely keeping up with changes in the classroom (Rényi, 1998). We do not, however, believe that teachers will automatically join the ILF and engage in critical reflection on-line.

The culture of sharing and discussing teaching practices, and the E-ILF as an on-line tool to support that activity, are not consistent with the current state of teacher professional development. As such, we have been leveraging existing communities, and designing sociability structures with the goal of fostering trust and connections among participants. We are working with school districts and individuals to develop more structured participation opportunities that fit into the professional and personal constraints and needs of teachers. We are also integrating the ILF into undergraduate teacher education courses. It is our hope that the community established on-campus will rapidly grow into off-campus, inservice communities. However, as highlighted in the user experience presented above, getting students to see ILF usage as more than an assignment will prove to be a challenge. We are currently working to provide preservice teachers with more authentic and meaningful opportunities to participate in the ILF community. In addition to preservice teachers, we have been forging relations with other teacher development efforts, allowing us to link with existing communities.

We are enthusiastic about the potential of the ILF to change the nature of teacher professional development, offering a new model that is grounded in learning and community models rather than instructional delivery models. The use of videos allows teachers to transcend the systemic constraints that make it difficult to visit other classrooms. However, it can also instill alternative conceptions of what constitutes best practice if users do not have a full appreciation for the context of what they are viewing or if the video camera highlighted problematic aspects within this classroom over others.

Because the ILF leverages the Internet, it is also available to teachers anytime and anywhere as their individual needs and time constraints

allow. Over time, as the project continues, so will our research. We believe the E-ILF will allow teachers to connect and learn from each other in a way that was not possible before the Internet. Through these connections, teachers will be able to share and reflect on practice with colleagues in meaningful ways that have the potential to produce real changes in classroom practice. These evolving changes of classroom practice can then be fed back into the E-ILF design, allowing more teachers to observe and model evolving notions of best practice. □

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Sasha Barab is with the faculty in the Department of Instructional Systems Technology and Cognitive Science at Indiana University Bloomington. James MaKinster is a doctoral student in the Department of Curriculum and Instruction, and Julie Moore in the Department of Instructional Systems Technology at Indiana University—Bloomington, and Don Cunningham is with the faculty in the Department of Counseling and Educational Psychology there. The ILF Design Team consists of Brian Beatty, Tom Duffy, Geraldine Haas, Chris Keslin, Sun-Myung Lee, Justin Marquis, and Kirk Sluder. Correspondence concerning this manuscript should be addressed to sbarab@indiana.edu or School of Education, Room 2232, 201 N. Rose Ave, Bloomington, IN, 47405.

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