16 Illuminating the Braids of Change in a Web-Supported Community

A Design Experiment by
Another Name

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Design-Based Research

The methodological paradigm of “design experiments” is traced back to 1992 when Alan Collins (1992) and Ann Brown (1992) advocated a new methodological approach that would guide them as they carried out research and design work in the context of real-life settings. What began as a reaction to traditional experimentation and its focus on controls, laboratory settings, and replicable results has emerged into a growing field that can be grouped under the label of Design-Based Research Methods. In communicating the activity and the need, Brown (1992: 141) stated:

As a design scientist in my field, I attempt to engineer innovative educational environments and simultaneously conduct experimental studies of those innovations. This involves orchestrating all aspects of a period of daily life in classrooms, a research activity for which I was not trained.

Design-based research involves introducing innovations into the booming, buzzing confusion of real-world practice (as opposed to constrained laboratory contexts) and examining the impact of those designs on the learning process. Specifically, this type of research involves examining the design team, interactions among the designers and the members of the communities being researched, and the everyday practices of the users of the innovation as they use the current iteration of the design. Then, the implications of the findings are cycled into the next iteration of the design innovation in order to build evidence of the particular theories being researched. Because design experiments develop theory in practice, they have the potential to lead to interventions that are
trustworthy, credible, transferable, and ecologically valid (Barab et al., 2001a; Brown, 1992; Kelly, 2003; Roth, 1998).

Collins (1999) suggested seven major differences between traditional psychological methods and the design experiment methodology (see Table 16.1 for an abbreviated list). Central to this distinction is the emphasis in design-based research on understanding the messiness of real-world practice, with context being a central part of the story and not an extraneous variable to be minimized. On a related note, design-based research involves flexible revision of the design, multiple dependent variables, and capturing social interaction. Further, participants are not “subjects” assigned treatments but, instead, are recognized as coparticipants in the design and analysis, contributing their expertise and in-depth understanding to the research. Lastly, given the focus on characterizing situations (as opposed to controlling variables), the outcome of design-based research focuses on developing a profile that characterizes the design in practice (as opposed to testing a hypothesis).

The importance of characterizing the design process more generally is that, in design research, the focus is on developing a design and generating new theory simultaneously. At one level, the design work occurs in the service of theory generation with evidence of

<table>
<thead>
<tr>
<th>Category</th>
<th>Psychological experimentation</th>
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<tr>
<td>Location of research</td>
<td>Conducted in laboratory settings</td>
<td>Occurs in the buzzing, blooming confusion of real-life settings where most learning occurs</td>
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<tr>
<td>Complexity of variables</td>
<td>Frequently involves a single or a couple of dependent variable(s)</td>
<td>Involves multiple dependent variables, including climate variables (e.g., collaboration among learners, available resources); outcome variables (e.g., learning of content, transfer); and system variables (e.g., dissemination, sustainability)</td>
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<tr>
<td>Focus of research</td>
<td>Focuses on identifying a few variables and holding them constant</td>
<td>Focuses on characterizing the situation in all its complexity, much of which is not known beforehand</td>
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<tr>
<td>Unfolding of procedures</td>
<td>Uses fixed procedures</td>
<td>Involves flexible design revision in which there is a tentative initial set that is revised depending on its success in practice</td>
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<tr>
<td>Amount of social interaction</td>
<td>Isolates learners to control interaction</td>
<td>Frequently involves complex social interactions, with participants sharing ideas, distracting each other, etc.</td>
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<tr>
<td>Characterizing the findings</td>
<td>Focuses on testing a hypothesis</td>
<td>Involves looking at multiple aspects of the design and developing a profile that characterizes the design in practice</td>
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<tr>
<td>Role of participants</td>
<td>Treats participants as subjects</td>
<td>Involves different participants in the design in order to bring their differing expertise into producing and analyzing the design</td>
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its effectiveness being a precursor to theory development. Barab and Squire (2004: 5–6) state:

Although providing credible evidence for local gains as a result of a particular design may be necessary, it is not sufficient. Design-based research requires more than simply showing a particular design works but demands that the researcher [move beyond a particular design exemplar to] generate evidence-based claims about learning that address contemporary theoretical issues and further the theoretical knowledge of the field.

Although one can use traditional validation schemes as evidence for the effectiveness of a design, a central challenge for design-based researchers is to determine how to characterize and share their local experiences in ways that will advance and make useful theoretical claims; in other words, how can they package their local stories in a manner that will prove useful to others (Geertz, 1976)? For such ends, it is our belief that an effective, design-based research program must include the following information:

- The designed product.
- The context within which the design was implemented.
- Warrants for evidence of the local impact.
- The theoretical assertions and their relations to the design work.
- The conditions through which the theoretical assertions were generated.
- Warrants for evidence of the theoretical assertions.

This all needs to be carried out in ways that are useful to others engaged in similar work (Barab & Squire, 2004). Furthermore, as evidenced in our six criteria listed above, for the work to be useful, there must be reasonable warrants with respect to both the design work and the theoretical assertions being advanced. In this chapter, rather than restating methods used traditionally to assess the worth of a product or program (see, for example: qualitative methods [Stake, 1983]; quantitative methods [Isaac & Michael, 1990]; mixed method [Greene & Caracelli, 1997]) or methods used to justify the methodological warrants of one’s research, the goal is to provide a specific example of one methodological process-design narrative—for sharing design trajectories and accompanying theoretical assertions in ways that will be credible, trustworthy, and useful to others. In providing a specific example of a method for sharing design trajectories, it is necessary to touch on these other aspects in order to justify to the reader that the design and the design story are worthwhile; that is, we are not saying a lot about nothing.

A Design Narrative

A challenging part of doing educational research on design-based interventions is to characterize the complexity, fragility, messiness, and eventual solidity of the design so that others may benefit from it. One of the central ideas in the scientific paradigm is replicability; however, because design-based researchers cannot (and may not want to) manipulate cultural context, it becomes difficult to replicate others’ findings (Hoadley, 2002). Therefore, in helping others to determine the generalizability of the theoretical assertions derived, the goals are to lay open and express as a problem the completed design in ways that provide insight into the construction of the design (Latour, 1987). This involves not only sharing the designed artifact but also providing rich descriptions...
of the context, the guiding and emerging theory, the design features of the intervention, and the impact of these features on participation and learning. Hoadley (2002) argues that design-based researchers must meet the challenge of replicability by describing the research adequately in a form that he suggests should be a design narrative. Narrative—one way of making sense of a particular design trajectory—is a historical method that involves conveying a series of related plots and describing the unfolding of the design over time (Abbott, 1984, 1992; Mink et al., 1987).

In describing the process of building narratives, Abbott suggests that the first step of narrative analysis is to delimit the case itself, or what historiographers refer to as the “central subject problem” (Hull, 1975). The crucial difficulty lies in “drawing boundaries around the central subject given the continuous character of the social manifold” (Abbott, 1992: 63). However, these boundaries are fuzzy because the properties have case-specific meanings and the cases pass through transformation over time. In fact, in design studies, the focus of the research is on understanding these transformations and on highlighting the conditions that led to particular transformations. It is the unpacking of these transformations or the describing what the case endures that philosophers refer to as the “colligation” problem (see Abbott [1984] for an extended discussion on this topic).

All too often, designers merely report the ready-made structures, thereby concealing the trajectories through which design decisions are made. This is problematic in that much of the theory generation process necessary to move from design work to design-based research occurs through an examination of these processes. However, uncovering these processes and sharing them in ways that allow others to understand the conditions that gave rise to the theoretical assertions presented is a complex business. According to historians, the important and somewhat disheartening point with respect to the colligation problem is the awareness that each event is complex, enduring multiple transformations, having multiple antecedents, and resulting in myriad consequences (Isaac, 1997). Abbott (1992) discusses the coming of an event as a sequence of major turning points (kernels) and sets of situational consequences flowing from these kernels. As such, a fundamental challenge in presenting design narratives lies in uncovering these events so that the reader understands their complexity but doing so in a way that will give global meaning to other work while simultaneously capturing meaningfully the dynamic unfolding of the phenomena.

It is important to note that we do not see the sharing of design trajectories as a theory-forming methodology after which we can strip out contextual variables and run “true experiments.” For some theoretical issues, we believe that the design narrative provides the minimal meaningful methodology for understanding the theoretical issue at hand. This is especially true when examining something as complex as community. From the proliferation of work about researching and designing online communities (e.g., Collison et al., 2000; Hakken, 1999; Jones, 1999; Kim, 2000; Preece, 2000; Smith & Kollock, 1999), we can assume correctly an urgent interest in online communities, even those with the specific focus of supporting learning (Barab et al., 2004; Renninger & Shumar, 2004). However, it is one thing to theorize or proselytize about the importance of such communities and the structures they might employ, and it is another thing to design an online space that a community and its associated members will use to support their learning.

Even if a group can design something resembling a community online, it is an even greater challenge to share these experiences in a manner that will be useful to others engaged in similar design efforts. It is these types of messy complex contexts and her realization that much of the phenomena of interest to learning scientists occur as parts
of these contexts that led Ann Brown (1992) to introduce the design experiment methodology initially. Therefore, although some theory can be tested by isolating variables and randomly assigning participants theoretically distinct treatments, much of the theoretical assertions of interest to learning scientists and educators more generally require understanding the phenomena of interest in rich contexts—online community is one of these types of variables that it may be impractical to study and generate theory about in laboratory-based contexts. In this chapter, as an attempt to illuminate the challenges of designing for a community online, we use a design narrative methodology to share the process of making a web-based community—the Inquiry Learning Forum (ILF)—highlighting the design challenges and successes and advancing some theoretical assertions in the hope that others may carry out their own design work more fruitfully.

Context of this Study

Theoretical Grounding

The term community has a long and rich tradition. It is used in sociology, anthropology, psychology, philosophy, advertising, business, popular culture, and education, among others (Barab & Duffy, 2000; Bellah et al., 1985; Brown, 2001; Grossman et al., 2001; Kim, 2000; Preece, 2000; Rogoff, 1994; Smith & Kollock, 1999; Weedman, 1999; Wenger, 1998; Westheimer, 1998). In its many different uses, the term community has become so varied and omnipresent that we must be cautious about its continued usefulness as a descriptor of specific societal relations. For example, “intentional community” is used to describe the people who form joint housing projects where they share common space, recreational facilities, and common goals and values in the way they choose to live and negotiate together on a daily and continuing basis. Compare this account to talking about a “community of accountants” who share a common way of making a living but have never met the vast majority of their fellow community members.

Many authors note the variability of the notion of community and struggle with its use in their research (Riel & Polin, 2004). Bellah et al. (1985: 333) stated that a community is “a group of people who are socially interdependent, who participate together in discussion and decision making, and who share certain practices that both define the community and are nurtured by it.” Jenny Preece (2000), who researches computer-mediated communities, defined community as a collection of people who interact socially with a shared purpose, guiding policies, and supportive computer systems. Carolyn Shields and Patricia Seltzer (Shields, 1997) struggled for a robust definition of community in highly diverse and bilingual school communities on Indian reservations. After deciding that community is too variable to be encompassed by one term, they proposed three separate concepts of community: a moral community, a community of difference, and a community of dialogue.

Lave and Wenger (1991) advanced the term community of practice to capture the importance of activity in fusing individuals to communities and of communities in legitimizing individual practices. In the context of communities of practice, learning is conceived as a trajectory in which learners move from legitimate peripheral participants to core participants. Based on a review of the literature, Barab et al. (2003: 23) define online community as “a persistent, sustained socio-technical 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.” Communities of practice have histories, cultural identities, interdependence among members, and mechanisms for reproduction (Lave & Wenger, 1991). The important point is
not whether another researcher can add or delete specific indicators, or produce a different definition, but the acknowledgment that communities are more than a temporary coming together of individuals around a particular goal, for a workshop, or for a course (see Riel & Polin, 2004). Much like a living organism, they are self-organizing and do not emerge designed at their first appearance. They grow, evolve, and change dynamically, transcending any particular member and outliving any particular task.

In spite of the challenges of building something like community online, we are seeing numerous examples of designed communities that exist primarily online. Notwithstanding the fact that community has become an obligatory appendage attached liberally to almost any website, or that “community member” is a label applied to anyone who visits a website and pays a fee or types in a password, building online community is an important and viable opportunity for supporting learning that educators need to understand better. Building and maintaining online communities involves the design and manipulation of technologies in ways that foster human connection (Grossman et al., 2001; Kim, 2000; Preece, 2000; Schlager & Fusco, 2004). Indeed, online communities face all the challenges of copresent communities, with the additional challenges caused by the technologies and by the physical distancing that these technologies allow. In this chapter, we focus on the design decisions that we have made in attempting to support the development of an online community of practice for mathematics and science teachers.

Design Context

The Inquiry Learning Forum was developed over three years as a National Science Foundation-funded project, and it had a design/research team of five graduate assistants, five faculty professors, a programmer, a project manager, and a postdoctoral fellow (see Barab et al., 2001b, 2003, for more discussion). It was designed to support a virtual community of in-service and preservice mathematics and science teachers sharing, improving, and creating inquiry-based, pedagogical practices (register or take a tour at: http://ilf.crlt.indiana.edu/) (see Figure 16.1). Founded in our previous research and consistent with our pedagogical commitment (Barab & Duffy, 2000; Chaney-Cullen & Duffy, 1998), the ILF was designed with the belief that teachers need to be full participants in and owners of their virtual space. Specifically, although our conceptualization of the ILF has evolved over time, four principles guided its original design and are still powerful elements in the current iteration of the project:

1. **Foster ownership and participation.** We believe that a truly effective professional development environment must include a community of professional practitioners with varied experiences and skills who accept responsibility for building and maintaining their environment.
2. **Focus on inquiry.** Our goal is to foster inquiry, both in terms of inquiry pedagogy in the classroom and teachers’ inquiry into their own practices.
3. **Visit the classroom.** A central strategy in the design and implementation of our knowledge network is the use of video streaming and web-based technologies to situate participants in the social context of other community members’ teaching practice.
4. **Support communities of practice.** Initially, we focused on the more general notion of communities of practice; however, over time, we adopted the more constrained focus of a common purpose. We focused on bringing together and supporting groups of teachers organized around a collective experience and/or a curricular interest.
The hallmark of this environment is that teachers and students with a broad range of experiences and expertise come together in a virtual space to observe, discuss, and reflect upon pedagogical theory and practice anchored to video-based teaching vignettes (see Figure 16.2). When the antecedent to this chapter was written in 2000, there were over 1,500 registered ILF members, among them university faculty and preservice and in-service teachers.

The ILF encompasses a large and complex website, called the e-ILF (electronic ILF) in this chapter, and a large group of people as users and designers who transact with the e-ILF and each other. We have come to view the ILF not merely as a website but more as a sociotechnical interaction network (STIN) that includes technical structures, people, and the interactions among them (Barab et al., 2003; Kling et al., 2002). All these people come to the project with their unique, sometimes overlapping, and sometimes conflicting historical cultural settings. As a result, the project’s trajectory, including the social, technological, and pedagogical elements, was complex, transactive, and dynamic. It is our understanding that this will be the case almost always when the design work is not geared toward producing a particular artifact that will be “boxed” and disseminated but, instead, is participatory and is focused on social interaction or even targeted toward the development of a community with a reform agenda. This is because the creation of a design is a much more complex, situated, and problematic process than is represented frequently in the straightforward reporting of the “ready-made,” final, blackbox product (Latour, 1987).

Methodological Process

Data Collection

Our research can be described best as naturalistic inquiry, with interpretations based on qualitative data (Guba & Lincoln, 1983; Stake, 1983). Although some interpretations
Figure 16.2 Current Iteration of a Specific Inquiry Learning Forum 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.

were based on ILF team members (“insiders”) writing about their experiences and their perspectives about events in which they participated directly, other interpretations were developed by two researchers (“outsiders”) who were hired to observe the ILF team as it developed and researched the ILF. In addition to attending meetings and taking field notes, this research team conducted structured and semistructured interviews with both the member-participants and the designers. The structured interviews consisted of over 20 questions that covered a wide range of project design issues and individual perceptions. The questions were derived from the conversations with team members and an analysis of the literature on knowledge networks, and they evolved continually through group meetings. The interviews typically lasted 60 to 90 minutes.

In addition to these sources of data, interpretations were triangulated using field notes, interviews, document analysis, and member checks (Lincoln & Guba, 1985). Some of these data were collected as the events occurred and other data were based on retrospective recall through interviews and examinations of traces. For example, the authors reviewed shared e-mail, early iterations of documents, and project notebooks, with the goal of using these multiple sources of data to build a story about the making of the ILF. These collection efforts resulted in a large corpus of data, such as field notes, interview transcripts, design artifacts at various stages in the project, record-keeping, meeting notes, e-mail interactions, ethnographic observation of the online space, ethnographic observation of members in their classes, and interviews with the research and design team as well as with teacher users of the e-ILF. Comments on the manuscript also were received from eight ILF teachers, who, as members of the ILF’s Participant Advisory Board, provided feedback and were co-designers of many ILF features.
Data Analysis

In analyzing the data, we began by having each of the authors examine the data, their personal notes, and e-mail, and reflecting on their firsthand experiences in order to develop a timeline that communicated the core design episodes of the ILF history. Each episode consisted of four components: (a) a definable and bounded set of preconditions, (b) a change in our thinking, (c) design intervention, and (d) impact. The preconditions of the design intervention were envisioned as those nested occurrences that gave rise to the particular design intervention, which could have been a technical interface change or a change in our practice (e.g., conducting face-to-face workshops to introduce the e-ILF).

Design interventions usually came about as a result of a change in our thinking, which was triggered by a single event or a cluster of related events, such as design team meetings, comments by the research and participant advisory boards, interviews with teachers, visits to classrooms, focus groups, or other activities. The impact involved writing a description of what happened after we implemented the change in design. Our goal with this four-step analysis was to identify the events and their constituent features with the intention of developing what historians refer to as a “loose causal order” of the design trajectory. Each of the six authors compiled a timeline of episodes from his or her perspective and shared it with the other members. Based on this list, we produced a representation and the design episode trajectory discussion described in The Nature of the Design section later in this chapter.

Although we found this linear episode trajectory useful for gaining a coarse picture of the design trajectory, it was incomplete. As we began to fill out the specifics of each design episode, we found the portrayal illuminative but somewhat artificial and not representative of the actual complexity. More specifically, drawing boundaries around the episode was problematic given the continuous, dynamic, and complex character of the process and the product. As such, we grew uncomfortable with, and had difficulty characterizing, the phenomena using discrete events as starting points or as ending points, in part because many of the changes we made involved complex social interactions occurring over extended timeframes. We also were concerned with the usefulness of the timeline-of-episodes approach for characterizing our work in ways that would be useful to others. We started with a conception of design episodes as points in time, like stones placed in a river, changing the direction of the flow. However, we came to understand design decisions in terms of tensions that boiled over periodically and, in time, yielded substantive social and technological changes in the ILF. As we pushed the discussion toward more detail, we further came to appreciate that bracketing change in terms of a point, even when conceived as a chaotic attractor (Prigogine, 1984), did not capture adequately the unfolding trajectories of life. In our observations, we witnessed multiple social, technological, economic, and emotional forces all transacting to form extended plots in ways that gave rise to (or transacted with) emergent design interventions.

As we struggled to reconceptualize the design episodes identified into something more representative of the complexity of the process, we realized two things. First, each episode by itself was not critical enough to stand alone as the primary cause for a change in design. The episodes were the confluence of many prior happenings and experiences and the realization of the change was distributed across an extended trajectory in time. Second, each one of the changes was interconnected. It is almost impossible to talk about changes in one area without referring to changes in another. We struggled with how to convey the complexity of the interconnected episodes and finally decided to
treat and represent our experiences as “braids of change.” Each experience can be talked about independently, yet, by weaving them together, one gets a better sense of the design of the whole.

In understanding the braids, we used the timeline to identify core issues or major turning points, including the sets of situational consequences flowing toward and away from these points. Similar to the constant-comparison method (Glaser & Strauss, 1967; Strauss & Corbin, 1997), we looked across the multiple episodes identified, collapsed them into major categories of the ILF experience, and then highlighted those that were most significant to the project and that would be most useful to others. Our goal was to capture and present the identified braids as theoretical constructs that potentially would prove useful to others engaged in similar design work. As such, it was our challenge and, we would argue, a challenge of design-based research more generally, that the braids be both methodologically sound and theoretically useful. The former is depend-ent on our ability to convince others that our methods were credible and trustworthy, whereas the latter caveat (theoretically useful) is based in part on our ability to connect the derived assertions to the literature; however, it is also important that we justify the usefulness of the assertions for ourselves while showing their relevance to others.

This process resulted in the identification of four braids that are presented in the Braids of Change section: (a) Evolving an Identity; (b) Supporting Bounded Participation; (c) Moving Beyond the Technical Dimensions; and (d) Designing for Sociability. It is our intention that these braids have both local resonance with the data, as well as global significance in that they serve as theoretical assertions with respect to the challenges of designing for something like online community. We come to understand the boundaries and how a particular braid endures over time. This led us to re-examine the data and our participant observer experience in order to determine the contingencies that pushed a state along a particular path. We viewed each design braid as being engaged in a perpetual dialogue with its environment, a dialogue of action and constraint that historians refer to as “plot” (Abbott, 1992). The plot of a particular braid is complex, with each weave of the braid having “many immediate antecedents, each of which has many immediate antecedents, and conversely a given event has many consequents, each of which has many consequents” (ibid.: 66). As such, the issue of a braid having a beginning, a middle, and an end (what historians call periodization) is a major problem that required us to make boundary commitments in terms of what events constitute a particular braid.

The Nature of the Design

Before exploring the instantiation of the braids in the ILF project, readers may find it useful to have some background to the project. Figure 16.3 provides a graphic timeline to illustrate the following points. The ILF was conceived during the spring of 1999 in a graduate seminar composed of faculty and students from various curricular areas and interests (Reynolds et al., 2001). Class members interviewed teachers, built and tested prototypes, and studied the literature and latest thinking about online communities. During this period, some of the faculty codified the thinking of the seminar into a grant proposal that could be submitted to the National Science Foundation (NSF). Hoping to bring a broad perspective to the project, co-principal investigators included faculty in instructional systems technology, math education, educational psychology, and library and information science. By the end of the semester, three prototypes had been developed and the grant request had been submitted. One group of students continued to work after the semester had ended, developing one prototype further.
During the summer of 1999, NSF sent notice that the grant would be funded, so work on the prototype continued. Throughout the fall of 1999, project team members were hired, and work began on the development of the website. Testing with teachers in November 1999 led to fundamental changes in the user interface. In addition, the teachers brought in to provide input became ongoing members of the Participant Advisory Board (PAB), a group that met every few months throughout the project to provide insight and feedback from the perspective of the in-service teachers who were using inquiry in their classes. The site went online in March 2000, with seven virtual classrooms complete with streaming videos of teachers doing inquiry in their classes, lesson plans, teachers’ reflections, examples of students’ work, and more. Mathematics or science teachers in grades six through twelve in Indiana were welcome to join. Members were sent a password and were invited to explore the classes. Discussion areas encouraged members to reflect on the practice they saw and on their own practice. The site used an interface that resembled a simple map of a school, with rooms branching out from a central space. The central space was Visit Classrooms. The adjoining rooms included the Lounge, a space to connect to discussions, and the Auditorium, where developers envisioned posting videos of guest lectures. Although there were other spaces, our focus was to push teachers toward the classrooms and discussions as opposed to their using the ILF only to download lesson plans, for example.

About three months after the site was online, the introductions of new theoretical perspectives and philosophies were reshaping the ways in which the research and development teams viewed the ILF. This resulted in changes in the design of the website and the instigation of other activities. For example, the idea that a project such as the ILF might be portrayed more accurately as transactions among people, technology, resources, and populations, and not merely as the electronic artifact (the website), led to changes in the project. The project team began to view the website as one part of the entire sociotechnical interaction network (STIN; Kling et al., 2002). The website began to be called the e-ILF (electronic ILF) internally, to emphasize that it was a part of the entire ILF project. More emphasis was placed on face-to-face interactions through outreach activities and workshops. Development team members became more active participants in online discussion forums. The overriding emphasis on “online” community was lessened, with the belief that online interactions were only one of many different interactions possible in the STIN. The most visible change on the website was the new name of the project. No longer the Internet Learning Forum, the site and the project became known as the Inquiry Learning Forum, highlighting the new emphasis on all of the parts of the project above and beyond the website.

A second complementary theory circulated throughout the development team in the
spring of 2000. It involved focusing on sociability instead of usability in the design of communities. Moving away from the focus of the development team on such technical questions as “Can we build the site?” and “Can people navigate through the site?” the new focus became, “How can we support people talking and working together?” and “How can we support more meaningful and richer dialogue?” Throughout the spring and summer of 2000, development continued, with small alterations to the site. More classrooms were added. The technology was improved to make the site work better. The PAB met and discussed adding features, including lesson plans. A rubric to be used by ILF community members to evaluate videos was developed. In fall 2000, a new functionality that would have great impact was introduced. One of the co-principal investigators received a grant to support a group of in-service teachers, university faculty, and practitioners in the collaborative iterative design of mathematics lessons. This group could use the e-ILF, but they needed some extra tools, and, more importantly, they needed their own online space. Although not available to the general ILF community, the ability to create these spaces, which came to be known as Inquiry Circles, and the tool set necessary to support the tasks were developed in collaboration with this group and brought online in October 2000.

Another important development during this time was the beginning of onsite training sessions in inquiry. In January 2001, membership hit 500. Although a significant number, it was not the thousands of enrollments hoped for in our grant proposal. There were never explicit goals for enrollments or numbers of postings, but, clearly, the website was not meeting our expectations. This problem grew to be all-consuming throughout the winter and spring of 2001. Outreach efforts were not being very successful. A presentation at a science association for Indiana teachers was sparsely attended. Workshops were not generating many postings. Membership requirements were relaxed to allow all educators in Indiana, some educators in other states, and administrators to participate. An area was added to the front page that provided the date, new events, hot topics, and links to new classrooms. The belief was that this would make the front end more dynamic, indicating that the site was active and interesting.

Even with this change, comments about tumbleweeds blowing through the streets of the ILF became common at development team meetings. It was obvious that the postings were neither numerous nor particularly rich. Teachers on the site were posting mostly “I like . . .” types of messages. It was becoming clear that critical reflection on another teacher’s practice was not a part of school culture and that neither inclination nor training supported this type of collaborative critical practice. In one teacher’s words, “We don’t usually sit around the water cooler and critique each other’s teaching . . . it’s just not what happens.” To expect that this type of critical dialogue would begin naturally because there was an online space for it was naïve. In March 2001, a student doing a usage study found that fewer than ten people who were not members of the development team logged on for longer than five minutes. During March and April 2001, there was a growing realization that something revolutionary had to be done. Although it had been planned that this second year of the grant would involve little design and development work, switching instead to a research focus, that was not possible. There was not enough going on to study. There was an interesting contradiction between what potential users said in usability tests or during the needs analysis and what they did. At demonstrations, the responses were overwhelmingly positive. Teachers and other educators loved the e-ILF and loved the idea of an online space for teachers. However, they did not use it, not even those teachers participating directly in the design process. As a result, the development team realized in spring 2001 that it was necessary to revisit the core design decisions and consider a fundamental redesign of the site.

Illuminating the Braids of Change in a Web-Supported Community
During this time, three parts of the sociotechnical interaction network of the ILF were fostering change. The first change involved partitioning off private areas of the ILF. The tool set developed for the mathematics collaborative lesson plan project was being used to good result. The feedback from the group using it led to several changes, with the resultant online area proving useful to this project. Another researcher, peripherally connected to the project, expressed an interest in creating an Inquiry Circle (as they were being called) for a project involving teachers working on a water quality curriculum. The second change was the first use of the ILF in a preservice teaching methods course. Students who were training to be teachers were able to see teachers engaging in the practice of teaching and discuss it not only among themselves, but also with the teachers who were featured on the video. Although there were some problems with the class usage, the overall response was positive, and plans were made to use the ILF in more methods classes. The final change was in personnel. The lead programmer, who had spearheaded a drive to freeze the feature set of the e-ILF while undertaking to rewrite the original underlying code for the site, left (amicably) in March 2001. Programmers often have very different styles. The new lead programmer did not feel that rewriting the code was an essential task and did not mind continuing to support the evolution and change of the technical side of the project. As a result, suggesting and implementing changes became much easier, and, so, a much more common practice.

During the late spring and throughout the summer of 2001, an intense re-evaluation of the basic design tenets of the entire project resulted in several dramatic changes. Perhaps the most obvious was setting aside the key metaphor of “visit the classroom.” Instead of its key position both on the website and in the stories used to explain the ILF, visiting the classroom became merely one of the online tools used to support inquiry. In addition, the focus for support and promotion of the ILF turned to bounded groups or Inquiry Circles. This meant that instead of trying to attract members from the general population of mathematics and science teachers, the development team solicited pre-existing groups, offering the ILF as a tool set and web space and for online and offline community support. We offered other universities the opportunity to use the ILF as a resource for preservice teacher education. Lastly, instead of being merely a space to support member-directed activities, we developed a set of explicit, professional development activities that involved a more directive, top-down approach.

The visual representation of the ILF in 2001 used a new map in which inquiry was the central focus; the Classrooms were at the periphery of the map and the other participant structures were represented at the same level as the Classrooms. Figure 16.4 included two iterations of the front page, illuminating the theoretical and design changes of our thinking over the life of the project. Because the site had become more complex and diverse, a bookmarking function was added to allow users to tag an Inquiry Circle or a discussion. These tagged discussions showed up in a member’s My Desk area, allowing an easy way to keep abreast of new postings in areas of interest. There were now organizing documents for those visiting the site. The central area of the front page once filled by the link to the classrooms now contained four brief explanations under the tag What is Inquiry? Those four links provided brief guides to what inquiry is, why one might want to do inquiry, how to link inquiry to standards, and how the ILF may help. This indicated a shift from a commitment to discovery (“We shouldn’t provide a definition, they should decide for themselves what constitutes inquiry”) to trying to make the site more explicit, more guided, and potentially more useful. Providing even more guidance was an Inquiry Lab area in which teachers could access modules that provide
concrete ways to use the ILF for professional development. These laboratories introduced ways to use the ILF to bring inquiry teaching into one’s practice. They can be used individually or as part of a group.

A new area, the Collaboratory, allowed access to and creation of the Inquiry Circles. As of this writing in the fall 2001 there were 49 of these circles, with some open to all members who asked for entry, and some with restrictions. More were being started on a regular basis. The Lounge area linked to the (at the time of this writing) 21 discussions not specifically part of an Inquiry Circle or a classroom. An ongoing debate among the members of the development team about whether or not to include teaching resources such as lesson plans was resolved by establishing a virtual library. Lessons in the library supported inquiry and had discussions linked to each resource. Members were encouraged to share their experiences and lessons learned, using each lesson as an opportunity to reflect on practice. The Classrooms were still a major part of the site, allowing in-service and preservice teachers to see inquiry on site, to read these teachers’ reflections on their experience, to view the actual lesson and students’ work, to make connections to standards, and to engage in reDections with the teacher in the video and with other teachers about inquiry in their own practice.

Having put the story of the ILF in context, we can explicate the braids of change that occurred throughout the development cycle. We believe that this will add texture and focus to the understanding of what happened and why during this project. Whereas the above discussion provides a general historical narrative, each braid provides a more in-depth perspective into the challenges we faced in the design of a web-based community in the service of learning. The discussion of braids is followed by a brief review of participation and value warrants.

Figure 16.4 Iteration of an Inquiry Learning Forum (ILF) Inquiry Circle (Water Ecology). The Sections in an Inquiry Circle Include Announcements, Highlighted Documents, External Resources, ILF Resources (with Activities), ILF Classrooms, ILF Discussion Forums, and the Private Discussion Forums.
Braids of Change

In examining the braids of change, we touched on four dimensions that focused our discussions and that we believe provide the minimal context for characterizing a braid. First, we focus on the *sociohistorical and cultural context* through which the braid emerged and operates. Second, we discuss *guiding theory* and how it evolved in relation to the particular braid being presented. Third is the actual *practice*, including both technical design changes as well as social interventions. Fourth, we review the *impact* of the particular outcome being considered. In addition, we highlight tensions that we faced in the design process (e.g., usability and sociability; designing with and designing for; online and face-to-face; supporting needs and facilitating reform). With this framework, we now discuss the four braids that emerged as pertinent to our analysis: Evolving an Identity, Supporting Bounded Participation, Moving Beyond the Technical Dimensions, and Designing for Sociability. Beyond providing an organizing structure for the sharing of our experience, the braids serve as theoretical reflection points for others engaged in similar design work.

**Evolving an Identity**

Over the course of the three years that the ILF community had been active at the time of writing this paper, groups involved in the ILF collaboratively evolved an identity for the project; which involved changes in people, assumptions, and commitments, as well as the e-ILF. This evolving identity influenced our theoretical vision of what the ILF should be and how that vision should be represented in the multiple technical structures. This identity also influenced the design of the e-ILF in three main areas: changing the name of the site, changing our visual representation of the site, and changing the rules about who should be allowed to participate.

A name is an instantiation of identity. As noted earlier, in June 2000, after three months online, the ILF changed its name from *Internet Learning Forum* to *Inquiry Learning Forum*. This change reflected an evolution in the perception of the ILF by those involved. Initially, the ILF was regarded as primarily an internet-centered, professional development project that sought to develop online community. In time, this vision grew to become a vision of the ILF as a project that is centered on supporting student and teacher inquiry, with participation on the website, in person, through workshops, and more. This change was evident in our tagline on the opening page of the website. Our earlier tagline, “Building a community of Indiana math and science teachers,” was changed to “Supporting student learning and teacher growth through inquiry.” These changes paralleled our shift in focus from building an online community of practice to supporting existing groups in developing and implementing inquiry in the classroom. These changes were prompted by conversations with our Research Advisory Board (RAB), our PAB, and informal conversations with teachers who concentrated our thinking on their everyday needs and not on the more theoretical notions of building community. The tension between our reform agenda and the practical needs of the participants created a design challenge that we balanced continually throughout the project.

It was our intention to have the core activity be observing classroom videos. Each classroom became a narrative case study, developed collaboratively by the video production team and the featured teachers. A help page was added to guide interactions between the participants and the video, and, later on, featured teachers were asked to provide opening questions for discussions in an attempt to structure participation.
“Should I have been more specific when asking them to order or classify the galaxy pictures? Were my instructions too vague?” are examples of a featured teacher’s questions that fostered many responses and modeled self-reflection for other teachers.

The website’s central focus on the classroom videos developed into a tension between the ILF developers and the ILF participants. The ILF developers attempted to push classroom videos as the central focus of the site and as a model for the critical reflection of practice. However, the ILF teacher-participants were more interested in obtaining resources such as lesson plans, lesson ideas, and materials. Many had no time to view videos or lacked the practice or inclination to engage in critical reflection in a semipublic forum. A PAB member gave us this candid feedback at a focus group on inquiry and science that was a part of the PAB meeting in February 2001:

But let me share a perspective with you. I must admit I don’t come very often to the site simply because I’m so darn busy that just, I mean, when I get a chance at school, I’ll peek in, but not a lot. I will be honest.

At the same time, a suite of tools was developed to support collaborations among university faculty in the School of Education, faculty in the College of Arts and Sciences, in-service teachers, and preservice teachers to study and develop lessons collaboratively. This tool suite was one of a series of new technical structures that led to a radical shift in focus from having the classrooms as the central point of the site to treating the classrooms as merely one of several resources to support inquiry (see Figure 16.4 above). This tool suite also led to a dramatic decrease in the development time spent on classroom video production.

Two new areas of the site were added to the map: the Collaboratory, which included all of the Inquiry Circles, and the Inquiry Labs, which offered structured, professional development modules that showed and used the ILF to support inquiry teaching. In addition to changing the visual appearance of the front end, a definition of inquiry was added to the front end page. We were spurred on to make these changes by the feedback from several RAB members at the RAB meeting in May 2001. One wrote these reflections at the end of the meeting:

I think there needs to be a commonality of purpose reflected in the ILF, the state standards, and the teacher-participants. I am troubled by the duality between teacher needs and ILF objectives as separate. I encourage us to find ways to satisfy teacher needs for curriculum and activities or lesson plans and at the same time to encourage methods of inquiry which help meet teacher standards.

Another wrote:

You need a mission statement. The ILF needs to have a stronger, more obvious focus. It needs a theme and that theme needs to speak to teacher needs. You’ve got to stand for something more than online learning community. For example, it could be sold as a resource for teachers who are trying to use inquiry teaching to meet state standards. A theme based on a problem that teachers have and know they have—this can be the subterfuge for pulling in customers.

This reflected a theoretical shift from a view of the ILF in which definitions would emerge from community participation to a view of the ILF in which the designers collaborated with teachers to provide more structure for participation.
Supporting Bounded Participation

The creation of the suite of tools that would support bounded groups or Inquiry Circles led to changes in epistemological and ontological commitments. The initial assumption of the site was that if a critical mass of teachers came to the site and discussed the classroom videos, a community of teachers would emerge. The very strong commitment to developing community and the belief that allowing private work groups would discourage the development of community was challenged about twelve months after the ILF launched, when the numbers of postings and registrations were still minimal. It led the ILF team to re-examine the design approaches it took.

Pressured by one principal investigator’s critique of low usage and confirmed by the RAB and PAB, there was an extreme epistemological shift from designing the ILF community of practice to supporting multiple pre-existing communities. The PI saw this mandate coming from the requirements of the NSF, which wished to see its monetary investment yield positive results and not be another boutique project. The PI also had a social relationship with participants in a number of different organizations and projects (e.g., the Indiana Mathematics Initiative project) and saw their needs of private space as congruent with the NSF’s needs to see more action in the ILF. This excerpt from an e-mail that was part of an exchange between a PI and a doctoral student on the project demonstrates the PI’s view on private spaces, here called bounded groups:

The bounded groups finesse this problem by “off-loading” trust formation and group development to the real-life groups . . . so when CEMI [one of the Inquiry Circle groups] uses the e-ILF facilities, their communications can be more open than perhaps among e-ILF newbies in other parts of the site because they have developed some level of trust elsewhere and bring their preexisting relationships online.

After the fall 2000 PAB meeting, the design team decided that teachers were unlikely to take the risk of critiquing other teachers whom they do not know unless they felt safe to speak freely, thus recognizing that such trust building is difficult within such a large social space. The reconceptualization of the ILF mandate was aided by the initiation of regular PI meetings, with the PIs taking a more active role in decision making, whereas, previously, there had been a loose, consensus-building venture at research meetings.

The first venture to provide social structures that could nurture teachers’ collaborations and deep reflections was to design a space for the new federally-funded project entitled Collaboration to Enhance Mathematics Instruction (CEMI) in the fall of 2000. The CEMI project is modeled on the Japanese Lesson Study Groups that bring together kindergarten-through-grade-twelve teachers, university educators, and preservice teachers who collaboratively develop, teach, critique, and redesign lessons in their respective areas of expertise (Lewis & Tsuchida, 1997; Stevenson & Stigler, 1992). The CEMI project met in face-to-face settings but wished also to have an online space to facilitate the collaborative construction of lesson critiques, lesson plans, and unit plans during times when they could not meet face-to-face. They needed a collaborative editing tool and private discussion forums. The ILF design team created a space called the Working Circle, in which small groups could construct their own private areas. In the Working Circle, CEMI created a bounded group that brought together several in-service and preservice teachers, mathematics educators, and mathematicians to develop and revise mathematics lesson plans through implementing them in kindergarten-through-grade-twelve classrooms. The design of the CEMI approach was different from the design of other public areas on the ILF in that the circle was initiated by a group
who shared a similar interest area and was tailored to the group’s specific needs. Beginning with supporting existing or already connected groups, this concept expanded gradually to include initiating new groups and seeking to support courses for preservice teachers. It is this feature that prompted the Indiana University’s School of Education to fund the continuation of the ILF for three years.

The endeavor inspired other small-group activities. By the spring of 2001, there was general consensus that the ILF needed to support already existing community groups with bounded groups of Inquiry Circles, but that there also needed to be a major redesign of the ILF to support this change. The programmer on the project began a very deliberate and prolonged redesign of the e-ILF. This effort bogged down quickly from lack of coordination and lack of interest in such a tedious task of redesigning for such a deferred goal of change. However, the programmer left the project voluntarily and was replaced by a colleague who was willing to tinker with the program to make it support bounded groups, rather than requiring a totally new system. The result was that, by the end of the summer of 2001, the concept of bounded groups was actualized as the ILF Collaboratory, with groups of members referred to as Inquiry Circle members. These spaces became populated quickly because they were used both in preservice classes and by existing professional development groups looking to expand their collaboration beyond face-to-face meetings.

In fall 2001, there were 49 Inquiry Circles in the ILF Collaboratory that ranged in emphasis from elementary science methods classes from four different universities, a group of middle- and high-school science teachers who participated in a summer workshop on teaching science through inquiry, to teachers who use water ecology and water quality as a focus in their classes. The important point was that the group shared a common purpose, whether it be a class focus, a workshop focus, or a topic focus. It was in this way that our emphasis shifted from an interest in supporting a community of practice to supporting groups with a common purpose. However, rather than predefining the practice and the purpose discussed in the space, our emphasis was on networking with groups of teachers who needed collaboration tools to support their own goals. Each Inquiry Circle space enabled teachers to: (a) organize the ILF classrooms and resources and create discussion forums of interest to this group, (b) share announcements, ideas, weblinks, and electronic documents, (c) create and edit documents collaboratively, and (d) organize the efforts and interests of this group as they used this space as a way to keep in touch (see Figure 16.5).

Along with these bounded groups (Inquiry Circles), another level of bounded activities was being implemented; for example, discussions that go on for only a certain time period and time-focused events. Also, the inquiry modules discussed briefly above provided a bounded sequence of activities that members could use as a guide to structure their ILF participation. The bounded group opportunities revitalized the ILF and contributed to a change in the basic notion of the ILF from building communities of practice to supporting groups. Members of the Working Circles have participated steadily in the discussion, especially preservice teachers using the Collaboratory as part of a university course. Moreover, a few teachers in the PAB created Inquiry Circles and moderated their groups, which exemplified the transfer of ownership from the designers to the teacher-participants. In fact, it was these Inquiry Circles that were the most prolific in terms of postings. (Note the rise in postings in September 2001 in Figure 16.5, one month after the space supporting Inquiry Circles was implemented.)

Many Inquiry Circles applied strategies to create groups that included both online and multiple, face-to-face meeting options, with an informal, web-based, professional development approach being written into future grants and grants already funded. A
major goal of an ILF designers’ and researchers’ retreat in August of 2001 was to provide a structure of copresent meetings and goal-setting for the Inquiry Circles. This approach involved an initial face-to-face meeting in which a pedagogical skill (e.g., open inquiry, anchored instruction) or a tool (e.g., graphing calculators, innovative software) was introduced and a lesson or a unit was developed by each member, followed by an implementation period in which Inquiry Circle participants used the ILF to share lessons and reflections about implementing their lessons. Then, the group was expected to reconvene for a second face-to-face meeting in which they shared what they had learned, developed relations and built trust further, learned about new skills and tools, and planned another inquiry-based lesson or unit. This was to be followed by another round of implementation and online reflection and sharing, with a last face-to-face meeting for final reflections and closure. Multiple groups have adopted this model already, writing the ILF and this participatory framework into funded grants. However, for the most part, we have not been able to sustain this consistency of activity across Inquiry Circles. This is partly a function of the large number of Inquiry Circles and partly a function of our philosophy that supports the needs of teachers rather than imposing values on them.

Moving Beyond the Technical Dimensions

An important question that we wrestled with was that in spite of the positive perceptions and although teachers communicate and demonstrate continually to us the value...
of the ILF, why was it so hard to monitor participation? One simple, but important, response is time. Time is perhaps the scarcest commodity of in-service teachers. Another is that the practice of inquiry-based teaching is not necessarily compatible with preparing students for standardized tests and the necessary factual retention. Another more complex response is related to the culture of teachers, a culture in which collaboration and critique of each other’s practice are not the norms (Grossman et al., 2001). Exacerbating this problem is the challenge of situating this activity in an online space where any critique is permanent, where the people involved may not know each other, and where this delicate act of critiquing each other involves adding an online comment (a posting) that is available for the public scrutiny of over 1,500 members.

The initial proposal for the ILF included face-to-face elements, but, as the project got under way, we focused mainly on the development of the technical space. When the site launched in March 2000, we had forgotten principally the face-to-face aspects of our original proposal, looking instead for the development of a community almost exclusively through the online environment. We hired a person in the role of teacher liaison, for the first year of the project. Primarily, the teacher liaison communicated with teachers being video-taped as a part of the video production process. We had hoped that the classroom videos would create a source for encouraging posting, but we learned that, for in-service teachers, they wanted to interact with teachers they knew. As one member commented during a face-to-face meeting with other teachers, including those who were featured in the ILF Classroom area:

I have not spent a lot of time in anybody’s video. Okay? But now that I’ve met these people, I’ll go home and do it. What’s missing is I don’t want to look at home movies if I don’t know the people.

This comment suggested to us that we need to spend more time focusing on face-to-face relations. Given this awareness, coupled with a shift from project development to project impact and use, we began to concentrate more on outreach and professional development options as means to get teachers involved in the ILF. In essence, we found ourselves falling back on the traditional avenues of workshops and conference sessions to promote this “new” model of professional development through the online community that the ILF offered.

In the spring of 2000, we developed a three-tiered outreach plan. First, we were available for demonstrations and hands-on workshops about the ILF free of charge to anyone in the State of Indiana. Second, we developed a two-day workshop called “Why Ask Why? Inquiry Based Teaching in Math and Science,” which was conducted four times at the Indiana University campus and was offered (but never conducted) on-site at schools. There was a minimal cost for this two-day workshop, charged primarily to provide a level of commitment on behalf of the participant or school. Although both of the first two strategies were valuable, they did not reflect either our values or what the research literature says is the importance of long-term, sustained professional development (Grossman et al., 2001; Guskey & Huberman, 1995; Heaton & Lampert, 1993; Westheimer, 1998). Our third outreach option involved co-designing a long-term partnership with a school or schools to design professional development options that met their specific needs and goals. Two such relationships have been developed, one during the spring 2001 semester and one in fall 2002. Although we certainly were able to generate activity in the ILF during the face-to-face sessions, this did not translate necessarily into long-term, active participation in the ILF community.

This last outreach may prove to be our most important strategy because preservice
teachers in mathematics methods, science methods, and educational psychology courses have found the ability to “see” lessons and connect with real-world teachers incredibly valuable. Some of the impetus to support preservice teachers came from the enthusiastic response of these students, as shown in this posting from one of our discussion forums:

I really enjoyed getting to see her lesson because it allows students like us who want to be teachers to go over what she is teaching and look at how things went. It is almost as if we are in there observing her and it is nice because we can watch her while at home. I thought the students were using inquiry because she was prompting them to give out information and open-ended questions allowed students to reply. I really like watching the examples.

Two forces combined in the summer of 2001 to compel a reconsideration of our outreach activities. First, we were concerned that the pedagogical focus of the original workshops and outreach activities was too broad to create any real sense of community for or commitment by other participants. Second, as stated above, the project’s emphasis shifted from creating community to supporting existing communities. Thus, during the 2001–2002 year, we changed our outreach focus in three major ways, leading to an increase in member participation; note the resultant peak in activity in the fall of 2001 in Figure 16.5. First, we developed curricular-based workshops that brought teachers together around a particular curricular topic (axolotls or water ecology). Although this would not work necessarily as a long-term or scalable strategy (with limited curricular expertise on our staff), it did provide an opportunity to see how the ILF might be used to support other such efforts. Our second new outreach focus evolved from our shift toward supporting existing communities by reaching out to existing professional development efforts. We began to work with state professional organizations in Indiana and the State of Indiana’s Department of Education to support professional development efforts in the state. Third, we began to promote and use the ILF with preservice classes at Indiana University and other institutions.

Additionally, our hope is that as these students move into classroom positions, they will take their experience in the ILF with them into their schools. Coinciding with this rethinking of our outreach program was the development of the online group workspace. Thus, not only did we shift the nature of our outreach, but also the online environment now provided rich tools for group identification, organization, and work. In the last year of the project, the teacher liaison role focused on professional development, connecting ILF members, and promoting the project, with video organization responsibilities going to another staff member. Overall, the evolution of ILF’s outreach can be seen as moving toward a mixed-modal model, evolving hand-in-hand with the change in the project’s focus and identity from an “online” community to a “web-based” community.

Designing for Sociability

Once the initial design and implementation of the e-ILF coalesced into a functional and potentially meaningful entity (March 2000), we began to understand that merely having a usable structure would not foster social collaboration necessarily. We began to view the ILF not only as an electronic structure, the e-ILF, but also as a sociotechnical structure (Barab et al., 2003). This new conception had important implications for the continued design of the electronic structures as well as the nontechnical ones, and it was our belief that the ILF writ large consisted of both. It was in the second year that we
began to concentrate on issues of sociability, meaning those social policies and technical structures that support the community’s shared purpose and the social interactions among group members (Barab et al., 2001b; Preece, 2000).

The core sociability challenge was to increase connectedness and active collaboration among members. Reported in previous work (Barab et al., 2001b), our examination of meeting notes, e-mails, usability documents, and relevant literature highlighted three, core, sociability themes:

- The need to develop participant structures to support group collaboration and work.
- The need to provide structured tasks for using the e-ILF and for engaging the ILF community.
- The need to provide more visible connections to people, conversations, and artifacts of interest.

In addressing these needs, a number of design steps and participant structures were implemented, with the broad focus of fostering increased opportunities for collaboration and a greater sense of connectedness among the ILF community.

In fostering sociability, we recognized that a feeling of trust was a necessary prerequisite for teachers to feel comfortable reflecting on their own and other teachers’ practice. Teachers usually have a lot of autonomy in their classrooms. There, they are able to shut the door and concentrate on the needs of their students in a self-contained space. This individualism in classroom culture, this type of isolation, is very different from the atmosphere of collaboration, openness, and self-reflection that we were trying to foster in the ILF. Postings tended to be few and lacking in critical reflection. An example of the many very agreeable postings follows:

> It was interesting to see this lesson in action. I thought that the students appeared engaged in the activity, and the examples of student work were impressive. I wonder, was there any aspect of the lesson that you felt needed to be tailored to needs and concerns of the students?

In the second PAB meeting, in the spring of the second year, we heard from several members that face-to-face, social connection was necessary before participation would be comfortable. Often, the need for a social connection was compared to the experience of the PAB members who had gotten to know each other in their copresent meetings and then used the online interactions to continue that relationship.

This need for connection with people they knew relates to a core misconception dating back to the development of the original prototype in which the designers believed that any inquiry-based classroom placed on the website would be of interest to in-service teachers. Teachers interviewed during the development process identified seeing another teacher teach as their overriding desire for improved professional development. The ILF was constructed to allow teachers to “visit classrooms” and view teachers. However, over time and through interviews and observations, we have come to narrow our understanding of what teachers wanted. They wanted to view specific teachers that they knew. Similarly, they wanted to reflect on practice with teachers they knew, not merely anyone who happened to be in an online space. One teacher said during a focus group:

> It’s a developed collegiality that can only be established truly, authentically when
you are warm bodies in a room, and there’s immediate feedback. Not, “Let’s wait and see if they’ve posted and responded,” which is effective to a point, but I think that there’s probably more of a willingness to share and be truthful with each other about our videos when we can understand the personalities and what makes, you know, good feedback for you without hurting your feelings or you know, making you feel like, “Yeah. Okay. I’m going to try some more.”

It is these types of comments that led us to view and develop multilayered interventions that treated the ILF as a web-supported community and not as an online community.

In 2000, we also were struggling with what we considered a lack of sufficient involvement in the discussion forums. There would be a surge of activity to post after a workshop or class assignment, followed by a quick leveling-off in postings. We implemented a number of design changes in order to address what we perceived as insufficient interaction in the e-ILF. The teacher liaison and other ILF staffers made a point of getting online and modeling critical dialogue. We instituted user profiles with self-description and pictures as an option for all members. Our PAB suggested, and we implemented, a procedure whereby each teacher who had produced a video also would provide a series of questions meant to foster critical dialogue in the discussion forums in their classrooms.

We encouraged teachers to facilitate discussion forums on topics of their chosen interests, reasoning that this would give more ownership to our members. Indeed, some of most active discussion forums turned out to be the ones designed and facilitated by in-service teachers. It is in these discussion forums that we saw some of the most useful and productive debates, with teachers arguing and pushing their understandings about what counts as good practice. For example, “Useless Math,” “Science Misconceptions,” and “Technology: How much is too much?” are examples of teacher-initiated and -facilitated forums that have been popular with both preservice and in-service teachers. The extended example below is a thread from “Technology: How much is too much?” where teachers questioned the “accepted” place of technology in teaching as well as exchanged information in a meaningful way.

Teacher 1: Using technology in my classroom has opened doors for my students as well as myself. My students can find organisms or specimens under a microscope, capture them with a flexible camera and software, and save them for their computerized lab portfolio. They have the ability to produce a cool pond water lab, the stages of mitosis, or chart the progression of their lab dissections. With just a little technology, I have turned some “boring” labs into really cool activities! It really can be a great tool when used as a stepping stone instead of a crutch!

Teacher 2: Hi. I enjoyed reading how you are using technology. What grade(s) do you teach? I am interested to hear what you have your students do for the pond lab. We are doing a water ecology unit this fall and using a similar camera setup might work really well for some things I have in mind.

Teacher 3: I agree with using technology as an additional aide in biology, yet it cannot be the only way to teach. I am a preservice teacher in a school district whose technology coordinator wants all labs to be computerized; this came from the head of the science department. As she states, and I agree, nothing takes the place of hands-on lab time. There are some things you just can’t teach with a computer.

Teacher 4: I would agree with that, although I am a math teacher, so I can’t really speak or the topic of teaching or running a science lab. I do remember how
much I loved science labs; the hands-on stuff was great. What is your opinion on graphing and charting data? Would you have the students do that by hand as well, or would you allow them to use a spreadsheet program to analyze and chart data?

This is just one example of the engaged types of comments that took place in these forums.

One of the most significant design changes that occurred during the summer between project years two and three (one year post-implementation) was the institution of bounded groups—smaller, more intimate areas on the website that could have restricted access, created to support interest groups, workshops, and preservice classes. Initially, we resisted making this change from a single web space open to all members to a larger space that also allows many smaller, restricted spaces. We resisted for a philosophical reason. We thought that fostering a community of practice online required as many interactions as possible among members. Finally, we accepted that affective issues of trust and intimacy were crucial to engaging in dialogue. Teachers would not participate in the larger space, so we moved to a model of both bounded private spaces organized by interest and the larger space as well (see the section on Supporting Bounded Participation for more details).

Less dramatic changes made to encourage sociability included rethinking participants’ roles and enlisting more teachers to be facilitators and “critical friends.” In some cases, we paid teachers to take on this role. The Inquiry Lab and its focus on specific tasks in the ILF, with the consequent reward of earning continuing education units, was another attempt to enhance sociability, although also a part of our new professional development model. One example of a directed professional development laboratory is:

Visit Tony’s Earth Science Class. View Clip 3: “Preparing the Class for Groupwork” and read Tony’s reflection about using “talking chips.” Why does Tony use them? How effective is this strategy?

Lastly, we made a policy change to house a library of curricular materials, with the caveat that each one would have a discussion forum attached to it. We had resisted being a repository for curricular materials because many other websites met this need already and because we wanted to encourage the reflective use of materials, not be a “download and go” repository. We finally saw a role for a library of curricular materials as a carrot to get teachers to enter, be comfortable, and form social bonds before engaging in the difficult processes of self-reflection and reform. Not all of our attempts at fostering sociability have been successful. For example, although every library resource includes a discussion forum, these forums have had virtually no postings except the initial ones that are required when the item is added to the library. This area of increasing sociability continues to evolve. We have found it best to follow Harry Truman’s advice—“Try something . . . if that doesn’t work, we’ll try something else.” The important point is that this trying of something else is not haphazard but is based on reviews of the literature, needs analyses, and observations of teachers using the space in their everyday lives.

Participation and Value Warrants

In December 2001, there were 1,489 registrants, suggesting that the e-ILF as a product was adopted and used. During that month, new levels of use were set with 16,817 site
hits, including 2,233 hits from teachers, 12,921 hits from preservice teachers, and 1,424 hits from university faculty. Teachers logged 198 sessions, with an average visit lasting ten minutes. Preservice teachers logged 791 sessions, with an average length of 23.8 minutes. There were 598 new postings during December 2001 and 1,600 the previous month in the discussion forums (see Figure 16.6). The site was being used extensively. In addition, face-to-face outreach rose, with members of the research and development teams spending much more time in schools talking with teachers about how they were using or might use the ILF. Presentations at a science educators conference were full, in stark contrast to the empty room of a year before.

We have investigated not only usage, but also the value and impact of participation for teachers. In trying to understand the value of the ILF for preservice teachers, MaKinster (2002) compared the reflections and carried out interviews with preservice teachers who were assigned conditions in which they either reflected on their student-teaching placements in a private journal, in a collaborative discussion forum with other preservice teachers, or in a public discussion forum in the ILF Lounge area. The Private Journal group wrote more complete initial reflections, but they saw the experience as merely another assignment and attached little meaning or value to the exercise. The students in the Private Discussion Forum considered their teaching both through their initial reflections and the responses that they posted to the reflections of their peers. Their perceptions of the assignment were mixed and several students found little value in the experience. Finally, the students in the ILF Lounge Discussion Forum also reviewed their experiences both through their initial reflections and the responses that they posted to the reflections of their peers, but these students found significant value in the assignment, the interactions they had with their peers, the interactions with the ILF in-service teachers, and the idea of thinking about one’s teaching as a means for personal and collaborative professional development. During a post-interview, one student stated:

It was being able to think back about what I had done, what had gone well and what hadn’t gone so well. That I could kind of make note of that and maybe the next time around I teach this [differently]. . . . The more minds that are looking over what you are doing and being able to positively critique you, I think the better off you are. You know, if you are able to take criticism, which I would hope most teachers would take that to help better their instruction and their curriculum . . .

**Figure 16.6** Inquiry Learning Forum (ILF) Number of Postings Per Month from its Release in February 2000 through December 2001.
The results of this study pointed to the value of using web-based, community-integrated discussion forums as a means to foster meaningful and engaged reflection.

In another study, Barab et al. (2001b) interviewed teachers who reported their ILF experiences as highly beneficial. The following teachers’ comments are not unique perspectives:

Doing this [participating in the ILF] makes me do a couple of things. It makes me assess my lesson more than I normally do . . . spend a little bit more time thinking about what questions I’m going to ask, thinking about the follow-up questions, thinking about introducing the lesson in an interesting and meaningful way. And all the things that it’d be nice if every lesson I taught met those qualifications . . . Assessing my teaching. By viewing and making notes and having those little discussions and being asked some good questions that normally I wouldn’t ask myself. So yeah, that’s why I like this.

Or:

Well, I’ve always emphasized in my teaching what I call the nature of science and inquiry is part of that. And I probably haven’t put the right emphasis on inquiry until I got more active and I wouldn’t say that I’m still putting as much emphasis on inquiry as I should but at least I know what I need to do now and can work toward it . . . Yeah, I see myself as I continue to be involved in this forum to be bringing more inquiry-style instruction into my classroom.

We have carried out dozens of interviews and multiple case studies with teachers both to understand their thoughts and observe their actions, with the goal of understanding better how through ILF participation teachers’ understanding and the practice of inquiry-based teaching improve over time.

Examination of the content of online discussions provides further evidence of the value of participation, with there being numerous postings in which teachers reflected deeply on their own practice and that of their peers.

In my methods class, we are learning a lot about teaching through inquiry; it certainly has its benefits. However, we realize that you cannot teach everything through inquiry . . . If your students are struggling with open or guided inquiry, go back and try something more concrete. By the way, this topic relates well to a concern Alex [Alsmith] was having concerning his student teaching experience in Barton’s [a different discussion forum in the ILF] discussion.

Finally, as teachers participated online and in face-to-face meetings, we have observed the forming of meaningful relations, with some teachers collaborating on lessons, others merely providing each other a voice of support, and still others developing friendships that go beyond professional interactions. An example of an experienced teacher being a voice of support can be seen in the following:

New Teacher: I am a first-year teacher and I am having trouble getting started. I will be teaching biology this fall. I don’t know where to start. It all seems so overwhelming. Any pointers on where to begin?

Experienced Teacher: I always start with a nature of science unit and even though it
can be done within biology content, I don’t restrict myself to biology content.

The experienced teacher eventually decided to contribute a video of his classroom that shows the first day of his three-week, nature of science unit. More generally, the value of the ILF has been expressed by various interested parties. For example, although funding from the original grant ended in July 2002, the School of Education at Indiana University agreed to fund continued operation of the project for the next year. This expenditure underscores the perceived worth for preservice teachers that the project has offered and can continue to offer. In spite of the observed and perceived value of the ILF, maintaining participation has not been a straightforward task; we have examples of teachers coming once to the site or participating in a workshop, never to return, and other examples of sustained participation.

Theoretical Assertions

Online communities face hurdles that are similar to—but more challenging than—the issues in copresent communities (Wellman, 1999). The absence of visual bodies or any kinds of visual cues makes for greater difficulties in establishing trust among participants. Members cannot see to whom they are speaking and thus cannot gauge their reactions, emotional state, or interest in the conversations. Verbal explanations, emotive icons (emoticons), and textual smiles are used to fill this emotional void, with only limited success. In fact, one might argue that online communities are best at supporting the needs of already existing copresent communities rather than being the site of new community development (Barab et al., 2003). However, the potential of supporting learning anytime, anywhere, and the pedagogical as well as social appeal of a community model have led to current interest in designing for online communities in the service of learning (Barab et al., 2004).

This work suggests that there are not only technological issues of establishing online communities, but also social issues that are important in establishing functional communities. Further, in spite of the challenges of building online communities, our work provides evidence that designers can facilitate successfully the emergence of online spaces that support active member interactions, even those with the goal of supporting learning. In understanding the sociotechnical challenges and lessons learned, four issues were identified and presented as braids of change using a design narrative methodology (Abbott, 1992). Beginning with Evolving an Identity, our commitment to change our conceptions continually and the resultant design allowed the e-ILF to evolve in ways that met the everyday needs and interests of the site users. For example, terms like internet and community were too broad and general to engage members. Although teachers’ professional development and reform were our focuses, these goals could be achieved best by providing teachers with materials that they could use immediately and then supporting discussions of professional development through the implementation of their practical needs. With respect to Moving Beyond the Technical Dimensions, we found that internet-only participation structures did not offer sustained levels of activity. Our best successes involved a mixed-mode approach that used the ILF as an extension of face-to-face professional development activities.

Related to the Supporting Bounded Participation braid was an appreciation that outreach efforts were improved by taking a more focused approach to supporting specific topic areas and connecting with pre-existing groups, rather than inviting all visitors to the website to discuss inquiry in an open (semipublic) forum. On a related note,
although the internet allows for professional development anytime, anywhere, our participants wanted bounded time chunks with a clear beginning and for which they could experience closure. Although initially we concentrated on human–computer interactions and developing a usable structure, in the Designing for Sociability braid, we discussed the importance of supporting member–member interactions and in thinking through the challenges of fostering meaningful online discussions. For example, supporting critical dialogue is more of a social challenge than it is a usability one, even though developing the Inquiry Circle feature facilitated such dialogue.

Although much design-based research has focused historically on human–computer interactions, in many current design efforts, the emphasis is on designing structures to support social interactions, especially those that are web-based or targeted toward building virtual communities. In these design efforts, the issues shift from human–computer interactions to human–human interactions as mediated by the technology. As such, one needs to move beyond issues of usability and address also issues of sociability. In response to this challenge, our research dealt with sociotechnical issues and the design efforts that relate to understanding local contexts and norms as much as they relate to designing a technical product. Techniques such as recognizing the contributions of members, identifying members in profiles, establishing guides or mentors for newcomers, celebrating events, and meeting face-to-face all tend to build connections and trust (Kim, 2000; Preece, 2000). Also, establishing bounded groups with a common purpose and limited membership further helps establish and maintain trust in an online community. Additionally, our more successful interventions involved a combination of face-to-face meetings and online activities, using the e-ILF to support what teachers are doing already, as opposed to being a space in which all the activities, relationship building, and outcomes occurred. Working with this complexity is a central design challenge that community-focused, design-based researchers must grapple with and understand.

Although participatory design is an important commitment in theory, it is much more challenging in practice, especially when one has a reform agenda in which a core goal is to change practice (Schwen & Hara, 2004). Issues of ownership, codeveloping intentions, and respecting local practices while simultaneously fostering change become problematic, with power, agency, and ownership all coming into play. In our case, our development involved “metadesign,” in which we developed structures that afforded others the opportunity to design for themselves. This feature was an essential aspect of the successful Collaboratory and supported the Inquiry Circles. It was also evident in the fact that all the most successful discussion groups were created and moderated by teachers. On a related note, designing for online community in the service of learning requires a deep understanding not only of design, but also of the context in which the design will be used. Although our commitment to building community and supporting open inquiry might have been laudable theoretically; in practice, it did not meet the everyday needs of the teachers. In part, this is because most of our design work, even though involving numerous teachers, took place in a university context. We can only speculate how teachers’ recommendations might have been different if we had done more design work in their everyday environment, surrounded by their everyday pressures. In fact, the Collaboratory, one of the most successful participant structures in the e-ILF, was a space and a suite of tools that were designed with teachers in the kindergarten-through-grade-twelve schools. Participatory design with a reform agenda faces complex challenges that complicate design work in ways that make it personal, social, and cultural, not only technical. It requires leaving commitments at the door, or at least in the shadows, first understanding local culture and then bringing in the voice of reform opportunistically.

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Implications

Design narratives are especially useful for characterizing design work focused on supporting the emergence of complex contexts in which multiple members and technologies transact, as is the case when using technology to support the emergence of something like an online community. In these cases, assigning participants randomly to conditions or isolating specific variables, although possible for some research questions, results in an impoverished design condition for understanding many of the complex dynamics that are critical for designing for the emergence of online communities (Barab et al., 2003). Given the importance of voice, agency, power, trust, and other sociopolitical issues, it becomes challenging to take the designed outcome, examine it, reproduce it, and implement it successfully with another group of participants in a manner that community will emerge. One needs to understand the sociotechnical dynamics through which the design decisions were made and the solutions were implemented so that one can navigate more intelligently the struggles in one’s own design work.

In presenting the design narrative of the ILF, we had to make a number of decisions. For example, we could have encompassed our interests by using discrete events as starting points of discussions or as ending points of discussions. However, we found ourselves being unable to have our discussion of design changes bracketed by both starting points and ending points. This was because, for the most part, the changes we experienced were not discrete and linear; thus, the issue of causation was complicated, if not impossible, to untangle. Also, it would have been inappropriate if we described changes in ILF usage as a direct effect of a design change when, as we have explained already, the ILF was more than the e-ILF. Many of the changes we made involved complex social interactions, sometimes instantiated as planning and design sessions where many people voiced opinions and were heard and heeded differently. Power, social rank, and eloquence of speech—as well as the confidence of the speaker—all played roles in determining the outcome of these meetings.

For these reasons, we searched for an appropriate metaphor to explain the reasons and the consequences of a multitude of design changes over the three years of the NSF-funded part of the project. We started with the notion of being able to locate specific changes on a timeline and then used the linearity of time to look at the causes and the results of these specific and well-defined changes. This notion of discrete change gave way quickly to recognizing the need to encompass a larger time span and, thus, the notion of design episodes because we realized that very few of our substantive design changes were rolled out instantaneously. We began to see the emotional aspects of our work and started talking about the tensions that grew and boiled over periodically to yield substantive social and technological changes in the ILF. We then examined the metaphor of braided or knotted changes where many social, technological, economic, and emotional forces coalesced to provoke movement and change in our very dynamic system. It is in this last metaphor that we have attempted to communicate our experience in this research project.

Although we frequently present the outcomes of our designs in terms of completed, ready-made artifacts, what may be more useful to others is to highlight the making of our designs (Latour, 1987). Toward this end, we attempted to highlight the ebbs and flows, characterizing our design-based research in terms of four core design trajectories that we refer to as braids of change. It is through understanding and balancing the interplay within and among these braids that designers can inform and evolve their own and others’ design efforts. The challenges are to illuminate these local braids in ways that will have local meaning but, at the same time, to present them in ways that have
relevance to others in other contexts with different goals (Geertz, 1976). Doing this well requires attending to the local issues while concurrently having a deep appreciation for the global issues, situating design in the hermeneutic dialectic that has become so common in qualitative research.

Methods associated traditionally with program evaluation can be used to determine local impact, but we are still learning what methods will provide warrants for advancing credible, trustworthy, and useful theoretical assertions. At one level, we can use methods employed already for conducting rigorous research, such as providing evidence of the reliability and validity (or credibility and trustworthiness) of interpretations. However, in sharing design-based research it is our belief that usefulness to others is a necessary warrant that is not discussed usually in design-based research circles (Barab & Squire, 2004). We have attempted to present this discussion in a manner that will allow other designers to identify readily patterns that occur in their own designs and to navigate intelligently the challenges they face in their design process. This is because it is our belief that, for many complex processes, such as designing for online communities in the service of learning, it becomes meaningless to attempt to research these issues irrespective of the rich contexts in which they exist and are given meaning.

Here, we had to make decisions about the methodological processes that would prove most useful for illuminating the design, the theoretical assertions, and the conditions through which both operate. When reading a design narrative, one must question to what extent such theoretical claims are generalizable beyond the instantiation through which the initial narrative was built. Merely telling a local story, no matter how credible and trustworthy is one’s account, does not mean that the story will have meaning or prove useful to others. We would not want policy-makers to make decisions with tax dollars based on a case of one, no matter how convincing the case. At the same time, to consider the only “true” research to be that which takes place in laboratory contexts or with randomized trials would prove incomplete also. Clearly, both approaches are useful. However, if the generalizability of design narratives is to extend beyond a particular case, it is necessary that the designs and theoretical assertions be presented in ways that provide others insight into: (a) the designed product, (b) the context in which the design was implemented, (c) the theoretical assertions and their relations to the design work, and (d) those conditions through which the theoretical assertions were generated.

Additionally, the researchers need to provide warrants for the evidence of local impacts and for the theoretical assertions being advanced. In our research, this involved presenting the design trajectory in ways that illuminated the conditions through which our assertions were derived and would allow others to determine whether the theoretical assertions seemed justified. Ultimately, a line of study would examine other trajectories to determine the extent to which similar assertions revealed themselves. In this way, and consistent with the generation of grounded theory as discussed by Glaser and Strauss (1967), over time, the theoretical assertions might become saturated and suggest theoretical generalizability. However, another form of generalizability that may be relevant to design narratives is the notion of “petite generalization”; that is, when others use the case to identify more readily patterns that exist in their own work and to navigate the challenges they face there more intelligently (Stake, 1995). It is in supporting the generation of theoretical claims from which others can make petite generalizations that we view design narratives as most useful. We look forward to hearing about other design efforts, comparing the braids identified, and compiling the lessons learned, so that as a field, we can have the greatest impact on those the design work is meant to serve.
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Notes

1 Some widely used, online communities include those targeted toward, for example, e-commerce (e.g., http://yahoo.com; http://www.talkcity.com/), social interactions (http://www.aaintergroup.org; http://www.ca.org/), adventure gaming (e.g., http://asheronscall.com; http://www.everquest.com; http://www.ultimaonline.com), kindergarten-through-grade-twelve students learning disciplinary content (e.g., http://forum.swarthmore.edu/; http://onesky.engine.n.umin.edu), and teachers’ professional development (e.g., http://www.tappedin.sri.com/; http://ei.cornell.edu), among others.

2 In this chapter we have drawn on a variety of data sources, including minutes from weekly research meetings, various advisory board meetings, outside observers’ reflections on these meetings, focus groups with teachers, individual interviews with teachers, usability studies, and discourse from the online discussions occurring in the e-ILF. Given the diversity of the data and to maintain the fluidity of the chapter we have integrated these data and contextualized them in terms of the source by using textual descriptions in the body of the chapter rather than formalized, field-note references.

3 At the writing of this chapter in December 2003, there were over 4,000 registered members, with an average of over 5,000 hits (each unique page visited is considered a hit) per day for the period from December 2002–December 2003.

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