

A Study of Dynamic Design Dualities in a Web-Supported Community of Practice for Teachers

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ABSTRACT

The concept of a community of practice (CoP) is prevalent in several venues for teachers' professional development, especially in online environments. However, there are few descriptive accounts that effectively represent a CoP in a manner that will be of use to other designers. In order to illuminate potential difficulties which may arise when attempting to design a framework to characterize or to build a CoP, this study describes the dynamics of five dualities (specific areas of tension) that were identified during the design and testing period of the Inquiry Learning Forum (ILF), a Web-based community for teachers' professional development. During the three-year design trajectory of the ILF, these five dualities emerged from and characterized the interactions between the participating teachers and the site designers. As part of the data collection for this study, we conducted document analyses, interviews with designers, researchers, and teachers, and observations of online and face-to-face meetings. The findings of this study are intended to help future Web-designers both to better realize the full potential of online professional development environments and to avoid potential design development issues which may hamper the utility or participation rates in newly created CoPs.

Keywords

Community of practice, Online community, Teachers' Professional Development, Design dualities

Introduction

The notion of a collaborative community of practice (CoP) is currently prevalent in online environments designed to facilitate teachers' professional development. In the online environment, a community is no longer limited by physical boundaries; this changes the way we learn and communicate (Barab, MaKinster, & Scheckler, 2004; Bonk, Wisher, & Nigrelli, in press; Riel & Fulton, 2001). Advances in online communities allow people "not just to do more of the same, but to do something different, something powerful, something appropriate for all learners in the new millennium" (Riel & Fulton, 2001, p. 523). It can provide avenues for teachers to deal with real problems collaboratively with a diverse group of other teachers who might otherwise be difficult to meet. In theory, informal online activities and services allow teachers to share ideas, build a professional culture, and encourage educational reform. However, many websites have not been that successful. In practice, the realization of a community is far from what is promised in theory.

Frequently, the modus operandi is to build online communities by mapping existing professional development strategies onto the Internet without first attempting to understand the unique characteristics of online-based systems (Schlager, Fusco, & Schank, 1999). In regard to this discrepancy, Schwen and Hara (2004) have further pointed out that little *prescriptive* (or practical) knowledge is available to help Web-designers design and represent the *descriptive* nature of a CoP. Therefore, it can be an extremely challenging task to generate guidelines for developing an online CoP to support social dynamics for learning. If prescriptive solutions or guidelines are generated hastily, and without a deep understanding of the dynamic interactions that occur between developers and teachers who are co-constructing a CoP, this practice will result in insufficient designs.

Rather than focusing on specific prescriptive guidelines, Barab and colleagues (2004) and Barab, Barnett, and Squire (2002) suggest that understanding the dualities that become apparent during design processes is a useful first step for designers of online communities. This process allows the designer(s) to form a design framework that will broadly guide the decision-making process while creating a community. Both studies also argue that the dualities also serve as an analytical lens to help site designers and researchers to better understand the design process for creating successful online communities. The notion of a “duality” in the design of a CoP was first suggested by Wenger (1998). A definition of this term is offered in the following section. Here, it should be noted that in the present study, the terms “duality” and “tensions” will be used interchangeably. Further, here we specifically analyze *emergent* design dualities using the grounded theory approach.

Our case focus is the Inquiry Learning Forum (ILF), which is a Web-based community for teachers’ professional development. The ILF dualities discussed below were constructed after considering the initial values that guided the design of the ILF website; what aspects of the design were gradually changed; and how, why, and when they were changed from the initial design. The research conclusions presented in this study have several implications for instructional designers. The offered design dualities help to illuminate dynamic interactions which may generally occur between teachers and designers during the process of co-creating learning activities in a Web-supported CoP. A better understanding of such social dynamics in the context of a Web environment is necessary if designers hope to realize the full potential of interactive online environments. In addition, this study contributes to the field of teachers’ professional development.

The stories that are presented reveal actual challenges that were faced by the members and builders of the ILF online community. These real-life stories serve to remind us of the human element in online CoPs—the users themselves, who are supposed to be our main focus in all design considerations. Before introducing the ILF and discussing its related dualities, in the following section we briefly discuss Wenger’s general definition of design dualities.

Understanding the Design of a COP

Lave and Wenger (1991) defined a CoP from a socio-cultural, historical perspective on learning:

A community of practice is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. [It] is an intrinsic condition for the existence of knowledge, not least because it provides the interpretive support necessary for making sense of its heritage. Thus, participation in the cultural practice in which any knowledge exists is an epistemological principle of learning. (p. 98)

A CoP requires a group of people negotiating and working toward a common goal using shared or common resources. Along the same lines, Barab and Duffy (2000) proposed three features of communities of practice: 1) a community has a “common cultural and historical heritage,” 2) a community is composed of individuals who are interdependent and interconnected within the community context, which is also a part of a larger community, and 3) a community has an ongoing “reproduction cycle,” in which new members come in, work with other members, and become core members (p. 37).

As the above definition and features suggest, a CoP emerges when conditions are nurtured naturally, rather than by design or making it happen intentionally. Trying to design an artificial structure to create someone else’s community is a challenge, because the concept of a CoP originated from descriptions of natural learning processes, or “legitimate peripheral participation.” Through such processes, an apprentice becomes a master and forms his/her identity in his/her community (Lave & Wenger, 1991; Wenger, 1998). The design process of a Web-supported CoP entails dualities between those who use the online community space and those who are responsible for designing the space.

A duality includes two distinctive concepts that are interdependent and interplay with one another continually (Giddens as cited in Jackson, 1999). According to Jackson, the notion of a duality was introduced by Giddens to overcome the limitations of the term dualism, which posed two concepts as opposites (like agency and structure, or individual and society). This oversimplifies the complex interrelationship of those two concepts while describing social phenomena. “Duality” implies the dynamic interactions of paired elements. A similar idea to duality can be found in the Yin and Yang of the Tao, and the Supreme Ultimate or Goodness.

Dualities, rather than something to be avoided, can spur rich interactions and system dynamics that drive innovation and change (Barab et al., 2002). Regarding the design of a CoP as a social learning place, Wenger (1998) discussed the concept of an architecture of learning. This idea can help designers to create the basic space that will constitute a CoP learning environment. Below, we summarize the four main elements of Wenger's architecture of learning, which are called the *four spaces* (dimensions): participation and reification, emergent and designed, local and global, and identification and negotiability. As can be seen from these pairings, the concept of duality is embedded in Wenger's learning architecture.

Participation and Reification

This dimension concerns the duality of meaning; that is, to what extent something is reified, and what is left to participation. Participation is "the social experience of living in the world in terms of membership in social communities and active involvement in social enterprise" (Wenger, 1998, p. 55). Reification is "the process of giving form to our experience by producing objects that congeal this experience into thingness" (Wenger, 1998, p. 58). Participation and reification are complementary. This raises issues about whether and to what extent designers have to provide already existing codified materials, such as articles and books, and how much designers need to help participants to create their own meaning while engaging in the learning process.

The Designed and the Emergent

This dimension focuses on time issues and captures the tension between pre-organized teaching activities and emergent learning activities. Even though macro-level activities can be designed, their realization in reality is uncertain. The designer or the instructor needs to be flexible enough to allow emergent learning agendas, which give learners opportunities to negotiate meaning anew. Learning can take forms quite contrary to what developers intended.

The Local and the Global

This dimension refers to the challenge of meeting particular needs, while at the same time sharing in a manner that has global relevance. Wenger (1998) stated that, "due to the inherently limited scope of our engagement, now practice is itself global" (p. 234). The challenge is how to share and illuminate local specifics in a manner that meets the needs of the particular case, while at the same time doing so in a way that will be of use and have relevance for others who are not involved in the particular case. This is a particularly difficult challenge to overcome from a design perspective, especially when the designers are more interested in building community connections than in simply supporting individual needs.

Identification and Negotiability

This dimension concerns "how the power to define, adapt, or interpret the design is distributed" (Wenger, 1998, p. 235). It offers scope for identity formation through the mix of participation and non-participation—as an insider (full participation in CoP), or an outsider (full non-participation in CoP). In the first three dimensions, each part of the duality comprises a complementary but opposite entity—for example, local and global. The relationship between identification and negotiability also entails the tensions inherent in a duality; likewise, these notions are similarly interactive. For example, for a man and woman, a wedding ceremony is the identification process of being a couple. Their "coupleness," however, can become either stronger or weaker depending on how they negotiate their roles (cooking, gardening, taking care of babies, etc.) and resolve conflicts that they face as they live together. Thus, if the first three dimensions are issues of balancing, the identification process and negotiability are a situation of one being a necessary condition for the other.

Though Wenger's framework does not make any references to the design of an online learning environment or an online CoP, we argue (along with others; see for example, Barab et al., 2004) that this conceptual framework has implications for analyzing and designing online, as well as offline, CoPs.

Situating the Inquiry Learning Forum

Because the Inquiry Learning Forum (ILF) is the focal online community discussed in this study, a brief preliminary description of the ILF is offered below.

Primary Components of the ILF

The ILF (<http://ilf.crlt.indiana.edu>) is a Web-supported community of practice for teachers' professional development, which was funded by a USA National Science Foundation grant offered during the summer of 1999 for a term of three years (Barab, Cunningham, Brown, Duffy, & Kling, 1999). The core project goal was to research and "support a virtual community of in-service and pre-service mathematics and science teachers sharing, improving, and creating inquiry-based pedagogical practices" (Barab et al., 1999, p. 1).

Logging into the site with a participant's password accesses the front-end of the ILF. As shown in Figure 1, the ILF was designed using a school floor plan consisting of seven main components/participant structures: Classrooms, Collaboratory, Lounge, Inquiry Lab, Library, My Desk, and ILF Office. **Classrooms** was formerly a primary design metaphor of the ILF. It contains video clips of contributing teachers' teaching practices. **Collaboratory** is another key component, which was developed to support smaller groups of teachers (called **Inquiry Circles**), who share an interest in working together.

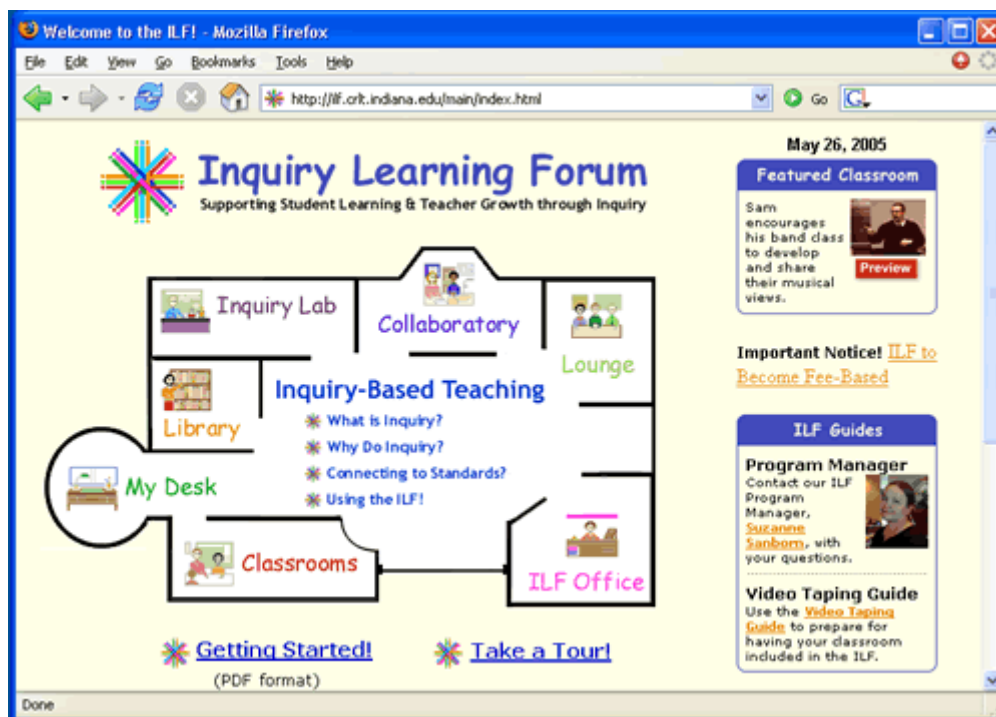


Figure 1. The front-end of the ILF

Besides the two key components above, the **Inquiry Lab** was developed to support teachers' guided professional development in inquiry-based pedagogy in science and math. **My Desk** supports individual participants' more customized or tailored ILF use. It also makes navigation easier by allowing users to bookmark Inquiry Circles and their favorite ILF discussion forums. **Lounge** is a public discussion area for general discussion topics—for example, Useless Math (outdated math topics) or Learning Gap (a book club). **Library** is the place where members can share lesson/unit plans and store other resources (as of September 2005, there were 123 lesson plans posted).

Guiding Design Principles

There have been some changes in the principles that guide the ILF design. In the grant proposal, originally there were four design principles: 1) visit the classroom; 2) foster ownership and participation; 3) focus on inquiry; and 4) focus on mathematics and science in the transition grades. These were later revised to the principles described below. Before examining these, it should be noted that the basic principle of using a “community of practice” was implied in the initial design and significantly influenced the ILF from its conception (Barab, MaKinster, Moore, Cunningham, & the ILF Design Team, 2001). Early emphasis, however, was placed on “building” communities of practice rather than “supporting” people with common purposes. Also, though the mathematics and science focus was not formally included in the new list of principles, it remains a key area that the ILF continues to support. Members of the ILF team explained each of the following, revised principles (Duffy, Barab, Kling, & Cunningham, 1999):

- Foster Ownership and Participation: We believe that a truly effective professional development environment must be distributed throughout a community of professional practitioners of varied and wide experience and skill; [these] will accept responsibility for building and maintaining the environment. (p. 5)
- Focus on Inquiry: Our goal is to foster inquiry, both inquiry pedagogy for the classroom and teacher inquiry into his or her practices. The focus of the ILF classrooms will be on sharing inquiry-based learning environments. (p. 7)
- Visit the Classroom: A central strategy in the design and implementation of [the ILF] network is guided by the goal of situating the participants in the social context of the practice of other community members. An important starting point for sharing practices in a community of teachers/practitioners is to visit each other’s classrooms to observe the craft of teaching as a basis for further analysis, discussion, and reflection. Live visits, however, are difficult to manage, and are fleeting, one-time experiences. Therefore, we have turned to video of classrooms as a strategy for virtually situating teachers in each other’s practices. (p. 4)
- Support Communities of Practice: We hope to bring together and support groups of teachers organized around some collective experience and/or curricular interest. (Barab et al., 2004, p. 59)

Generally speaking, all of the ILF community members influenced the design process. But three key groups were the most directly involved in the process: the ILF designers/researchers, the Participatory Advisory Board (PAB, teachers group), and the Research Advisory Board (RAB, external researchers). As Wenger (1998) stated, in an online learning environment in which someone is mainly taking the responsibility to design a place for someone else, neither teachers nor developers/researchers acting alone can fully design a site for teachers’ learning. It requires co-development by all of them as a community of members.

Methods

The grounded theory approach was used in this study to first identify and then analyze design dualities that emerged between the community members during the building process of the CoP (Creswell, 1998; Strauss & Corbin, 1998).

The Case

Using purposive sampling strategy, we selected the ILF website for our examination. Our selection criteria were based upon both the definition of a CoP and the following elements which characterize this site:

- The informal network of the site aims at helping its users to build an online learning community for professional development opportunities, and teachers are connected to each other in terms of their expertise and interests.
- The site has a comparatively long history.
- Participation is on a voluntary basis and not specifically targeted to earn educational credits or other benefits.

Data Collection

Both authors participated in the data collection, but from slightly different positions. One of us was the principal investigator for the project, which entailed involvement in the entire design and research process. The other was a research assistant, who became involved in the project during its second year of development. We used three sources of evidence to consider both online and offline interactions of teachers (participation).

As a first step in this study, the overall content and structure of the website were reviewed. The site's design and development logs, newsletters, research papers written by the ILF design and research teams, and minutes of meetings were analyzed within the framework suggested above. To review meetings, we referred to meeting notes taken by another research assistant (who was hired to support the ILF researchers), and audio- and video-tapes recorded in the meetings.

We conducted semi-structured interviews with sixteen participants (eight teachers and eight designers who were part of the community of the website, and who had participated in it either from the early stages of the design or since the launching of the site) as shown in Tables 1 and 2. Some teachers were members of the Collaboration for Enhancing Mathematics Instruction (CEMI) – a small group that had developed in the ILF.

Table 1. Profiles of Teachers/Participants Involved in the Interviews

Name of Teachers	Years of Teaching	Subject	Affiliation to ILF
TE1	12	Mathematics	PAB
TE2	23	Science	PAB
TE3	19	Mathematics	PAB
TE4	9	Mathematics	PAB
TE5	22	Science	PAB
TE6	13	Elementary	PAB
TE7	27	Mathematics	CEMI
TE8	10	Mathematics	CEMI

The range of years of the teachers' teaching experience was between nine and twenty-seven years. The types of interview questions used were background questions about their site, design values and principles, design guidelines, and the functions in which they were included. With Human Subject approval, most of the interviews were held only one time through face-to-face meetings, each lasting approximately one and one-half hours. However, we asked for additional comments from several interviewees after the main interviews; this was done by phone or email.

Table 2. Profiles of the ILF Designers/Researchers Involved in the Interviews

Name of Designers	Title	Main Role
DE1	Principal investigator	Leading role in the design and research of the project
DE2	Designer	Design and development
DE3	Designer	Design and development
DE4	Project manager	Leading the development of the project and weekly development meetings
DE5	Teacher Liaison	Connecting the ILF with teachers
DE6	Director of the Center	Initially attending design meetings regularly, later mainly research meetings
DE7	Principal investigator	Facilitating CEMI Inquiry Circle; attending PI meetings
DE8	Principal investigator	Participating in research meetings

A focus group interview, including teachers, designers, and project managers, was conducted in the PAB meeting after the end of the second round of data analysis. The focus group interview had two purposes: 1) member-checking and 2) data collection. First, we presented a brief draft of our interpretations, and then we obtained the participants' feedback and provocative ideas. These involved intellectual challenges to, as well as advocacy for, the interpretations (Morgan, 1988). Secondly, the interviews were used as an opportunity to draw upon their reflections, in order to elicit their feelings and their further reactions (Morgan, 1988).

We participated in both online and face-to-face design meetings. While public spaces in the ILF could be accessed after an initial login to the site, small group work areas were accessible only with permission from the facilitator of the group. We requested permission from the facilitators of three small groups. In addition, conversations on two email listservs, for the ILF designers and the ILF researchers respectively, were analyzed in order to study the ongoing negotiations process regarding changes in the ILF design among the ILF designers and the ILF researchers.

Data Analysis

The analysis process in grounded theory entails systematic procedures: open coding, axial coding, selective coding, developing a conditional matrix, and discussion of theory (Strauss & Corbin, 1990). For the open coding, we formed initial categories of information about the phenomena discovered in the data, which generated 278 different codes. For the axial coding, we assembled the data in new ways after formulating the open coding; in this stage, we related our categories along their dimensions to combine them into supra-categories. This collapsed the initial categories into 55 supra-categories. After finishing the axial coding stage, we asked a colleague to review the print-out of both the original data and the coding assigned to words, sentences, and paragraphs, in order to see whether the way we coded them made sense (peer review: see Lincoln & Guba, 1985; Merriam, 1988). The selective coding process was undertaken to integrate and refine a theory (Strauss & Corbin, 1998). The initial theoretical schemes, consisting of four dualities: 1) technical, 2) social, 3) pedagogical, and 4) administrative, were revised based on the second member-checking. The revised scheme included purpose, design, social, boundary, and interaction dualities. Later, the “usability duality” was added to reflect feedback from the third member-checking (focus group interviews), and the interaction duality was combined into other dualities.

Dynamic Design Dualities

As the ILF evolved, the site participants and designers had to cope with a series of emergent design dualities. Five specific dualities emerged during the design process of the ILF website. Figure 2 represents these dualities.

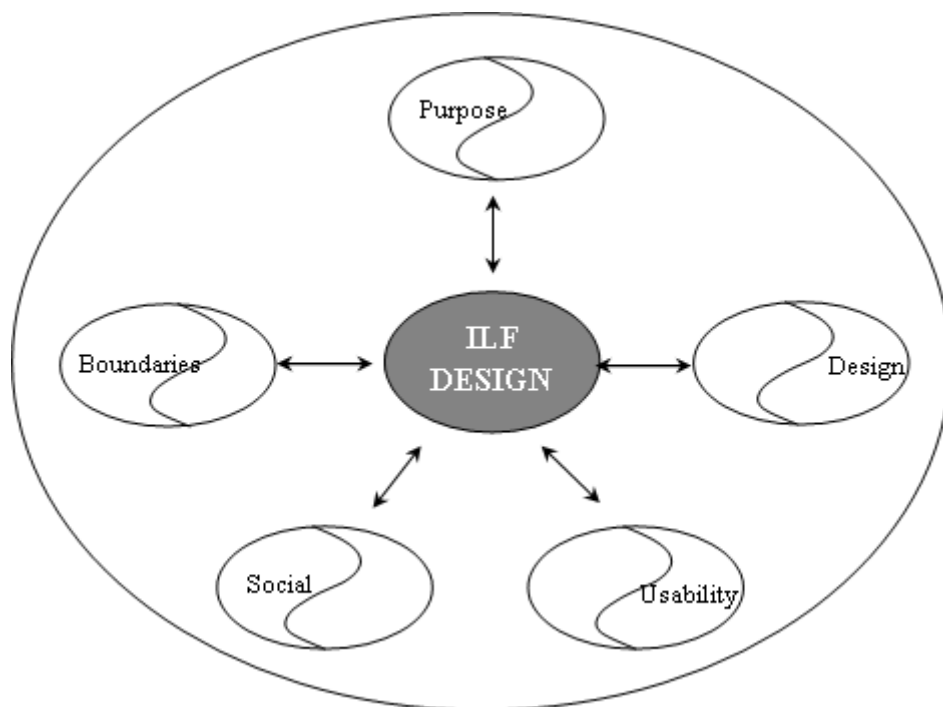


Figure 2. The five dynamic design dualities

The five dualities are essentially constructed explanatory devices, each of which encompasses two concepts that dynamically interact with each other. Some of these dualities are dichotomies, while others are tensions. Together, they illustrate aspects of the context in which teachers and designers worked together to build the ILF as a Web-supported community of practice (CoP). It should be noted that these apparent conflicts need not be interpreted as entirely negative in relation to the evolution of this CoP. To the contrary, though they are frequently presented as challenges to the participants, they also sometimes generated innovations. In this study, we depict how these dualities affected the evolution of the ILF design. The five dualities are: Purpose (School Reform v. Daily Support), Design Approach (Design for v. Design with), Usability (Simple v. Complex), Social (Public v. Private), and Boundaries (Inside v. Outside).

Purpose (The Inquiry Reform Agenda v. Supporting Daily Activities)

Debates on what the purpose of ILF community should be and what it should do caused intense tensions to arise between the teachers and the designers. The main issue was whether to promote the facilitation of long-term educational reform, or the support of short-term and immediate user-needs. Like many other educational reform networks, the ILF started with noble, long-term aspirations. The ILF grant proposal stated that the purpose of the ILF is “to support a virtual [online] community of in-service and pre-service mathematics and science teachers sharing, improving, and creating inquiry-based pedagogical practices” (Barab et al., 1999, p. 1).

Basically, the ILF was originally envisioned to support educational reform by developing a space for mathematics and science teachers to discuss and practice inquiry-based pedagogy. It is important to note that in this early stage, the ILF community was geared toward educational reform at the individual teacher-level rather than toward providing support for school-level reform. In the later phase of the project, it moved toward school reform as well, but the overall focus was still the reform of individual teachers’ practices.

To support these notions, “Visit the Classroom,” which is a key metaphor of the ILF, and several discussion forums in the public Lounge area were developed. However, teachers’ participation in those activities only occurred in the earlier stage. Two months after the site’s launch, there were almost no postings within the discussions in Visit the Classroom, and the overall participation rate significantly dropped. Critical reflections and inquiry were also rare. This result was far from what was expected.

Teachers who visited the site did not significantly engage other community members in dialogues about the contributing teachers in the instructional videos or about the supplied discussion topics. In the PAB meeting in June 2000, while the teachers acknowledged the value of engaging in discussion, they all claimed that they needed something that would support their immediate curricular needs. They wanted to have more ready-to-use resources—“a lot of different cans filled with things” and “a quick idea; something hit and run”—to help them prepare for classes which they would teach the next day. Regarding the teachers’ participation in Visit the Classroom discussions, DE4 said:

The fact is that they didn’t have time to do it... Even if it’s online, they still won’t have time to do that—even if we cut down a 3-day class to 30 minutes.

TE6 commented:

The one basic need that teachers have is time. And when developing the ILF or anything—time has to be considered. Teachers won’t have the time to just sit down behind the computer unless they can get their information within a minute. If I can’t get my information under a minute, I’m out of here.

In response to the teachers’ requests for quick support, the designers agreed that, as a way to support daily practice, the addition of lesson plans into the site could generate more participation. The teachers and designers seemed to reach a semi-consensus that it took a long time or several visits for teachers to benefit from video discussions or other open discussions on inquiry-based pedagogy. Having ready-made lesson plans on the site would partially alleviate this time-related tension.

However, the issue of having lesson plans on the ILF as a way to meet teachers’ immediate needs was not settled for over a year. This prompted the principle investigator (DE1) to say the following in an ILF internal research meeting:

We are committed that no lesson plan will be up without a discussion. ... They can’t just grab a lesson plan. ... They MUST go to a page that has a discussion.

DE1 believed that supplying lesson plans would degrade the integrity of the site. He was not the only one who hesitated to include lesson plans on the site. Many other ILF developers confirmed and seconded this objection. They wanted teachers to have an experience that is richer than simply downloading lesson plans. DE3 well captured this duality.

There is a big push not to have lesson plans on there. Even though teachers really, really wanted them... I think they were ... only part of the puzzle, and I think we were missing a number of things. The biggest challenge was addressing the day-to-day concerns of the teachers. Teachers have specific needs to identify materials and resources and things that they can use in their classroom tomorrow and the

next day. We really wrestled with this. We didn't want to become a lesson repository, and there was talk about putting demonstrations on there. Other sites had already done that...I think that's probably been the biggest challenge—how do you sustain, how do you hold onto and put forward a reform agenda in terms of professional development and at the same time address the needs of teachers on a day-to-day basis?

Even though teachers involved in the design process were highly motivated regarding their professional development and acknowledged the importance of reflection, when site contents were not directly related to their daily teaching, they rarely visited the site. While the ILF team and the teachers were wrestling with this issue, in the RAB meeting in 2001, DE8 raised two very basic and pertinent points: 1) the NSF, which was the project sponsor, was not happy about supporting only a handful of teachers with the grant; and 2) it was impossible to push transformative teaching [inquiry-based teaching] when the designers could not even get participants to visit the site and post. DE8 went on to say that they needed to support immediate needs and then hope that the teachers would come back again and “hangout” on the site. After this RAB meeting, several other members supported a similar idea.

One teacher educator, however, said that shared lesson plans can be carrots to draw teachers in, but that caution was advisable regarding the provision of lesson plans. This person described the dilemma of the ILF being as *functional* as well as *ideal*:

My thoughts were that teachers will ask "what will I teach tomorrow," because they don't have a perspective on teaching—at least in the case of mathematics teaching—that goes beyond looking for a good way to explain the next page in the textbook. As long as we just offer cute lesson plans for how to teach the next page, the issue of what to teach tomorrow never goes away. One of the real values of the ILF is that it shows classrooms where the tasks are complex and interesting—students are answering at most a handful of problems or questions in a class period rather than the 15 to 30 typical in traditional classes, and the interaction patterns within the classroom tend to be very different. The ILF should be helping teachers to move toward more interesting lessons and more student involvement. While lesson plans may be a way to attract them to the site, they should only be the hook to get [teachers] more involved in progressive instruction. Teachers who really think like the teachers in the ILF classrooms think, become interested in much more than lesson plans.

Overall, the research members supported the proposition that the ILF needed to support teachers' daily needs. This, they agreed, could be done by sharing resources that have relevancy and which are useful to their practice; that eventually increase the value of the practice; and that influence students' learning. Thus, this tension in the purpose of the ILF led to a strategy of “both/and” rather than “either/or.”

Design Approach (Design For v. Design With)

In order to encourage teachers to change toward educational reform, *purpose* needs to fit *audience*. The question that naturally follows is: Who's ideas will influence the design and the generation of agendas for the online community? With the growth of the ILF, the criterion of its membership was expanded from pre- and in-service science and math teachers in the state to all educators, including elementary teachers and even administrators throughout the nation. Whether the teachers' role would end up being that of information providers or of co-designers was one of the biggest challenges the ILF designers faced. “Designed for” in this duality indicates the approach in which the designers took “leadership” in the design process. “Design with” is the approach in which the teachers took “ownership” in the process.

A needs analysis was the first step that the ILF designers had originally taken to understand what teachers wanted in terms of challenges and needs for their professional development. The project manager recalled with satisfaction that the needs analysis results confirmed the site's Visit the Classroom metaphor. The designers, however, were critical of the approach they had taken. DE3 said:

We did a very poor job. We did it very, very badly...I don't remember us having a nice report about specific findings or anything like that. I don't ever remember seeing a following write-up of the needs analysis.

DE4 attributed this to the limited initial development time available to the designers.

The needs analysis turned out to be a process of confirming what the ILF project team initially thought the ILF should be, rather than a serious attempt to try to understand what the teachers' actual needs were. This was brought up by DE1:

I think we had ideas that we were trying to get confirmed. When I think back...I don't know how legitimate or open we were to hearing whatever the teachers said.

TE5 viewed teachers as "peripheral" participants rather than as "central" members in the community. He also pinpointed common mistakes that the instructional technology developers or the technology innovators usually made because of their lack of a sufficient understanding of the teachers' culture.

Yet, in the ILF, there were many different communication channels through which teachers were able to make their voices heard. PAB meetings were one of the formal channels. These consisted of teachers and ILF developers, and were held once each semester. However, one significant tension that emerged concerned the unrepresentative profile of the PAB teachers. Most of these "spokespersons" for the wider body of target participants were teachers who were very active in the area of professional development. They were also very well established in their field and were clearly receptive to the concept of inquiry-based pedagogy. This was not typical of most of the potential users of the site. A related issue was that there were no pre-service teachers in the PAB group. The ILF designers and some of the PAB teachers were therefore critical of the representativeness of the PAB. However, other PAB teachers asserted that they could provide the perspectives of a wider variety of teachers.

In the PAB meetings, these highly motivated teachers contributed their ideas and made suggestions about the ILF. TE1 and TE3 saw these teachers' main role as makers of theory into practice. They explained that, while both the school and the university worlds are similar in that both are within the educational enterprise, each "world" has different standards of practice, which originate from their own conventions. Thus, the role of the PAB teachers turned into one in which they helped the designers to translate ideal, abstract visions into functional, concrete Web design features.

Concerning their active participation in the design process, the PAB teachers commented that the ILF designers were open to their opinions, and that the teachers' role was that of collaborative partners in the ILF. TE6 said:

I think that our voices were well respected. I really think that they heard what we were saying...I felt like we were collaborative partners...

TE1, TE3 and TE4 also echoed this positive impression of the designers' openness. However, there were differences of opinion. TE5 saw the teachers' role as more like that of information providers rather than co-designers of the site: "The problem was that they ask the questions."

Returning to the issue of fair representation in the PAB again, most of the ILF designers thought that the majority of teachers who might use the ILF lacked sufficient time to become directly involved in its design. DE3 included this among three factors that he suggested were the possible reasons for low teacher participation in the ILF design process:

[There] are three reasons. One—poor planning on our part. We should have dealt more money in the grant so we could buy [hire] either teachers, buy out class periods for them out of this semester, or buy them out for a semester...Two—would be our current lack of resources to do that...And then Three—would be...the constraints on the teachers' time. They don't have the time to come in and spend a lot of time at the University when they're not getting something back that's of value to them. Now, we can pay them all the money in the world. But if they come to the University, they want to do things, interact to get things they can take back. And we're asking them to come and evaluate and build a site that *in the future* might be useful. That was hard.

One development of the ILF, the "Inquiry Circles," was primarily driven by participants. For example, the first Inquiry Circle, CEMI (built in the fall of 2000) was initiated by the CEMI group. After DE7 received a grant from Lucent Technology in the summer of 2000, she (with two graduate students in the CEMI) requested to meet DE4 in order to discuss what kind of components and functions were necessary to support the CEMI activities. The main components identified in the meeting were document building and communication functions. In this process, the CEMI group members' roles were close to those of the designers of the ILF. Also, many inputs came from members of Inquiry Circles that were developed later, such as pre-service methods

classes and in-service teachers' groups. These participants shared an interest in discussing what was working and what was not in the ILF.

How to incorporate the teachers' voices in the design was an extremely complex issue. In the ILF design, there were several communication channels through which teachers delivered their ideas, but the teachers' perspectives tended to be limited by the relatively narrow profile of those involved. Also, the PAB meetings, while useful, did not generally enhance the teacher/designer dialogue.

Usability (Simple v. Complex)

Ensuring the usability of the ILF was considered to be essential from the start. Thus, the designers attempted to make the components and functions in the site both visible and simple, so that the participants could easily figure out what they needed to do, what was going on in the site, and then use it—all without undergoing a long learning curve. However, there were many incidents during the site's development in which the process of adding more functionality—even if this was in response to the teachers' requests—created problems and made the ILF more complex and less usable. Here, in order to usefully illuminate this tension, we will focus more on the challenges that were encountered in developing a site with maximum functionality in a manner that was “visible” to teachers (Norman, 1990). It is important to note that while many challenges emerged for in-service teachers during this development phase, the site has since been successfully used by thousands of pre-service teachers and has been financially supported and integrated as a virtual field placement for these teachers.

The design of the ILF evolved over three years, during which time it gained new features. The initial information structure of the ILF was more or less simple and visible, which made the ILF fairly usable. However, it did take a while for the teachers to become familiar with the system. Once they got to know it, the designers began to make changes here and there, which caused problems. About this issue, TE3 said:

It was...hard to navigate. I felt I needed more direction in terms of “if you're looking for this, go here.”...I wasn't even sure how to get off the front end and go somewhere. Oftentimes when you would open the site, there were some new changes, what's been newly added. I was not sure where I should go, or what has been changed.

TE3 was a teacher to whom other teachers in her school brought technical problems, and she provided answers to them. Also, and more importantly, she had been a PAB member from the beginning of the ILF. The difficulties caused by the frequent changes also affected the teachers.

One key example that shows how this duality emerged is the development of the small, private work spaces. When the first Inquiry Circle, CEMI, was built in the fall of 2000, this tension became acute. The CEMI Circle needed to have a working space where their group could co-create lesson plans and share ideas on those lesson plans. To meet the team's request to open such a space when the fall semester began, the designers developed the space in about a one-month time period. As DE4 pointed out, this was a big task for such a short development period:

I think the big thing for [us] was making sure there was a discussion tied to that. And from a pure screen real estate point of view, that was very difficult to do. And actually, from a programming point of view, that was very difficult to do.

Though the space was developed for the CEMI members, it contained a lot of usability problems. It was meant to make the ILF more useful, but it added complexity that required a long learning curve and caused participant frustration. From a computer-mediated discourse analysis, 42 out of 293 postings (14%) by this group were complaints about the ILF system. Postings related to the complexity of the ILF centered on the functionality of the document editing tools, discussion structures with three different levels (whole class, project, and document), problems with uploading files, and simple access to the Circle. After the CEMI group used the space for one semester, they all agreed that the *potential value* of the space was a plus. Both TE7 and TE8 said that “It's distance planning. It has a potential.”

Such technical complexities and glitches did not always have negative effects. As Riel and Fulton (2001) argued, those technical difficulties ironically contributed to an increased sense of community among the teachers by providing them opportunities to share their frustrations and to find alternative ways out. In this way, members

were able to solve their problems while working together. This area has proven to be the most active component of the ILF.

After the PAB meeting in 2001, TE3 argued for more technical supports to help struggling teachers. She directly emphasized ongoing face-to-face support or help functions to help teachers use the site properly. In response to concerns about the complex information structure, the ILF team developed My Desk. DE1 envisioned the My Desk area as, “My Desk becomes a Portal. If the system is going to get any more complicated, there has to be a place of simplicity. My Desk becomes that place.” The teachers also shared similar expectations about the feature, which allowed each participant to customize the site. This eventually contributed to easier navigation. However, certain other new features, whether they were intended to add new functionalities or to help with navigation, required extra time for the teachers to become comfortable with them, and so, in this sense, were an extra burden. Building a site that has enough functionality to meet various participants’ needs and at the same time is easy to use can be an extremely difficult task.

Visit the Classroom was the main metaphor of the ILF, and the use of video technology was important in implementing the idea. In the interviews, all of the teachers liked the idea of watching other teachers’ practices, but they also all agreed that they experienced difficulties when attempting to view the videos and that this feature added complexity to the site. Coupled with other technological issues, such as accessibility to the computer/Internet, technology expertise, and video download speed, teachers faced a complex of obstacles in their daily usages of the site. The ILF designers made several efforts to reduce the problems—for example, by dividing a class video into several segments and posting text class-descriptions related to each video class. However, video technology was a high-end technology from the teachers’ perspective, and it was a big task for teachers to view the “classrooms.”

DE4 shared her on-site workshop experiences with other teachers in a school in 2001. The faculty, “had *just* got email accounts at the school. Many of them had to look up their email address in order to register for the ILF—they had never used it before!” DE6 was also concerned about the teachers’ basic competencies. He said that “cool stuff” in the design was not what the teachers wanted:

I kept saying, “why don’t you have some teachers who could get you some insights as to whether you need all that cool stuff or all those neat things.” ... “Does this way of presenting the interface with the cool features make sense to someone who hasn’t been working on computers for the last 10 years of their life?”...One of the responses was, “well, we’re designing for someone who already has some computer sophistication.” So—they will assume everyone is tech savvy. I think that’s a mistake...If you look at the teachers in the elementary school, I would say maybe 10% of them would meet the requirement for the computer sophistication needed to use the ILF without a lot of coaching or...a steep learning curve. Some teachers [only] know how to click and what is a clickable point, but they don’t know how to get back once they get someplace.

In the summer of 2001, the ILF designers responded by developing the Help section, including Video Help, the ILF Getting Started Guide, and an email link to the tech support team. But by 2002, even this had not fully solved all of the teachers’ usability problems, especially concerning the videos. This duality embodied a classic contradiction; the process of meeting the teachers’ needs created technical and utility problems, which decreased their use of the site.

Social Contingencies (Public v. Private)

However technically well-designed, a network does not necessarily guarantee active participation. New social contingencies are required, in which participants are willing to engage in critical dialogue about teaching practices. This dialogue must be based on emotional support, empathy, and trust (Preece, 2000). In this section, we describe social tensions that instigated negotiation, both public and private. The addition of a private place where small groups could work together called for fundamental changes in the underlying assumptions of the ILF design. The idea of *building a community* needed to shift to *supporting a community*.

In the early ILF, Visit the Classroom and Lounge were developed to facilitate teachers’ reflections about videos in Visit the Classroom and to help them to engage in discussions on topics of interest. DE3 observed that active engagement is a sign of a healthy community:

I think a healthy community is one that is willing to engage, and critique one another, and be critical of one another's thoughts. Ideally in a supportive manner, but you could have a community [that might be] a somewhat hostile environment for some people when they put out their ideas...this does sort of work, because if everyone was agreeing with what everyone said all the time, then the community would stagnate and not go anywhere. But if everyone was critical of what everyone said all the time, then the community wouldn't have any ties binding it together, and it would just break apart.

However, participation and posting rates in the ILF were low, and a majority of the postings were superficial, like "you did a good job" or "I really like this lesson." Obviously, the level of reflection necessary for critical dialogue was not present.

The needs analysis data suggested that teachers would be favorable to the idea of visiting other teachers' classrooms. However, the participation and postings demonstrated insufficient critical reflection. The dilemma was, Why the discrepancy? How to increase the teachers' involvement in critical dialogue was the main agenda of the PAB meeting in 2000. Here, both the teachers and the designers agreed that teachers in the videos themselves should invite critiques as a catalyst or as an initial way to generate posting in the discussion. The invitation would let teachers know that it was acceptable to critique other teachers.

Besides these socio-technical aspects of Visit the Classroom, the ILF designers theorized that the lack of criticism was a result of teachers' lack of trust and an absence of reflection in their professional lives. DE 4 commented:

The fact is that their [teachers'] structure and culture does not support them doing it, so they're not very good at doing it. Their culture is not one of "let me come in and sit in your classroom and critique you and help you to grow."...So, for the most part, they don't know how to sit face-to-face with somebody and talk critically about their teaching, which is a very personal process...What did occur did so between people that we knew had gotten to know each other in the participant advisory board and *trusted each other*.

The teachers did not necessarily have the experience or know the proper language to properly critique one another. It was worse when teachers had to critique other teachers whom they did not know or had not met face-to-face, especially when there was little other opportunity to build trust among the teachers. They were also afraid of judging or being criticized in a public space, and worse still—in a space where the criticism could be permanently recorded. All of the designers were aware of this difficulty and echoed this notion. DE2, who was a former teacher, added another dimension to these reasons for teacher avoidance of the forum:

Teachers are nervous about being criticized... They get criticized all the time by other people. They're a pretty set-defensive group...The press attacks them, the government attacks them because test scores are low, and then they always hear about how under-trained they are—and they are underpaid. So I don't blame them for not wanting to be critical of one another.

TE2 also shared similar ideas about the teacher's culture:

We always talked about the difference between congeniality and collegiality. How to be colleagues first, friends second. [But] so much of it's the other way around. Everybody's more concerned about being friends than about being colleagues. And then they don't say those collegial things...They won't say that because they're too concerned about the friendship aspect...they can't get past that.

As a way to address this duality, in the RAB meeting in 2000, the researchers suggested building small, private communities where a group of people with shared interests could come together and produce something that was useful for their teaching, such as lesson plans, in a more intimate place. This was intended to increase intimacy among the members, and was first tested with the CEMI group as discussed earlier. The group's main goal was to collaboratively develop lesson plans and implement them in in-service teachers' classes, and then to revise, re-teach, and revise them again, based on the idea of the Japanese Lesson Study Group (LSG).

In addition to increasing participant intimacy, which should ideally serve as a basis for building trust through their intensive cooperation in collaborative work, the small group approach also introduced the possibility of utilizing a facilitator(s) in each group to mediate group member interactions. Facilitators were employed for small group activities to welcome newcomers, and help them to find places or information that they needed. From this idea came the later and broader notion of introducing a facilitator for the entire site. This individual

could help to make connections between new participants and the community. This could help to break the ice for new visitors, and would shorten their orientation time and period of potential anxiety or awkwardness in the unfamiliar environment. The idea was informally tested with the cooperation of the ILF designers and the teacher liaison. A welcome message was devised by the teacher liaison (DE5) to greet new members on the site:

[Sample] Hello Vicky,
My name is Amy, and I'm the teacher liaison for the ILF. I think you'll find as you continue to explore the site that there are many opportunities for discussion and sharing of ideas and resources here in the ILF. You might find the Lounge an interesting place to visit, to see what other teachers have to say about some of the issues that concern you the most. Please let me know if I can be of any assistance in helping you find your way around. Welcome to the ILF! (February 20, 2002)

This message was in response to a perceived failure of the ILF community members to respond to an "Introduce Yourself" prompt that was located on the site, and was intended to act as a "human touch," to make the site seem more like a community of real and caring people.

As still another way to facilitate interactions and to build trust, the optional feature, My Profile, was created. Within this feature, participants could post their photos, their background, school, years of teaching, who they wanted to connect with, their hobbies, and their own definitions of inquiry. In different forms, each message was linked to a personal profile, so some idea of the identity of the site's participants could be established. Speaking about My Profile, TE2 commented:

I could see that getting those profiles and pictures and detail might be very helpful for visitors to the site, or for first-timers, to see that these are real people. They're not just imaginary characters out there somewhere in the digital world...I could see that being helpful in building a stronger, trusting relationship with the ILF.

All of these new features ultimately enabled users of the ILF to interact more comfortably. They were then better able to share ideas and co-develop teaching materials.

Boundaries (Inside v. Outside)

In regard to boundaries, two different dualities emerged during the design of the ILF. One involved aligning the ILF with school districts and educational and professional development institutes, such as the State Department of Education and State Professional Boards. The other involved bridging the small groups which were formed spontaneously as the ILF grew with the larger site as a whole.

The ILF (Inside) v. the Outer Community (Outside). Ruopp, Gal, Drayton, and Pfister (1993), speaking from their LabNet project experience (on building a teachers' CoP), commented that a community can be autonomous, but the growth of the community might then be less effective without external supports. DE8 articulated this tension in the summer of 2000. The ILF was initially perceived as more or less an isolated Web-based tool, which would over-simplify situations in order to view their complex dynamics. This new perspective helped the ILF designers to understand the relationships between the ILF and outside environments, such as the culture of schools, Public Law (PL) 221, and policies of the State Department of Education.

There was some attempt to link the ILF to the outside world in the earlier stage of the project. When the grant proposal was prepared, the former PI sent out letters to the State Department of Education, the State Teachers Association, and the State Professional Standards Board and received supporting letters from those institutes. These educational institutes were very much in favor of the project. However, these initial attempts to form links with other professional organizations faded as the ILF project proceeded. As to missing connections with other institutes and schools, DE3 said the following:

The Principal Investigator [DE1] is a relatively young faculty member. He hasn't been here very long, and he hasn't met or established a lot of relationships with teachers in the area. [Also] historically, the [University] School of Education has a poor history of working with teachers in the area...I think that not having a network of teachers that the school has been interacting with and working with over a number of years has really limited our ability to get people involved.

While summarizing comments from another PI, DE8 pointed out in an interview that, “we are trying to do something innovative, something that very few teachers are searching for, and there’s not much official institutional backing behind it.” There was not even a link in the ILF, for example, to the State Department of Education, which is closely related to the teachers’ professional lives and which would have improved the site’s “institutional legitimacy.”

It was not until the PAB meeting in the summer of 2002, which was held a few months before the end of the grant, that many people from professional development organizations were invited, in order to ascertain their input regarding better ways to support teachers’ professional development. Participants in this meeting emphasized that schools and teachers are currently faced with higher accountability for general school improvement and teachers’ professional development because of PL 221. This law specifically requires professional development plans to be matched with schools’ improvement plans.

Another tension related to Boundaries occurred a few months after the ILF was launched. This had to do with the membership of school principals. In the first PAB meeting in 1999, teachers indicated that they did not want to allow principals to have membership for fear of being judged; that is, their videos and postings could be used as evaluation tools. This seemed to reflect the reality of a stiff relationship between teachers and their principals. The principals were perceived by the teachers as having the roles of supervisors rather than facilitators or stewards.

In the RAB meeting in 2000, the participants continued to raise questions about the potentially negative effects that might result from the unregulated interaction of administrators. However, the teachers were largely in favor of opening the ILF door to principals. DE1 asked, “How do we get...support from administrative folks unless we show them [what we’re doing]?” Another teacher commented, “they come in and look at what we’re doing any way. Administrative involvement may spread word of it.” However, TE6 said that she was still in the “middle of the road;” that is, she thought teachers would be uncomfortable with expressing themselves if principals looked in and watched videos. But she also acknowledged that they are all educators, and that principals also want to know what their teachers are doing. Yet, TE3 seconded the objection, saying that involving administrators “could be a threatening move to a lot of people.”

This issue of whether or not to permit administrators/principals into the ILF was then asked of the ILF community as a whole in “an effort to make sure that they weren’t scaring people away,” as TE3 explained. The ILF team opened a time-bounded poll and a discussion (by the end of September 2000) entitled, “Should administrators be allowed to become members of the ILF?” There were only six postings, including two from the ILF developers. They all expressed positive reactions to the issue. The item passed. However, despite this measure and all the discussion, principal and administrator participation did not occur. Only two administrators registered on the ILF, and they posted no messages.

Bridging Communities within the ILF. As the ILF grew and became more diversified with many small groups, called Inquiry Circles, a question arose regarding how these groups could be linked to the bigger ILF. With permission required from the facilitator of the Inquiry Circle to join a Circle, the Inquiry Circles came to have their own boundaries within the ILF.

When the idea of the small group approach was conceived, according to DE4, there were two conditions those groups had to meet: 1) interest in inquiry-based learning; and 2) a willingness to share with the larger community. Contributions to the larger ILF community were expected from the Inquiry Circles. This rule was generally accepted. However, an incident occurred about a year later that illustrated that lack of trust and accompanying defensiveness could be easily excited among the teachers when the internal boundaries of their Circles were breached in a careless fashion.

In this instance, a comment was posted in a Circle discussion forum from another ILF member who was not a member of the Circle. The message was subsequently interpreted as a slight by the one of the Circle members. This situation was quickly resolved by an emailed apology sent on the following day. Apparently, the problem had been caused by a simple lack of “netiquette” on the sender’s part, which resulted in a wholly unintended negative reaction by the Circle members. Though this was an isolated and rare sort of incident on the ILF, it did subsequently raise the issue of how to conduct respectful and mutually beneficial communication between small groups and outer-members within the broader ILF community.

Conclusions

The main question that this research study set out to answer was “what are the design dualities that emerged when teachers and designers worked together to build a Web-supported community of practice?” Those design tensions, like the Chinese word “wei-ji”—which can mean both danger as well as opportunity, were like a double-edged sword. If tensions interplay dynamically and are well-balanced in their context, then those tensions may provide new opportunities. But if the tensions are not well managed, then they could be detrimental and might cause malfunctions in the system.

In the ILF, the design tensions entailed both opportunities and dangers. In some cases, dangers—in the form of frustrations or challenges—threatened the survival of the ILF. Overall however, as the term “dynamic” indicates, they were more like catalysts that triggered and created a wide range of opportunities. The ILF community members were thereby enabled to actively engage in dialogues that contributed to not only useful design changes in the ILF, but also to the participants’ learning together. These changes have resulted in a set of technical structures that have proven most useful in the context of the teacher preparation program, in which participation is mandatory.

Reflecting more generally, the duality “design for v. design with” may offer the most potential for overcoming the challenges faced by the ILF in being thoroughly adopted by in-service teachers. The application of a broad framework of participation could have provided the ILF designers with opportunities to better understand the teachers’ culture. One has to have an arena to informally test an idea in order to better match it to particular cultural contexts. Perhaps the design of an online or Web-supported community, being such a complex dynamic process, must always entail elements of “serendipity or discovery.” This seems to be the nature of community formation and a part of creative design. This process involves tentative interpersonal dialogues that need to be open and whose members are willing to negotiate. To create a Web-supported community as a vehicle for education reform is not to build a single technical tool, but rather to create a socio-technical network. The design paradigm of a tool oversimplifies the underlying dynamics and contextual issues, and eventually results in the naïve view that “if we build, they will come.”

While engaged in this study, we encountered the following areas or topics that require further attention. As was implied in many comments from the participants in this study, there is an underlying construct that influenced teachers’ participation in the ILF and eventually contributed to the emergence of those dualities between the teachers and the ILF designers. This construct is the teachers’ culture. An in-depth study of how the teachers’ culture influenced the emergence of these design dualities should be conducted as a preliminary by any designer who wishes to create an effective CoP to support teachers’ professional development. We offer this manuscript as an illuminative case study, highlighting particular challenges (dualities) that others might confront and, hopefully, with foresight may effectively balance so as to stimulate meaningful participation.

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