Online Teacher Learning Communities:
A Literature Review

by

Herbert Wideman

June, 2010

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Abstract

This paper provides a review of recent research literature examining the use of online teacher learning communities to support teacher professional growth. It focuses specifically on what the findings from these studies tell us about the conditions, processes, and structures that foster the development and sustainability of successful, effective online teacher learning communities. The paper begins by considering what constitutes a teacher learning community (TLC), and then outlines the rationales that have been offered for developing teacher learning communities as part of teacher change efforts in light of recent shifts in thinking about what constitutes effective teacher professional development. It then discusses the limitations of the literature on online TLCs and the generalizability of its findings to the ABEL context.

The following section of the paper presents a synthesis of the findings from the reviewed studies. The presentation of these findings has been organized by several categories emergent from the literature concerning the conditions, components, and supports needed to develop successful online TLCs that can foster reflective dialogue and the reform of teaching. The operational strategies and resources that the studies indicate are requisites for community success are discussed under their relevant category. These categories include the development of a shared, meaningful focus of interest for the community; the building of intra-group trust and a sense of community identity, belonging, and ownership amongst its members; the provision of a rich set of resources to support sharing, reflection, professional learning, and teaching artifact development; and the need to offer multiple, complementary means for members to communicate with each other and to effectively facilitate that communication..

The final section of the paper addresses the implications of the reviewed research for ABEL's support of TLCs. It considers the relevance and significance of the research findings for ABEL in light of the challenges ABEL faces as it attempts to foster and sustain online TLCs, and provides a set of research-based recommendations for the structure, resources, and management of ABEL TLCs which if implemented should enhance their likelihood of success. It concludes with a proposal for further research designed to provide ABEL management with an empirical basis for deciding whether supporting online TLCs continues to be a worthwhile objective for the ABEL program.

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I. Introduction

Over the past 25 years, there has been a growing recognition that effective teacher professional development needs to incorporate opportunities for teachers to work together in furthering their professional growth. The utilization of various forms of teacher learning community (TLC) has become a common element in advanced inservice programs. These communities provide a venue for teachers to emerge from their relative isolation in the classroom and begin to collectively and critically reflect on their practices, and to develop a shared culture that supports risk-taking and experimentation with new ways of teaching. The more recent appearance of online and blended teacher professional learning initiatives which take advantage of the conveniences and affordances offered by the latest computing technologies has led educators and researchers to begin to examine how teacher participation in learning communities can be effectively incorporated into these new virtualized forms of professional learning. The literature review presented here examines what has been learned about developing and sustaining successful learning communities for teachers in online and blended professional development programs. It develops a synthesis of the major findings presented in the recent peer-reviewed research literature with respect to the contexts, conditions, resources, processes, and structures that have been shown to be needed to develop and sustain successful online learning communities that support teacher professional growth. In assessing the literature, certain key interrelated questions have been kept in mind:

- How can the development of the meaningful social connections required to foster community participation best be facilitated?

- How can deep and transformative reflective dialogue and sharing of practice be encouraged?

- What have proven to be the best technologies for sharing experiences and resources?

- What is the role of leadership both inside and outside of the community in fostering its success?

The review begins by providing a working definition of a teacher professional learning community, and then briefly summarizes the major rationales that have been offered for the inclusion of such communities in professional development endeavours. A brief analysis of the scope and state of the literature reviewed for this report then follows, and the implications to be drawn from this about the certainty and robustness of the findings presented in the following sections of the report are discussed. The presentations of the findings themselves are organized by several emergent categories developed from the literature regarding the key conditions, community elements, and supports that studies indicate need to be present for the establishment and maintenance of successful and productive learning communities in online and hybrid professional development initiatives. Subsumed under each of these categories is a review of the relevant research findings and a consideration of the implications of these findings for the establishment of successful online/blended TLCs (both in terms of the requisite conditions needed and the relative difficulty in achieving success where this is indicated by the literature).

In the following section, the paper presents a set of recommendations developed from the findings intended to aid ABEL management in selecting, designing, and developing the optimal tools, online spaces, services, and supports for promoting successful online/hybrid

TLCs. The paper concludes by outlining a possible direction for future ABEL research examining the efficacy of TLCs in the ABEL context.

What is a Teacher Learning Community?

The theoretical notions of what constitutes a professional learning community have largely been derived from or contrasted with the seminal work of Lave and Wenger on communities of practice (CoPs) (Lave & Wenger, 1991). A community of practice has been defined by these two scholars as a group of people working towards a common goal, who share a repertoire of practices, and interact regularly to develop that repertoire and transmit it to new "peripheral" community members. CoPs are largely focused on the development and transfer of cultural norms of practice, with new members engaging at the periphery of the group, learning and being acculturated through their interactions with more experienced group members, and evolving over time to themselves become more central contributors of expertise to the group. Lord and Lomica (2008) note that different communities can have unique characteristics but common to most are several dimensions:

- Spirit, a feeling that there is community to which members feel they belong and in which they feel accepted;

- Trade, the feeling that all members will mutually benefit from community involvement;

- Learning, that the community is used to actively construct knowledge and that the educational needs of its membership is being satisfied.

Some scholars make a distinction between communities of practice and learning communities. Where a teacher community of practice is seen as focused on acculturating new teachers into a repertoire of existing professional practices through the interactions of its members, a teacher learning community is focused on the cooperative development of new set of shared understandings about practice and the exploration of new practice alternatives (Helleve, 2010). Members of a TLC ask questions about their teaching in order to learn from and improve it, and seek guidance from outside experts and facilitators as well as the professional literature. Learning communities have more explicit learning goals and include guidance towards particular outcomes not found in communities of practice (Whitehouse, McCloskey, & Ketelhut, 2010).

Grossman and colleagues note that teachers in learning communities have responsibilities to their peers (Grossman, Wineburg, & Woolworth, 2010.) Their central responsibility is to contribute to the learning of other teachers, which might entail their contributing to group discussion and providing resources for others' learning. Critique must be engaged in to further collective understanding. As these and numerous other scholars have pointed out (see Wubbels, 2007), having teachers take responsibility for (or even contribute meaningfully to) the learning of their peers is a radical departure from the typical professional norms of private, autonomous practice that have remained dominant in K-12 teaching.

A useful distinction can be made between task-based learning communities that are devoted to the completion of specific tasks, and where membership is assigned and project goals are well specified with an emphasis on product output such as a unit plan, and a practice-based learning community geared towards a more general elevation of teaching practice such as might occur in group lesson study, in which teachers observe and critique each others' teaching (Riel & Polin, 2004). Another dimension used to differentiate teacher learning community types

distinguishes between open, informal communities which are member driven in that there are no external curricula or assessments attached to participation and the topics taken up emerge from member needs, and more closed, formal communities that are typically an adjunct to formal professional development initiatives or courses in which participation is mandated and which are subject to the imposition of externally specified foci for the communities' activities (Falk & Drayton, 2009).

Online learning communities for teachers have a number of additional attributes, in that they leverage the affordances of networked technologies as both the media and locale for conducting the social practices that constitute the life of the community. The nature of the technologies employed to support the online community can vary widely, but include the use of synchronous communication tools such as instant messaging, audio chat, or videoconferencing, and/or asynchronous tools such as discussion forums, email, or video sharing. They also typically provide for the sharing of cultural artifacts for mutual reflection and critique, through the use of a portal for the up-and downloading of teacher products such as unit and lesson plans and teaching video clips, as well as student work and other reference materials such as links to relevant literature, pedagogical resources, and jurisdictional standards. Finally, some online learning communities provide their members with access to specific technologies designed to aid in the generation of reflective dialog around practice, such as video journaling tools for documenting and commenting upon pedagogical strategies-in-use.

The Value of TLCs in Teacher Professional Development

Beginning in the 1980s researchers studying the effectiveness of teacher professional development practices began to realize that the traditional mode of inservice teacher training almost exclusively relied upon by school districts to promote teacher change was largely ineffective. (In the traditional mode, central administrators or coordinators dictate the focus and content of inservice training. It is provided on a one-time basis to groups of teachers, typically in a central facility either after school or on PA days, using a direct teaching method.) Participants in conventional PD rarely have any opportunity for meaningful interaction with either the speaker "expert" or their colleagues at the event, and no on-site followup of any type is usually provided. Studies looking for changes in teaching practice subsequent to this type of professional development nearly always found that such training modes (variously referred to as "transmission" or "sit-and-get" models) resulted in minimal and largely short-lived shifts in teachers' classroom strategies (Scott & Scott 2010). This model of PD operated on an assumption that proved untenable: that once could take teachers out of their workplace settings, transform them elsewhere, and then return them to an unaltered school milieu where they would work as independent and isolated actors to change their pedagogy (Grossman, Wineburg, & Woolworth, 2001). Models of this type are lacking in any systematic approach to the provision of in-context support structures to aid the transfer of learning into practice (Scott & Scott, 2010).

In light of the documented failure of traditional modes of teacher PD, new conceptions and approaches to teacher professional learning have emerged which view it as a long-term process that needs to include a planned sequence of regular opportunities and experiences in order to promote professional growth. This perspective can generally be characterized as having the following seven attributes (Lindberg & Ologsson, 2010, see also Lock, 2006):

1. It is based on a constructivist rather than a transmissive model of learning.

2. It is conceived of as a long term process.

3. It is seen as a process that takes place in a particular context (situated and embedded learning).

4. It is intimately linked to school reform.

5. The teacher is viewed as an active and reflective practitioner.

6. Professional development is seen as a collaborative process.

7. Professional development may look and be very different in diverse settings.

Most relevant to answering the question "Why professional learning communities?" is the reconceptualization of teacher PD as an active and reflective learning process in which the learning of participants is at least partly a product of their engagement within a professional group (Forsyth & Schaveriaen, 2005), and as a situated process in which a teacher learns through participation in an embedded context as opposed to passively and abstractly as in traditional workshops. This newer form of practice-oriented learning involves relying on peers, is based on real-time needs, and provides a tighter coherence and integration of the pedagogies being promoted to the concrete teaching situation, thereby linking theory to practice (So, Lossman, Lim, & Jacobson, 2009). Scott, in his review of the literature on effective teacher professional development strategies, finds empirical support for these new approaches to teacher learning (Scott, 2010). He specifies that for teacher professional development to be effective it must:

1. take a problem-solving orientation;

2. incorporate opportunities for teachers to work together, and with experts;

3. facilitate exposure to innovations in knowledge, teaching practice, and supporting technologies;

4. enable teachers to try out in whole new teaching strategies and skills;

5. promote the creation and sharing of resources;

6. enable ongoing and purposeful reflections and discussion.

A review of the literature on collaborative professional development by Cordingley et al. (2005) produced a very similar list of requisite conditions that emphasized the need to provide opportunities for shared reflection and peer support.

There is a considerable literature suggesting that the most effective forms of teacher professional learning are those that require teachers to engage in reflective practices, preferably through sharing experiences with colleagues similarly engaged (see Carr & Chambers, 2006). Teachers who regularly interact in social and professional ways with other educators have been shown to be much more likely to display the "professional hallmarks" of continuous inquiry and effective teaching than those who operate in isolation (Havelock, 2004).

A growing awareness of the necessity of making collegial interaction and shared reflection an integral part of teacher professional development has resulted in the emergence of models and programs for teacher learning that incorporate learning communities as an integral and critical component (Scott, 2010). These programs usually involve teacher teams working to improve student outcomes through a collective analysis of teaching practices and assessment strategies, using student achievement data.

How does participation in a community mediate effective teacher growth? Analyses of community activities and dialogues offer a number of answers to this question. Community interaction provides a space to clarify understandings about teaching and learning issues as they relate to an individual's practice, and to share dilemmas and successes. The sense of belonging engendered by community participation through discussions and chats can lead teachers to provide anecdotal evidence of successful practice change that encourages others to take new approaches. Perceived need and inspired motivation become the drivers of change, a finding which contrasts sharply with the demonstrated reluctance of teachers to implement change based on research or suggestions from outside experts (Lloyd & Duncan-Howell, 2010). Communities can provide a safe place to interrogate one's own practice and that of others, and to absorb new ideas and approaches over an extended period of time. Classrooms become sites for inquiry that feed back into the community discussions. As Lloyd and Duncan-Howell note, these learning practices are all criteria for transformative professional development.

Haythornwaite and colleagues, in reviewing learning community research, note a number of positive outcomes associated with learning community participation (Haythornwaite, Kazmer, Robins, & Shoemaker, 2004). The strong interpersonal ties that develop increase members' willingness to share information and resources, setting the stage for collaborative learning. These ties also increase the availability of social supports, the commitment to group goals, cooperation among members, and satisfaction with group efforts. Members benefit from the community by experiencing a greater sense of well-being, and having a larger set of colleagues to call upon for support in times of need.

Within a community of learners a gestalt effect can be observed in which the collective wisdom of the group greatly increases the ability to solve individual problems, since individuals with different backgrounds, skills, and experiences bring different insights to a problem. This process of "distributed cognition" builds the collective capacity for learning and action (Havelock, 2004). Collegial dialog focused on classroom activities and improving student learning has been found to be a key element of effective teacher professional development (Scott & Scott, 2010). Teacher community participation facilitates more teacher-driven and situated forms of professional development, in which teachers work together on problems of their own choosing that relate directly to their practice, rather than following a predetermined curriculum (Whitehouse, McCloskey, & Ketelhut, 2010). It also provides opportunities for mutual support and reinforcement to innovative teachers who might feel isolated in their schools or are experiencing animosity from other teachers who do not understand the innovations they are exploring (Barab, MaKinster, & Schekler, 2004).

Why Online Learning Communities?

The extension of teacher learning communities into online spaces is thought to offer several advantages for supporting ongoing teacher dialogue and reflection. Practical limitations on

teachers' time and their access to peers place severe constraints on their ability to pursue sharing on a face-to-face basis; the affordances offered by networked technologies for anytime, anywhere communication offer a means of transcending these limitations to some degree (Carr & Chambers, 2006). Virtual online environments offer both synchronous and asynchronous communication channels for mediating more democratic and mutually supportive forms of professional development and community, and in so doing can contribute to a reduction in teacher (and classroom) isolation. Web 2.0 tools and technologies can be used to support e-portfolio communities based on the collective generation of sharable artifacts (So et al., 2009). But for online community participation of the desired type to flourish, a cultural shift is required in which participants develop a mutual trust through their interactions in the virtual community, adapt to the limitations of theses new modes of communication, and shape practices that foster constructive exchange (Falk & Drayton, 2009). Effective teacher learning communities must also leverage the power of the technology to exploit distributed knowledge by utilizing multimedia tools to develop and share teaching artifacts and resources.

Online Teacher Learning Communities: The State Of The Research Literature

While online TLC initiatives have been underway for more than a decade, the research base in the area remains very limited. As Kirschner and Lai noted in 2007 (and it remains true in 2010), there is a wealth of literature that explores the theoretical and conceptual issues related to teacher online communities, but very few empirical studies have been undertaken to document how they work and how they can be sustained in practice. Insufficient evidence exists to reliably describe the formation and perseverance of active communities with engaged members, or to provide a recipe list of prerequisites for community success with full confidence (Evans & Powell, 2007). Only a few online communities have been the subject of detailed research, and virtually all of that research has been qualitative in nature, consisting of uncontrolled case studies with data being collected through interviews with community participants, developers, leaders, and facilitators, as well as through the analysis of transcripts of computer-mediated community interactions. Very few studies reviewed here attempted to directly assess either changes in teachers' classroom behaviors as a consequence of their online community participation, or the impacts any such changes had on student learning. Indirect evidence of changes in teaching is provided in these studies, through their examination of teacher interactions, responses to relevant interview questions, and the nature of any resources they have shared with the community (such as teaching video clips).

A second limitation of the online TLC research which is of particular concern in assessing its relevance to the ABEL context is that nearly all extant studies have taken place in the context of professional development that is far more formalized and directive and less voluntary and "teacher-driven" than that offered by ABEL. Most of these studies investigate the use of online communities as an adjunct to either in-service courses mandated by school districts or states, or to pre-service and/or postgraduate university education courses, which may be either blended or wholly online. These differences in context can make generalizing from such studies to the ABEL case problematic, as the strategies and structures that promote effective TLCs under these conditions may not be as efficacious in the more informal context in which ABEL operates.

The scope of the literature review

As the present review was intended to be small-scale and highly targeted, the parameters set for the literature search were narrowly defined. The principal database for peer-reviewed educational research, ERIC, was used to search for published articles, edited volumes, and conference papers that addressed the design, development, and/or use of online TLCs in any form of professional training or development from 2005 to the present. Given the time available for the review, it was decided that this more recent literature should be given priority as it would be more relevant to the current ABEL context, given the rapid advance of technology saturation in K-12 education over the past decade and the concomitant growth in teacher comfort and competence in using technology for learning, communicating, and teaching. In addition, certain older key references cited in the retrieved articles were themselves retrieved for study. In the end, approximately 70 individual papers and six edited volumes of papers were located for review; many of these papers were solely conceptual or theoretical, but the majority did present research findings, which varied widely in quality and relevance. Much of the research literature focuses on a few major implementations of teacher learning communities, primarily in the United States. In the review of the findings that follows, each of these communities will be described in some detail when first mentioned to provide a context for situating the findings from that community as they are presented throughout the report.

II. Research-derived Principles for Building and Supporting Effective Online TLCs

Developing a Community Focus

Members of successful learning communities demonstrate a shared focus and common purpose in their community activities. Members interact within a well-defined domain of interest to foster mutual growth (Carr & Chambers, 2006). This development of a common focus has been found to be a key requisite for success in all of the reviewed studies. How is that focus to be achieved in online TLCs? The evidence to date suggests that the single most significant determinant is the perceived clarity and relevance of the community's purpose and objectives. Without a clearly defined set of goals that are seen to directly address the participating teachers' intrinsic needs, online TLCs are likely to fail. Teachers are unlikely to allocate precious time to activities for which the purposes and/or benefits are unclear. (Carr & Chambers, 2006). Generic online communities are less likely to succeed than those that specifically target groups of teachers with common needs and interests. It cannot be assumed that a common purpose will simply evolve in a community (Lock, 2006). Community goals and activities must be contextualized in authentic situations and presented in a manner that makes them relevant to the actual practices of teachers in their classrooms (Kayler & Weller, 2007)

Research undertaken on the Inquiry Learning Forum (ILF) (http://ilf.crlt.indiana.edu/), a large online TLC based at Indiana University, clearly illustrates the criticality of being responsive to teachers' perceived needs. The ILF, probably the most extensively studied online TLC to date, is a web-based resource for teacher professional learning that offers its teacher community a range of resources and tools for creating, sharing, and improving inquiry-based pedagogical projects and practices. Teachers can virtually visit each others' classrooms through the use of web-based video to observe and discuss approaches to teaching math and science topics and to share artifacts. In these virtual visits, teachers get an overview of the lesson context, the lesson plans, examples of student work, and connections with state and local standards. They also hear or read the presenting teacher's reflections on the lesson. There is a discussion area within each classroom page where teachers can engage in dialogue with each other regarding that lesson or pose questions to the presenting teacher.

In addition to its virtual visits, ILF offers a virtual auditorium for viewing videocasts by guest speakers and a related forum for interacting asynchronously with the speaker; a lounge for more general non-class-specific discussions and real-time chats; a personal space (my desk) to bookmark resources, discussions, and classroom visits of personal interest and track discussion threads in which they have been participating. There are also ILF portal areas for obtaining help, providing feedback, and volunteering to assume a leadership role; a news section; and a resource library for software, classroom tools, and relevant documents and reference materials.

The ILF was designed to enable sharing among community members at various stages of development. It offers each participant an environment in which, through observation, discussion, and reflection, they can find their own path to continued professional growth (Moore & Barab, 2002). While some ILF participants are enrolled in pre-service courses at Indiana University which mandate the use of ILF, many are practicing teachers that are participating on their own time and without any support or involvement from their local schools or districts.

The focus of the ILF community was initially developed by the academics who instigated the ILF, and in their initial design they incorporated long-playing classroom videos chosen to illuminate all aspects of the inquiry-based transformation in pedagogy that they were advocating. However they soon found that these long videos received little extended use or sustained viewing; interviews with teachers indicated that they found watching long videos of peers engaged in inquiry teaching was overly time-consuming (Barab, 2006). Being part of a reflective community built around the study of these videos held little appeal; what teachers wanted was access to content that was directly and immediately useful in their teaching (Baek & Barab, 2005). "Even though teachers involved in the [ILF] 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" (Baek & Barab, 2005, p.169). Focus groups confirmed that to gain teacher participation, the ILF would need to more directly target their perceived needs than did the topics then being provided for discussion. Initial ILF participation rates by the 320 practicing teacher members were quite low, with only 14% visiting the ILF portal site five or more times in its initial year of operation, and 18% posting five or more messages that year (Kling & Courtwright, 2004). An analysis of forum content revealed very little critical reflection in teacher postings.

Acting on this data, the designers moved away for structuring the ILF as a general professional development project that sought to develop a broad if ill-defined online inquiry learning community to one more sharply focused on supporting student and teacher inquiry in specific areas of expressed teacher need, through both its portal and the associated workshops that they began to offer. The ILF funded release time for teachers to participate in workshops and also provided for the acquisition of class science tools, and it shortened and segmented the class visit videos to target them more specifically to different interests. The change subject to the greatest level of internal debate was a decision made to support daily practice through the addition of lesson plans; it was thought that doing so would generate more participation in the community, although some of those managing the project feared it would degrade the purpose of the ILF, which was to provide much more than a location for downloading lesson plans. A clear tension emerged between putting forward a sustaining a research-based reform agenda for professional development while at the same time addressing the needs of teachers on a day-to-day basis (Baek & Barab, 2005). The former requires extended participation in efforts at practice transformation, including multiple "virtual visits" and extended participation in dialog before a teacher begins to reap any tangible benefits. Expecting this commitment from teachers without making salient the utility and practicality of what is being demonstrated and the changes being sought may be "too idealistic" according to ILF researchers. The research team concluded among other things that even though a teacher may be experiencing a disequilibrium in their practice that makes them want to learn new teaching strategies, supporting their reform through community participation remains a challenging process (Scheckler & Barab, 2009).

To provide additional focus and purpose for teacher participation in the ILF community, designers added support and structures for smaller private workgroups or subcommunities within the larger ILF space where groups of teachers wishing to investigate a particular topic, a common experience, or a specific pedagogical focus could work together. (The ILF designers had been reluctant to do this initially, fearing that the community would fragment and thus never truly materialize (Moore & Barab, 2002)). Tools that these so-called "inquiry circles" could use to collectively construct documents, gather relevant resources, and engage in private discussions and chat were added to the ILF; these circles have proved to be a very successful

innovation and the most effective means for generating dialogue. These small groups increase member buy-in by focusing on bounded issues of high personal relevance, creating a common ground for more meaningful interaction. Dozens of inquiry circles have emerged over the years, although the challenge of getting these smaller groups to contribute back to the larger ILF community remains problematic (Barab, MaKinster, & Schekler, 2004). Topics brought to the circles by the teachers themselves have proved more popular than those introduced by systems designers.

Researchers studying other online TLCs have also found that communities focused on purposes perceived as relevant by participants engender greater levels of meaningful participation. In one study in which teacher practices in the classroom were observed, primary teachers participated in a blended science teaching professional development project in which they worked together as a community using online communication to generate and explore new approaches to the use of ICT in science education (Rodrigues, 2006). Cohorts worked in teams with experts to develop resource materials involving technologies used in their classes. They met face-to-face once a month and worked together online at other times. Analysis of observational and interview data revealed that teachers were able to effectively reform their practice in desired ways. One of the key factors in promoting change was found to be the teachers' perceptions of the direct relevance of the tasks undertaken to their classroom; this galvanized them into taking ownership of their personal professional development. They valued the development of relevant resource materials for immanent classroom use, and this contributed to changes in their practices.

Similar support for the motivational impact of offering activities perceived as relevant on community participation can be found in a study of the use of Oracle's ThinkQuest environment for supporting community-based teacher professional development. In this investigation, a blended learning program for teachers employed a communal and constructive approach to learning in which teachers dialogued and worked together to build new practices. Teachers chose projects to pursue driven by their own needs and contexts; this motivated their investment of time and effort into their projects. (Participation in the program was voluntary and was not tied to any formal certification or degree program).

The Math Forum (mathforum.org), the preeminent community forum for math teachers in North America, brings together math teachers, students, mathematicians, and researchers, and offers a wide range of services, tool, discussion areas, and online activities and courses for math educators. Several years ago it undertook a project entitled "Bridging Research and Practice" that studied the collaboration of teachers and Math Forum staff as they worked online and face-to-face over a three year period to read and think together about the applications of research on mathematics learning to their work with students and to write a "video paper" that describes their insights from their readings and their classroom applications. The project proved successful in expanding both the participating teachers' understandings of mathematics teaching and their capacity to contribute to and collaborate as a community (Renniger & Shumar, 2004). Two of the keys to its success were the provision of rich meaningful content to foster reflective discussion and the connections made by staff between the activities in the project itself and participant interests.

Building Community Trust

Creating a community in which teachers are willing to engage in critical dialog about their pedagogical practices, whether that community be online or face-to-face, requires that a culture

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of mutual emotional support, empathy, and trust be established among the participants (Baek & Barab, 2005; Lock, 2006). Teachers do not collectively come into such a culture of trust and mutual support spontaneously (Barab, MaKinster, & Scheckler, 2004). In nearly all cases, teachers' pre- and in-service training and the institutional structuring of their teaching practices acculturate them to assume an individualistic and autonomous orientation in their professional activities. Isolated in their classrooms, they are reluctant to share their practices with unknown colleagues for fear of exposing any possible lack of skill, and are equally uncomfortable about criticizing the teaching methods of their peers in public or semi-public spaces (Baek & Barab, 2005; Barab, 2006; Scheckler, 2010). These attitudes and inclinations are well documented in the teacher interviews and observations of forum dialogues analyzed in studies of several online TLCs. ILF researchers have explored them in some depth (Baek & Barab, 2005; Barab, 2006; Schekler & Barab, 2009), and have found that critiquing becomes especially difficult when participants do not know other members of the community or have not met them in person. Even when the teachers did know their fellow community members, they were worried that critiquing these peers would damage friendships. Teachers also expressed a fear of being critiqued in a space where the criticism could be permanently recorded. The problem of developing meaningful discussion was to a large extent a problem of defusing the perceived threat of sharing so that teachers would come to trust one another enough to risk making mistakes, revealing problems in their practice, or critiquing another's teaching.

In his research on an online community supporting the infusion of ICT into elementary science education (discussed above), Rodrigues (2006) found that the partipating teachers also saw psychological risk in opening their understandings and professional skills to colleagues'' scrutiny. A study of the use of a community forum as part of a blended professional development program for 16 teachers from eight schools found that online community participation was negatively impacted by the difficulties teachers reported in developing trust when they had little prior engagement with other participants in the forum. They wanted background information on contributors' personal experiences and perspectives on concepts and ideas (Prestridge, 2009). Suggestions made were sometimes misconstrued as criticism, which would block further reflection.

Teacher fear of embarrassment was instrumental in quashing collaborative work in a study of the use of Sakai to support dialogue between teachers and consultants in a school district (Wilson & Christie, 2010). While other factors contributed to the negative outcome, such as lack of time and inadequate technology skills, teacher hesitancy in presenting ideas and examples of their practice for fear of embarrassing themselves or their schools through exposing their lack of skill was found to have a major impact on participation.

Lack of trust can result in the development of what Grossman and colleagues have termed a *pseudocommunity*. Where true communities are distinguished by "an authentic sense of shared communal space", pseudocommunities consist of individuals interacting in ways that are focused on impression management; participants work to project an image of competence without revealing anything that could challenge that image (Grossman, Wineburg, & Woolworth, 2001).

Establishing support and trust within an online group is particularly challenging as a group's channels of communication (typically email, forum postings, and online chats) deny the use of modes of human expression that are normally central to forming social bonds in face-to-face contexts—speech inflection, facial expressions, and other non-verbal cues (Carr & Chambers,

2006). Various approaches have been used in virtual communities to address the building of trust under these constraints. One has been to use a range of strategies to induct new members into a community in ways that establish their social presence. At the ILF, for example, site facilitators individually welcome new members, giving suggestions for starting out and offering any support needed (Baek & Barab, 2005). At the Math Forum, interactive services are offered to scaffold participants into feeling welcomed, to being heard, and to be taken seriously as learners (Renniger & Shumar, 2004). In interviews, participants indicated that the development of a sense of social identity online was necessary, as it allowed them to feel a sense of belonging. They also needed to have a sense of who those they were interacting with were.

Helping community members establish a social presence and furthering community sociability are considered vital factors in building a sense of community and trust. Social presence is built up by projecting personal characteristics into the community and its discussions in ways that make these salient to other community members. At the ILF, a "my profile" area was created for each member to help establish personal identities for the participants, and this together with the induction supports ILF provided enabled users to interact more comfortably. They were then better able to share ideas and co-develop teaching materials (Baek & Barab, 2005). Other design elements added to enhance sociability included creating a club-like feeling to the ILF web sites, partly by incorporating user rituals and roles and having members earned privileges from participation (although the researchers do not spell out the specifics of how these strategies were implemented). The ILF researchers concluded that "the maintenance of sociability is one of the biggest tasks of a successful online community of practice" (Barab, MaKinster, & Scheckler, 2004).

A study of community moderation (discussed in more detail later) found that socializing was considered by participants to be the essential "glue" keeping a community together and that it needed to be greatly valued. It was seen as giving people confidence to talk to one another and to humanize community interactions. (Seddon & Postlethwaite, 2007).

Another large online TLC, Tapped In, encourages members to build up a "persistent place and identity" through a virtual office space provided for them. Tapped In is an online community for teachers in which they can engage with colleagues, reflect on practice with them, and share their expertise in a distributed knowledge context. The goal of the program is to build a common understanding of new instructional approaches, standards, and curriculum. Using their virtual offices, members can share documents, post messages, and conduct chat-based meetings. As of the mid-2000s it had over 2000 members and a steady rate of growth. Research indicates that many members develop trust in the community and develop their sense of professionalism as educators as a result of participating (Havelock, 2004). Tapped In managers found that the provision of "multiple, explicit, and nonthreatening opportunities for individuals to establish their identity in the context of the community's group values" was central to building member trust.

One community design strategy almost universally employed to reduce the psychological barriers to community participation is the deployment of small subgroups within the community that are private in the sense that only subgroup members can see and contribute to their discussions. It was thought that these more intimate groupings would foster a franker level of exchange that explore the "backstage" of the teaching profession and its issues and dilemmas (Falk & Drayton, 2009). These smaller groupings make it easier for members to

collectively determine their objectives, and when subgroups are provided with a customizable resource gateway it can make intra-group resource sharing around a common focus much easier. This approach was used with considerable success by the ILF when it realized that its larger community-wide discussions were not drawing in significant numbers of participants. In their "inquiry circle" subgroups, typically limited to around 20 members, individuals had a better opportunity to establish a social presence with others and increase the level of intra-group social cohesion that fostered meaningful professional dialogue (Baek & Barab, 2005). By 2006, 80% of the tens of thousands of postings to ILF forums had been made to these private groups (Barab, 2006). Working with a more homogeneous group of like-minded colleagues has been shown to ease the transition to productive interaction in other communities as well (Grossman, Wineburg, & Woolworth, 2001). For example, in the study of the use of the Sakai LMS mentioned earlier (Wilson & Christie, 2010), teachers participating in the TLC favoured the use of smaller "cluster-level" communities. Smaller groups also allow for tighter membership self-determination; many groups of teachers will for example choose to exclude school administrators from participating, to increase the level of trust and foster frankness and risk-taking (Baek & Barab, 2005).

The last strategy for building trust and sociability that was been very widely employed with apparent success developed in response to mounting evidence that bringing new TLCs into being as wholly online entities from the start has not a been very successful approach (Kling & Courtwright, 2004). There is considerable consensus in the literature that efforts at fostering online community are more effective when directed at leveraging and extending prior community-building work done in face-to-face contexts to online environments, as face-to-face meetings if properly designed offer several communicative advantages that increase the likelihood of establishing high levels of sociability, trust, and belongingness in relatively short order. Teachers report difficulty in developing trust when they have had little prior engagement with other online community members (Prestige, 2009), and express a need for co-present contact before engaging in online discussions (Barab, MaKinster, & Scheckler, 2004); initial face-to-face meetings provide opportunities for that engagement. In the ILF, on-line risk-taking and engagement was encouraged by the trust fostered by participation in small, focused forum groups, particularly when the online exchange was preceded by face-to-face meetings of the group (Scheckler & Barab, 2009).

The interspersing of face-to-face meetings with online community activities in a blended approach has proved more consistently successful in fostering productive and fruitful online communities than has a fully online model. In fact nearly all of the successful online communities discussed in the reviewed literature either incorporated face-to-face elements into their design from their startup date or soon came to do so when they determined that co-present events were needed to build community sociability, trust, and focus (e.g. Cuthell, 2010; Hlapanis & Dimitracopoulou, 2007; Pachler, Daly, & Turvey, 2010). In the blended science teaching professional development project researched by Rogrigues (2006) discussed earlier, the cumulative support provided by complementing online dialogs with monthly face-to-face meetings was considered extremely important by the participants. Teachers valued the monthly meetings for keeping the momentum of their work going, and for building and maintaining relationships. Other studies have provided similar findings regarding the perceived value of the synergy between face-to-face and online discourse (e.g. Cuthell, 2010; Pachler, Daly, & Turvey, 2010; Prestridge, 2009; Renniger & Shumar, 2004; Scott & Scott, 2010). In the study by Prestidge, for example, teachers indicated that their idea of community was closely linked to their development of relationships with colleagues, something they considered more easily

accomplished through face-to-face meetings. Prestridge noted that where the development of common understandings of a complex concept has to be established in the group, this may be more effectively achieved in face-to-face meetings prior to online exploration of the concept. It cannot be assumed that teachers coming into a community will possess enough mutual knowledge to drive each other's growth (Wubbels, 2007). Initial face-to-face meetings provide an opportunity to lay down a common knowledge base for further exploration and interrogation.

When the IFL realized that their initial online efforts to generate reflective dialogue had not been effective, they decided to address teachers' reluctance to be critical by providing opportunites for face-to-face interactions through workshops and demonstrations for their overall memberships as well as for the smaller inquiry circles (Moore & Barab, 2002). They found that establishing mutual trust without initial face-to-face experiences was much more problematic (Scheckler & Barab, 2009), and came to acknowledge that sociability needs have to be addressed by creating more co-present opportunities that can be supported and integrated with solely online participation. Their greatest successes in generating online reflections and interaction have occurred when the ILF has served as an extension of face-to-face workshops, meetings, and classes, or when they brought together individuals that had previously interacted only online and allowed them to develop relationships outside of the virtual (Barab, MaKinster, & Scheckler, 2004).

Providing a Rich Resource Base

The provision of high quality resources to a TLC has proven important to stimulating productive teacher dialogue. These resources have taken many forms in online and blended community projects: release time for online and face-to-face participation, professional learning materials ranging from research summary collections to pedagogical and technical guides, training and classroom videos, guest speakers, external experts, classroom teaching resources such as unit and lesson plans and multimedia materials, technology tools, and links to a wide array of external resources. The provision of time for teachers to reflect on practice, to participate in community activities, and to take responsibility for their own learning has been an important resource for increasing participation in many TLCs (Lloyd & Duncan-Howell, 2010). In instances where community participation has not been meaningful, a lack of provided time has been cited by teachers as a major reason (Wilson & Christie, 2010). It takes considerable time for teachers to see how colleagues have made use of technology in a strategic and transformative way and to then begin to do so themselves. And where the intent is to utilize community to support teacher co-development of professional learning or teaching resources, such as annotated classroom videos or lesson/unit plans, time becomes an even more vital resource. When undertaking such tasks, teachers highly value the opportunity adequate release time gives them to work with colleagues over a long period on a regular basis (Rodrigues, 2006). It allows them to share ideas and lessons, gain insight into what is happening at other schools, share lessons, and hear different points of view about experience.

The provisioning of resources for a teacher community has been demonstrated to require a careful balance, ensuring that the materials being utilized by the community are of acceptable quality and that they support its goals without dampening the creative enthusiasm of contributing members or limiting the community's self-determination (Baek & Barab, 2005; So et al., 2009). On the one hand it is important not to raise barriers to contribution in ways that inhibit participation, but at the same time there must be some oversight to maintain the caliber of the resources at a level that will support good practice. Creating opportunities for

teachers to share resources they have found useful, whether self-developed or not, is an important community design objective; it has been found that teachers place the greatest weight on recommendations from peers (Drayton, Obuchowski, & Falk, 2009). Testimony from a colleague that he or she has found a particular article or tool valuable to his or her work shared within an active community can go much further in fostering change than suggestions delivered through more formal channels such as recommended reading lists or mandated workshops. Communities need to support such informal resource sharing through the provision of easily usable and well-indexed resource libraries where community members share reports, teaching activities, and lesson plans. Collaborative work tools such as Elluminate or Abobe Connect Pro need to be provided to support co-development of resources. Not only do these development activities produce valuable materials for other teachers to use, the cooperative work required for their design and realization creates social and collaborative ties that build and maintain community solidarity (Drayton et al., 2009). And given the proper resource support, teachers value creating relevant resource materials for immanent classroom use in tandem with developing their teaching skills, as was demonstrated in the blended science teacher professional development project researched by Rodrigues (2006). In a blended professional development program that had teachers from schools across a district work collaboratively to design and implement classroom inquiries into the effects of introducing new ICT-enhanced teaching strategies, where the teachers were supported in a community of inquiry through participant blogs and shared online spaces, group discourse was found to be central to teacher learning, and collaborative group work an effective vehicle for learning (Pachler, Daly, & Turvey, 2010). The face-to-face components of this program were critical to its success, but so were the online activities of the community, which led to co-constructivism among participants becoming a widespread practice. (The research team also found that staff facilitation as well as funding for release time was required for the teachers to benefit from the full spectrum of social and technical collaborative options offered, and could function effectively as a community.)

A few online TLCs have made use of classroom videos as a major resource for stimulating reflective discussion and fostering changes in practice, including the ILF, Knowledge Networks on the Web (KNOW), and the Math Forum (Beardsley, Cogan-Drew, & Olivero, 2007; So, Loss, & Lim, 2009). These communities typically post segmented and indexed video of expert classroom teaching that are either developed by the community management or contributed by community members. The video package as uploaded usually incorporates commentary from the demonstrating teachers, documentation of the lesson plan and the related curriculum standards and expectations, and embeds facilitative materials intended to foster viewer discussion. Questions meant to generate reflection are directly linked to forum threads so as to remove any operational impediments to visitors' contributing to the relevant community discourse.

Ensuring that proper support for discussion is offered has proved vital to the successful use of video resources as a stimulus for dialogue. In its initial interaction, the ILF found that despite high levels of visitation its videos were not fostering the desired level of reflection, so changes were made to incorporate questions for the audience in the text reflections and commentary provided by the videotaped teachers about their lesson (Moore & Barab, 2002). These questions ask for feedback and suggestions on very specific aspects of the lesson and are linked directly to discussion forums. They are deliberately designed to provide an easier entry point into discussions around teaching than a general discussion forum offers, and give users a specific reason to begin engaging with the community. The questions serve a second more

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oblique function: by indicating an openness to critical reflection on teaching on the part of the "host" teacher, they foster induction into a culture in which such reflection is accepted practice. The stance of being open to suggestions and recognizing areas of potential improvement are modeled for community members, helping to develop a community of "critical friends" who seek to mutually support each other in improving their teaching through reflective dialogue. And by linking these teacher questions directly from the host teacher's text reflections to the discussion threads, the discussion forums themselves are made more visible, accessible, and salient.

The ILF has employed a "gradual release of responsibility" approach to the creation of classroom video visits. Initially it provided all of the personnel and resources needed to create and select appropriate videos, generate the needed auxiliary materials and resources, and develop the community web page for the visit. It has since worked to move the responsibility for these tasks over to the teachers themselves by loaning out the needed video equipment, providing the requisite technical tutorials and software, and developing templates to guide teachers in preparing the needed auxiliary resources. Prompts to guide teacher reflections, exemplars of quality reflections and commentary, and questions that provide direction for selecting appropriate video clips are all provided (Moore & Barab, 2002).

A few research and development groups have created specialized software tools that integrate all aspects of the virtual classroom visit into a seamless whole for the end user in a manner intended to foster teacher reflection and community discussion. VideoPaper Builder is one such multimedia tool (http://vpb.concord.org/). Originally developed as part of the "Bridging Research & Practice" research undertaken by the Math Forum, it makes possible the synthesis and synchronization of different media, including text, video with overlay and/or captioning, and images, into one cohesive document. Digital video can be annotated with text or images on a synchronized track. Viewers can either read the text and then click on the author's "play" buttons installed within the text to play the linked video clips, or watch the video and click on the "link to text" buttons that appear within the video at relevant points to see the related text. Lesson content, plans, and the underlying pedagogical theory can be incorporated into the classroom video in this way. The intention is to ground and situate the discourse of research and theory in authentic classroom practice. The process of creating a video paper itself is intended to foster teacher learning by promoting a deeper intellectual and analytical involvement with one's teaching, leading to a greater understanding of the relationships essential to effective teaching (Beardsley, Cogan-Drew, & Olivero, 2007). When VideoPaper Builder was used with a small group of secondary mathematics teachers in one school over six months to document and improve their team teaching practices, it was found to play a major role in supporting the creation of content and enhancing teacher engagement in communal activities. It also served to make explicit the teaching decisions and assumptions being made in the classroom. Its use stimulated the teachers to redesign their teaching practices, and to mediate changes in those practices (as evidenced by classroom observations) (Hauge & Norenes, 2010). The researchers contend that their findings provided clear evidence of the importance of a community approach to fostering change.

A similar tool was developed in prototype form (with considerable input from practicing teachers) for potential use in a Singapore online TLC (So et al., 2009). The teachers involved in the design process made it clear that the tool needed to have specific affordances to be useful as a professional learning resource: it had to generate downloadable as opposed to streamed video, to avoid the viewing of low-quality and interrupted audio and video; facilitate the

creation of short, carefully edited video segments that quickly capture the essentials of practice and new ideas; provide a search function for quickly locating segments by subject area, grade, and topic; give confidential access to registered users only; and afford opportunities to create personal library and bookmark lists. The teachers also requested the provision of ancillary materials derived from interviews of those teachers contributing the videos to answer such questions as how long it took to prepare a lesson, what preparations were necessary, and what difficulties occurred and/or improvements might be made in the lesson. From this input, the designers developed a prototype, using the Blogger service for delivering the video and related text materials, and employing the Google Video service for uploading and storing the videos. RSS feeds were used to update community members when new videos were posted.

Other innovative tools are also being explored to support community-based professional learning in online environments. The Personal Learning Planner (PLP), an online e-portfolio tool for teachers and teacher candidates, has been created to facilitate critical reflection around teacher portfolios as they are developed. It assists teachers in planning, creating work samples, documenting teaching, and validating the achievement of learning goals (Havelock, Gibson, & Sherry, 2007). It incorporates tools for creating surveys, developing standards and rubrics, organizing uploaded work by those standards, informing and communicating with learners and advisors, and creating a web-based portfolio product. The PLP can be used both for professional development and as a tool for managing and advising student project work. The capacity of this tool to provide a diagnostic assessment of work in progress was valued by teachers and teacher candidates participating in an online learning community, and member learning was extended through the ongoing reflection and dialogue the PLP structure facilitated. It proved to be an effective support through a range of community activities, as teachers discussed challenges and approaches, conducted action research, shared results, and co-developed rubrics. But the researchers found that the simple availability of the tool was not sufficient to ensure its productive use. Existing conceptions about the utility of portfolios and content standards first had to be interrogated, as prior institutional practices and community member experiences strongly influenced initial engagements with the PLP. Potential users had to be persuaded of the viability and relevance of a new way of doing things using the PLP, and new norms for interacting and critical sharing had to be established. It was found that high levels of personal support and an upfront personal investment of time and effort on the part of community members was needed to develop the self-sustaining engagement with the tool that led to learning benefits.

Certain Web 2.0 social networking tools have been promoted as resources with the potential to enrich the activities of TLCs. These emergent technologies are seen as effective mediators and supports for the social learning strategies employed in learning communities, and throught to offer affordances for enriching the lateral, informal, and autonomous networking TLCs are designed to promote (Evans & Powell, 2007; Scott & Scott, 2010). Social bookmarking, for example, can allow community members to contribute readily to a shared set of easily accessible resources. Shared e-portfolios can be used both to foster generation of and provide a space for the sharing of learning artifacts (So et al., 2009). Albion (2008) provides a description of community use of Web 2.0 tools in a graduate education course. Students were required to complete activities which included blogging, collaborating on document production using Google docs and spreadsheets, prepare a multimedia presentation using a Web 2.0 tool, use Trailfire to create a teaching resource, engage in social bookmarking using del.icio.us, and create a collaborative concept map using CMap Tools (Albion, 2008). All of these tools have clear applications for supporting TLC collective activities. Flicker, Animoto, Slideshare, and

Openmind are other tools that can potentially be used to support collaborative processes online (although currently there is no rigorous research available that validates their application in TLCs) (Pachler, Daly, & Turvey, 2010).

The use of blogging to support learning community work has been the subject of a few initial studies. Ray and Hocutt (2006) studied the content of blogs generated by 16 teacher bloggers, and interviewed the teachers themselves. Their analysis found that the blogs promoted reflective practice as well as collaboration and social interaction among its users. The blogs served both to share conceptual ideas and to negotiate social and emotional factors such feelings of isolation and dealing with frustrations. A second study had mixed results; it examined the voluntary use of blogging to support an online learning community involving 15 beginning teachers, 11 mentor teachers, and 9 college faculty (Loving, Schroeder, Kang, Shimek, & Herbert, 2007). Some participants cited lack of time as a reason for observed low levels of participation, and most blogging activity was comprised of individual posts rather than sequences involving comments on posts by others. The faculty support offered was seen as beneficial but it was concluded that more time was needed to introduce blogging and its processes to the community. Blogging was seen to work well as a complement to face-to-face meetings.

A study of blogging to support a learning community of undergraduate physiotherapy students during a clinical fieldwork program produced some relevant findings for the design of TLCs. A random experimental design was used, with some students being assigned to blogging groups while others were tasked with private journaling (Ladyshewsky & Gardner, 2008). The blogging groups consisted of 4 to 5 students together with a faculty mentor, and the bloggers wrote about their clinical practice and evidence-based practice issues. Students reported enjoying the simplicity of blogging and the blogs' ready accessibility, and indicated that they learned from each other's contributions, negotiated new knowledge constructions, and gained insight into experiences they had not encountered in their own clinical work. Peer feedback was highly valued, and the blogging helped students realize that they were going through a shared experience and were not alone in their struggles and anxieties, thus reducing their sense of isolation. Analysis of the blogs led researchers to conclude that the students were actively involved in a true community of practice. Group size was important to success, with 6 to 10 member groups being optimal; groups of 4 or less did not establish a critical mass for effective discussion.

Kling & Courtwright (2004) make the point that the community must support the use of a shared set of tools and artifacts so as to provide a common operating basis for the group as a whole and prevent its excessive fragmentation into factions. The introduction of a new tool needs to be judged for both its affordances and its potential costs in this regard.

Supporting multiple modes of communication[1]

There is some evidence that online TLCs are most effective when they incorporate both synchronous and asynchronous modes of communication in their designs, as they serve

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[1] There is a large research literature on the educational applications of computer-mediated communication that has developed over the past 20 or so years, and some of this will unquestionably have relevance to the design and implementation of TLC communication. However due to the narrow focus of the present review that literature is not considered here, excepting recent articles that directly address community formation and activity.

different purposes in the life of the community. Online text chat has been cited in some research as promoting increased group connectedness, greater development of social relationships and a common group culture, and more active involvement in learning (Repman, Zinskie, & Carlson, 2005). But chats are subject to problems such as disjointed conversations or multiple parallel conversations that can be difficult to follow when chat groups grow too large. Moderators need to set protocols for chatting, keep the group focused, promote collective reflection, and delineate the border between acceptable and unacceptable practices.

Research on the use of text chat indicates that it can play an important role in the social processes of community building that cannot readily be accomplished using only asynchronous media, by reducing isolation through real-time sharing (Haythornwaite, Kazmer, Robins, & Shoemaker, 2004). However it may be less effective as a medium for deep, reflective discussion. A content study of synchronous chat amongst teachers participating in an online professional development program categorized the forms of discussion that occurred in six one-hour online course discussions (Chen, Chen, & Tsai, 2009). These chats were moderated but only lightly; participants were given a set of course-related questions to guide each discussion period. Only about one quarter of the teachers' messages demonstrated the use of cognitive or metacognitive learning skills; the majority served a purely social function. Despite this, 80% of the participating teachers reported that synchronous discussion changed the way they learned, bringing them into contact with new ideas and offering them opportunities to ask questions and make comments that tend not to happen in formal face-to-face workshops. The most common function chat was reported to have had was to provide opportunities to share experiences. Even though the teachers did not focus upon the guiding discussion questions and about half of the chat content was off-topic, the chat served as the social lubricant for building a sense of community. It was concluded that more active, focused moderation directed at evoking cognitive sharing and collective knowledge construction was needed for greater success. Teachers need to see models of effective dialog demonstrated by a facilitator.

Students in a graduate course that used both synchronous and asynchronous online communications were assessed using a validated scale of community feelings as to how well the different media promoted a sense of community in participants (Lord & Lomica, 2008). The results indicated that both chat and face-to-face interaction promoted a greater sense of community than did interaction through a discussion board; there were no differences found between face-to-face and chat communication on this dimension.

There is some evidence that the process of participating in forum-based discussions enhances literate forms of higher-order thinking in specific ways (Repman, Zinskie, & Carlson, 2005). For community members with language difficulties or for those who are inhibited about presenting themselves in public, having forums available can reduce the obstacles to participation. They can be used for hosting events that forward community objectives, such as Q and A sessions with invited guests, debates, and role-playing activities, and can support both individual and group-based work. But as a mode of communication, a forum discussion's capacity for capturing the richness and emotional content of face-to-face communication lies below that of real-time chat, and consequently it is not as effective in engendering trust in and commitment to the community. Technical issues sometimes inhibit participation as well (Kelly, Gale, Wheeler, & Tucker, 2007). Despite these limitations, forums have been effectively used in the service of blended and online graduate programs to foster a sense of community and a culture of shared critical reflection, and (where teachers have been involved) to change the stances teachers take in their thinking and attitudes about professional issues in

their classroom practice (e.g. Haythornwaite, Kazmer, Robins, & Shoemaker, 2004; Kelly et al., 2007). However the context of participation here is considerably at variance with that of a fully voluntary, non-credit TLC such as ABEL, so that any generalization from these findings to the ABEL case on the basis of such studies can only be very tentative.

The capacity of TLC forums to mediate productive discourse, in addition to being influenced by the other factors which govern the overall success of a TLC, is very much tied to the extent and nature of the moderation and facilitation provided in a forum. Where moderation is largely or completely lacking, as was the case during the initial rollout of the ILF, forum discussions are typically very limited, nonreflective, and superficial (Moore & Chae, 2007). As mentioned in the earlier discussion of building participant trust, teachers rarely spontaneously follow conversational norms that permit them to disagree productively with colleagues; consequently unmoderated discussions tend to be devoid of challenges or disagreements in teacher conversations about artifacts and practices, as teachers prefer to "go along to get along" (e.g. Groth & Burgess, 2009). Evidence suggests that free-form collaboration does not systematically produce learning (Araja, Hamallainen, & Rasku-Puttonen, 2010).When moderators participate in discussions, stimulating forum threads through their addition of comments and questions, participant engagement is increased (Riding, 2001). Gray (2004) was successful in developing an online informal learning community. She attributes this in large part to the moderation strategies used: summarizing, weaving, and nudging the discussion forward to deeper level helped participants construct meaning and identity in the community.

If forums are to be effective mediators of pedagogically fruitful online community dialogue, community members need to be provided with different forms of facilitation and support to sustain and deepen joint reflection and knowledge building around practice. They need timely assistance with practical and relevant classroom strategies and activities (operational support); they require affective support to build community belonging, trust, and ownership; and they need intellectual support to engage new perspectives and ideas (Carr & Chambers, 2006). Moderators need to encourage participants to not only develop their own thinking and to exchange their insights, but to incorporate knowledge from outside the community (Wubbels, 2007). Wubbels suggests bringing experts into forums as guest moderators/discussion leaders to stimulate theoretically and empirically driven reflections. In a study of learner interaction and its relationship to assessed depth of learning in online education courses, Garrison and Cleveland-Innes (2005) found that the nature of the interactions was a significant determinant of the degree of deep learning. Several factors proved crucial in optimizing the quality of interactions. Students had to be given the opportunity to establish a strong social presence in the online community, but that alone was not sufficient. With respect to facilitating discourse, a number of strategies were required. Clear participation requirements and a protocol for contributing were provided to students. Moderators acted to provide engaging questions, focus discussion, challenge and test ideas, model appropriate contributions, and ensure that the discourse is progressive.

The results of a study of a large-scale blended teacher development program incorporating forum use provide useful guidance on the use of moderation to facilitate effective discourse (Elges, Righettini, & Combs, 2006). It found that a traditional transmission model of teaching did not sustain teacher learning; participants needed multiple opportunities to engage with others in order to be willing to try new teaching strategies. Making teachers' tacit knowledge explicit was challenging, and teachers often had difficulty relating theoretical knowledge to their practice. Facilitators needed to force teachers to confront their readings in the light of

their classroom experiences. With that support, teachers demonstrated a gradual improvement in the detail and sophistication of the explications and analyses offered in the online discussion, and shifts in teacher beliefs about instructional practices were observed.

A second study examined a blended program for improving teacher use of ICT that focused on the development of a teacher learning community (the School Teachers Learning Community) (Hlapanis & Dmitracopoulou, 2007). Both informal learning channels and formal courses were made available; participation in forums and email exchanges were wholly voluntary. (In this project, as with many others, initial face-to-face meetings allowed the establishment of social bonds that made later online communication easier.) Both directive and non-directive forms of moderation were employed. Non-directive moderation focused on encouragement and questioning.proved more effective in supporting discussion than directive intervention (which involved the posting of long message presenting the moderators' points of view); the latter could turn students passive and resulted in lower levels of participation.

The School Teachers Learning Community was observed to pass through a maturation process. In its early phases, participants needed continual encouragement, and moderators used both directive and non-directive approaches to attempt to increase involvement. In its mature phase, the community began to function without the need for any significant level of moderator postings. However as much of the teacher posting was tied to formal courses participants were completing within the program, it cannot be assumed that a similar maturation pattern would develop in a completely informal learning community such as ABEL.

In a case study of discussion facilitation in the context of a blended in-service program for physics teachers, researchers found several strategies effective in getting participants to reflect on their progress in applying new teaching strategies (Berger, Eylon, & Bagno, 2008). Moderators would post interesting or provocative statements made by members at face-to-face meetings and invite responses. They would also periodically create online multiple choice polls on central issues previously discussed at these meetings and ask teachers to justify their responses. Facilitators would respond immediately to posts of requested progress reports on the implementation of taught strategies.

Seddon & Postlethwaite (2007) used a participatory design to develop and then test a set of questions intended to inform contributors to online collaborative dialogues about the nature of their contribution, and to guide the input from facilitators to improve online collaborative knowledge building. Questions for each of five discourse "zones"— sharing, comprehending, analyzing, synthesizing, and transforming—were developed through a literature review as well as interviews with experienced, expert tutor-facilitators. These were then field tested and modified. The final set of questions generated for both groups are presented below in Table 1.

Table 1: Participant and Facilitator Questions (from Seddon & Postlethwaite (2007))

Question Zone	Participant	Facilitator

		How can I encourage participants to offer personal information to help create an atmosphere for sharing?
Sharing	What personal information can I offer to help create an atmosphere for sharing? What professional knowledge can I present to add to the dialogue?	How can I encourage participants to offer professional knowledge to enrich the dialogue?
Comprehending	Do I agree or disagree with the information that participant has presented, and offer a reason for my opinion? What questions get asked to help my understanding?	How can I encourage participants to make comments that agree or disagree with information a participant has presented and to offer reasons why they agree or disagree? How can I encourage participants to ask for more information to help their understanding?
Analyzing	Can I pull in common threads from other contributions? Can I point out differences between contributions?	How can I encourage participants to pull out common threads from other contributions and present them in the debate - and point out differences between other contributions?
Synthesizing	Can I summarize a group of contributions? Can I put forward information from outside this debate that would enrich it?	How can I encourage participants to summarize a group of contributions? How can I encourage participants to put forward information from outside this debate that would enrich it?
Transforming	Can I think of how this information might lead to action- and state this in the debate? Have I carried out this action-then report how it went? Can I offer comments about my learning or change through this online interaction?	How can I encourage participants to think of how this information might lead to action - and state this in the debate? How can I encourage participants to report on results if they carried out this action? How can I encourage participants to offer comments about their learning or change through this online interaction?

This question matrix was not intended to be hierarchical, or to be applied in a sequential manner. When the discourse classification scheme used in the study was tested against large samples of online dialogue it was found that all five types of dialog were present, and that all five zones tended to be accessed relatively equally throughout the career of an online forum. The questions developed were thought by experienced moderators to be comprehensive and provide excellent guidance to participants and facilitators.

The training of facilitators is an important consideration for effective online communities. This is clearly demonstrated in a training study undertaken as part of an online statewide professional development project focused on improving teachers' reading pedagogies (Zygouris-Coe & Swan, 2010). This program provides certification to hundreds of teachers a year, and supports a large online TLC. To ensure effective discussion facilitation, the program provides a multi-pronged support system for facilitators. Selected on the basis of their

professional qualifications, they first participate in a seven week online course to prepare them to moderate online. They receive both theoretical and practical training as well as tutoring from experienced online mentors. Trainees participate in synchronous and asynchronous discussions as well as frequent, less formal chats.

Outcome assessments of the teacher certification course have been highly favourable, with participants coming away with new knowledge and attitudes about literacy instruction; pre- and post-testing indicated significant gains of a substantial nature in their knowledge of reading processes and pedagogy. Surveys of participants found high levels of user satisfaction, and 97% reported that their involvement in the program resulted in positive change to their classroom instruction. Ensuring a sense of participant connection to the online community was considered a major contributor to its success; the reduction of a participant's sense of isolation was critical given that this was a wholly online program. The program incorporates activities and assignments that encourage participants to talk about their personal lives as well as their successes and challenges in the online community, and facilitators encourage reflection, sharing, and the seeking of advice when participants plan their project activities.

The salience of effective facilitation became clear to the Inquiry Learning Forum staff when it was discovered that in those groups that had facilitators who actively posted, participants contributed significantly more critical, reflective comments than participants in groups with no facilitator (Barab, 2006). Significant intervention was usually required to foster participant trust. The ILF found a need to provide group building activities that help people get to know each other and work together in forums; technical design alone would not make this happen (Kling & Courtwright, 2004). It was recommended that moderators explicitly find ways to foster sharing, such as eliciting participants to talk about their situation and interests. Expertise in the community itself can be uncovered and drawn out by moderators to foster participant change. Facilitators can reward and reinforce contribution and change through recognition and praise. Positive recognition of change has been shown to increase teacher confidence and lead to more risk taking in practice (Rodgrigues, 2006). But Kling and Courtwright (2004) note that interventionist activities can be problematic, as they make more demands on participants for self-revelation, and for reading and posting within a specific timeframe. Extensive intervention by moderators to foster socialization and engaged reflection is also labour intensive and thus expensive. Nonetheless, the authors conclude that "In the end, community development is likely to be a complex accomplishment that is difficult to initiate without purposive interventions from some kind of leaders or stewards. It will rarely happen online alone through self organizing" (Kling & Courtwright, 2004, p. 113; see also So et al., 2009).

Designing for and Supporting Community: Additional Considerations

Several additional guidelines for online TLC design and operation have been offered by researchers based on their study of the parameters impacting TLC effectiveness. Underlying many of these guidelines is a key principle: community design should have as a major goal the fostering of a high degree of internal community ownership through the provision of a flexible and extensible set of tools, resources, and supports that optimally facilitate members in collectively pursuing their professional learning interests and activities. To this end, it is recommended that designers provide communities with multiple interaction formats and technologies (Farooq, Schank, Harris, Fusco, & Schlager, 2007). These should allow users to communicate synchronously or asynchronously as the need arises, to host their own self-created groups, and to create, store, and share discourse objects and teaching artifacts. Care must be taken however not to provide too many channels for communication; as one study

found, the use of multiple areas for asynchronous communications can reduce the scope for self-sustaining conversations to develop, as different individuals conduct conversations on the same issues in different places in the community (Carr & Chambers, 2006). Tools need to be provided that support an environment in which member interdependence can evolve as teachers wrestle with issues and collaborate with others to develop resources (Lock, 2006). The community's tool set must allow each group to share announcements, ideas, web links, and electronic documents; organize a shared set of resources; create forums on topics of group interest, and collaboratively create and edit documents (Barab, MaKinster, & Scheckler, 2004). At the same time, care must be taken to provide tools participants can readily master; designers often make too many unwarranted assumptions about the technical proficiency of teachers, and how well a naïve teacher can cope with new features or tools being added. This happened in the ILF's initial phase; in the process of addressing teachers' expressed needs, overly optimistic assumptions were made about user technical skills that led designers to inadvertently introduce technical and usability problems which decreased the use of the ILF site (Baek & Barab, 2005). A key principle here is the need for relatively transparent and low-threshold system and tool interfaces that allow participants to access relevant knowledge, to interact, and to collaboratively produce artifacts without significantly disrupting their workflow (Havelock, 2004). The technology used also needs to be robust and reliable to avoid user frustration and failure which can drive down participation rates (Riverin, 2009).

An essential step for building community member ownership and identification and providing the right mix of affordances in the tools, resources, and communication spaces brought to the community is to make use of a participatory design methodology. If the community for which the environment is being designed is to truly "own" it, it must participate in its development (Hauge & Norenes, 2010; Kling & Courtwright, 2004). Teachers need to be part of the planning team; experienced practitioners are in a position to articulate the perspectives and needs of those of their peers who may be less advanced. Undertaking a systematic mapping of user needs is but the first phase of participatory design; it must also incorporate ongoing work with community members to user-test and revise structures as well as evolve the norms and rules for participation (Barab et al., 2004). Feedback mechanisms such as "requested features" and "bug report" sub-forums should be incorporated into the community (Farooq et al, 2007). Insights gained by users as they master the community's tools and functionalities and apply them to their work need to be gathered and studied to uncover the limitations and constraints of tools and resources so as to better inform revision efforts (Drayton, Obuchowski, & Falk, 2009). Flexibility in the overall design is required so that community members can customize their space to meet local needs and interests; this allows the group's identity and focus to emerge from its membership rather than being imposed by designers or project leaders (Barab et al., 2004).

Care must be taken when adding requested functionalities not to overburden teachers with operational complexity. In attempting to meet user needs, the ILF introduced a level of complexity to its portal design that resulted in teachers finding the site hard to navigate. Researchers noted that building a community site with enough functionality to meet various participants' needs while maintaining ease of use is "an extremely difficult task" (Baek & Barab, 2005).

Many of the studies reviewed touch upon the importance of recognizing and developing internal leadership within the community (e.g. Farooq et al., 2007; Kling & Courtwright, 2004; Whitehouse et al., 2010). To ensure a self-sustaining community, teachers need to be given the

opportunity to take leadership roles. They have to be helped to develop the technical capabilities required for leadership, and provided with the social support they need to assume a leadership position. TLC members also need to have the authority to form new subcommunities on their own initiative (Kling & Courtwright, 2004). Research on the Tapped In online TLC determined that one key element important for ensuring the community's sustainability lay in reinforcing emergent leadership that developed from the work of individual members (Whitehouse et al., 2010). To the extent possible, the support of external leaders such as administrators and consultants in community members' schools and districts, should be sought as well; these individuals can be important in supporting and promoting a culture of sharing and risk-taking, allowing teachers to experiment with what they have learned in the community, and creating incentives to motivate sharing and leadership such as the provision of release time (So et al., 2009).

III. Conclusion and Recommendations

Extant research indicates that creating and sustaining a strong teacher learning community as a solely online entity is clearly a very difficult challenge; a high level of commitment and a considerable outlay of resources will be required for a significant chance of success. A handful of researchers even contend that online TLCs cannot be "birthed" at all but only recognized, encouraged, and supported (e.g. Kling & Courtwright, 2004; Thompson & Kanaka, 2009). Even the largest and best-funded online TLCs reviewed here found it necessary to incorporate some face-to-face components into their design in order to build the interpersonal connections and social presence needed to instill the trust and sense of identity with the community that is a prerequisite for reflective discussion. ABEL needs to more deeply explore how it can exploit this approach to support its online TLC components.

ABEL's community development challenge is magnified by the fact that it is attempting to build and support an online community that consists wholly of volunteers who are not participating in more formal professional development programs or accredited courses which make use of a TLC as one part of their program, as was the case of many of the effective online TLCs investigated in the reviewed studies. The data to date clearly show that encouraging meaningful participation in a community's life is generally less successful when the potential participants are volunteers than when participation is a mandated requirement of formal program or course or is even loosely associated with one.

Another aspect of ABEL's collegial network presents an additional barrier to developing a cohesive online community: its membership consists of a relatively diverse group of practitioners teaching at different grade levels and subject areas who do not necessarily share the same professional interests and concerns. As Drayton et al. (2009) point out, and the experience of the ILF demonstrates, collegial networks of such diversity are hard to construe as one large community; they must foster the creation of smaller, more focused member groups if true learning communities are to be developed.

All of this is not to say that ABEL faces an insurmountable barrier to establishing and maintaining effective online TLCs. The challenge will be considerable, and certainly our current understanding of the factors that build success is far from complete (the research base is replete with generalities but generally lacking in practical, specific guidance for practitioners). Nonetheless, if ABEL makes use of the community design and operating principles that recent work has shown to build and sustain fruitful online teacher communities it may be able to create the conditions that foster the growth of effective TLCs. The following set of recommendations provides guidelines derived from the literature review that if acted on should maximize the likelihood of achieving such an outcome.[2]

1. Leverage the power of face-to-face sessions to establish the social presence and connections needed for online community success. Survey members to determine the shared pedagogical interests which can serve as the focus for these sessions and the online community. Bridge the transition from the co-present event(s) to the incipient

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[2] As the rationales for all of the recommendations have been explored at length in the earlier sections of this review, for the sake of brevity they are not repeated here.

online learning community by creating a new private subcommunity for that group and sign all participants up for it; introduce it and have participants log in at the end of their face-to-face session to explore it; and assign small tasks aimed at building on the face-to-face events and establishing online social presence for participants to pursue over the next several days. Ensure that the group is properly moderated from the start, either by a community leader or ABEL staff member.

2. Offer a range of new member induction supports and activities. New members should be quickly welcomed by an ABEL facilitator, questioned about their interests, and given guidance customized to their responses. They should be asked to provide some profile information to build their social presence, and they should be provided with a personal work area or virtual desktop where they can assemble bookmarks to resources and discussions of interest and receive alerts about new contributions to discussions they are participating in or following.

3. Provide opportunities within the ABEL portal for the creation of member-initiated subcommunities to be formed on topics of mutual interest and at desired levels of privacy. Give these emergent communities access to customizable configuration tools so that they can set up their own resource and tool areas, giving their members ready access to the specific resources and tools of mutual interest. Where membership surveys indicate a sufficiently widespread interest in a topic or focus, create a new subcommunity, invite ABEL members to join it, and provide an initial set of resources and facilitative questions to stimulate interest and initiate discussion.

4. Provide forum moderator training for group leaders; in groups where no leader has emerged, trained ABEL staff should serve as moderators until emergent leaders can be tapped to assume this role. Moderator training should make use of the scaffolding questions developed by Seddon and Postlethwaite (2007) to ensure that moderators are well prepared to promote sharing and facilitate deeper forms of reflection. Seddon and Postlethwaite's participant questions should be distributed to community members to help foster self-monitoring of forum contributions.

5. Employ a participatory design approach to the development of community spaces, the selection of resources, and the choice of community technologies. Include practicing teachers in design groups to provide advice and feedback from the practitioner perspective. Conduct usability tests of new portal design prototypes and user test new technology tools prior to their introduction to ensure that an average teacher will be able to use these resources effectively with minimal training.

6. Give community members access to a rich suite of professional learning resources that are directly relevant to their professional needs, and do so in situated ways that maximize the likelihood that members will use those resources to enrich their contribution to the community discourse as well as improve their professional practices. For example, rather than posting a journal article on the strategies and advantages of inquiry learning to a resource library, use a community video sharing tool similar to ILF's to let a community member locate and view the use of such strategies in a situated classroom context directly relevant to that member, and frame the video with contextual information and reflections provided by the videotaped teacher. Include questions to provoke reflection, and provide seamless links to a connected forum/thread

where the viewer can respond without losing his place in his virtual classroom visit. Designs of this type will minimize the barriers impeding contributions to relevant community discussion areas, increasing communal knowledge building.

7. Provide sufficient technical training and support resources to ensure that community members are proficient at using the communication and collaboration tools a community has chosen to employ so that technical barriers to participation are minimized and members have the confidence needed to collaborate and contribute. This support can take many forms depending on the complexity of the processes involved, ranging from face-to-face training for more complex tools such as VideoPaper Builder to brief how-to documents or screencasts.

8. Given that the research literature reviewed offers few specifics regarding precisely how the principles and strategies for fostering community reviewed here were implemented in the online TLCs studied, it is recommended that ABEL obtain guest accounts on the major TLCs mentioned so that its staff can gain a detailed understanding of the design elements and operational practices these relatively successful TLCs have employed. Where appropriate and feasible these can then be brought over to the ABEL context.

Future ABEL Research

ABEL research has not yet addressed the question of whether the ABEL program can successfully build and sustain a productive online TLC for its members under optimal conditions. We would propose undertaking a study in which one or possibly two small learning communities were established and supported over a one to two year period by ABEL using the strategies and principles outlined in the recommendations above and discussed in more detail throughout this paper. The goal of the research would be to understand the individual and collective effect on community success of employing these strategies in the service of community facilitation. The criteria for determining community success would include both quantitative (usage) and qualitative (community discourse analysis, participant interviews) data. A case study approach would be used to illuminate the phases of community development, to document the various activities it collectively pursued, and to investigate the effects of the strategies used by ABEL management to grow the community. Should sufficient funding be available the research should also incorporate classroom visits with participating teachers at the start and end of the research time frame to make a direct assessment of the impact of community participation on relevant teaching practices. The outcome of this research will allow ABEL to make an informed decision about the advisability of continuing to expend resources to support TLCs as part of its program.

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