Virtual Professional Learning Communities: Teachers' Perceptions of Virtual Versus Face-to-Face Professional Development

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Abstract Research suggests that professional development that engages teachers in instructional inquiry over an extended time through collaborative professional learning communities (PLCs) is effective in improving instruction and student achievement. Still, most professional development is offered as short-duration workshops that are not effective in changing practice. Barriers to the implementation of PLCs include lack of shared meeting time and a shortage of teachers who share the same subject areas or common goals and interests. Convening teachers from multiple districts can alleviate this problem, but teachers are reluctant to travel for meetings due to time and cost restraints. Video-conferencing software offers a solution to these barriers while serving to foster the sense of community needed for PLCs to be effective. The researchers describe the use of Virtual PLCs in which two groups of teachers met monthly for one school year to collaboratively analyze evidence collected as part of their teacher inquiry plans. With help from a facilitator, these groups developed a relationship similar to other groups meeting face-to-face as part of the same professional development program. Analysis of the reflections of teacher-participants and facilitators revealed that teachers prefer face-to-face meetings, but that the virtual and face-to-face meetings provided teachers with similar social interactions in the PLC experience. The findings suggest that teachers perceive videoconferencing as an effective tool for facilitating PLCs when distance and time are practical barriers to face-to-face meetings. Practical considerations for developing and facilitating virtual PLCs are also discussed.

Keywords Professional development ·
Distance learning · Videoconference · Science teaching ·
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Introduction

The quality of teaching and learning in schools has long been a concern for school districts and governments, and continues to grow in importance. Nations across the globe are pushing to improve education, and in the effort, are investing in teacher professional development as the driving force behind reform (Borko 2004; Wei et al. 2009a, b). Recent publications have described the current state of professional development in an attempt to focus attention on providing more effective opportunities for teacher learning (Huebner 2009; Smith et al. 2009; Wei et al. 2009a, b). Most of these studies cite the continued prominence of one-time, short-duration workshops and presentation mandated by school leaders for all teachers, which have been shown to be inadequate strategies for bringing about change in teacher practices (Guskey 2002; Kesson and Henderson 2010; Wei et al. 2009a, b).

Many one-shot workshops engage teachers from all grades and subjects in the same activities without regard to the individual needs of teachers. Research has shown that teachers desire professional learning opportunities that focus on practical classroom strategies targeting their specific needs (Leask and Younie 2001) with support over a sustained period of time (Bell and Gilbert 1996; Borko 2004). School districts may not be able to provide sustained and differentiated professional development because of the need to customize programs to small groups of teachers. This is especially problematic for some science subjects with only one teacher, such as physics, chemistry, or Earth science (Ullman 2010). When budgets are limited, efficient delivery of professional development usually means teaching to larger groups of teachers, and schools are often not prepared to bring together teachers from multiple schools. Professional learning communities that bring together teachers with similar interests or needs may offer one solution for the needs of a diverse group of teachers.

The National Staff Development Council (Wei et al. 2009a, b) supports the implementation of professional development (PD) that includes ongoing support for collaborative teams of teachers to actively explore and test teaching strategies relevant to their own teaching contexts:

> Research also suggests that professional development is most effective when teachers engage actively in instructional inquiry in the context of collaborative professional communities, focused on instructional improvement and student achievement (p. 58).

This implementation of learning communities as a component of PD has strong support from the National Commission on Teaching and America's Future (2003):

> Quality teaching requires strong professional learning communities. Collegial interchange, not isolation, must become the norm for teachers. Communities of learners can no longer be considered utopian; they must become the building blocks that establish a new foundation for America's Schools (p. 17).

The professional learning communities (PLCs) cited in the NSDC report have become increasingly popular in schools (Darling-Hammond and Richardson 2009), but sometimes difficult to implement because of the limited availability in school schedules for shared time for teacher collaboration (Chappuis et al. 2009). School districts may also have limited numbers of faculty members teaching the same subjects, so finding a cadre of teachers with common needs and interests may be difficult. When PLCs include teachers who do not share a common goal, the groups are likely to be less effective in bringing about changes in teacher practice (Smith et al. 2009).

Creating groups of teachers from related content areas is effective, and PLCs have been connected to increased student achievement (Lomos et al. 2011; Siguroardittir 2010). But this strategy also poses problems; teachers are reluctant to commit to professional development programs if they must travel for meetings. The cost to teachers, in both time and monetary terms, deters participation in the kind of extended, collaborative professional development shown to be the most effective in promoting teacher learning.

Researchers in the Problem-Based Learning (PBL) Project for Teachers explored the use of videoconferencing to support and facilitate professional learning communities. Two-way video technology has been used to support classroom observations (Bell and Garofalo 2006; Dyke et al. 2008), distance learning (Kincade 2004; Salinas 2005), and virtual town hall meetings (Crane and Raucci 2003; Elliott 2009), but literature on how videoconferencing can be used to support learning communities for professional development is less common (Kincade 2004; Ullman 2010).

In the PBL Project (McConnell et al. 2008), two teams of teachers from school districts in Michigan met each month via videoconferencing software to share their own inquiry into the effectiveness of teaching strategies that address specific needs in their classrooms. This paper describes the design of the virtual professional learning communities, reflections from the groups' facilitators, and feedback from group members about the nature of the virtual groups. The paper draws comparisons between the virtual learning communities and other groups within the PBL Project who met face-to-face, and discusses the benefits and challenges of facilitating PLCs in a videoconference environment.

The research questions addressed in the paper include the following:

- How do videoconference PLC meetings compare to face-to-face PLC meetings?
- What considerations in the implementation of Virtual PLC groups facilitate collaborative learning?
- What are the advantages and challenges presented in the implementation of a Virtual PLC convened in a videoconference environment?

Review of Literature

Professional Learning Communities

Professional learning communities (PLCs) refer to groups of staff members committed to a collaborative learning effort with the explicit goal of improving practice, often

with a facilitator who guides discussion by focusing the discourse of the group on critical analysis (Hord 1998). These groups have been show to be an effective approach to teacher learning (Dufour 2004; Henderson and Gornik 2007; Putnam and Borko 1997). PLCs are based in a social constructivist view of learning (Vygotsky 1978) that views interactions between learners as an essential element step in the construction of new ideas. Eaker et al. (2002) include the practice of collaborative inquiry in their social constructivist model as a component that promotes teacher learning and revision of practice based on evidence.

While several models of professional learning communities have been presented, several key components must be included in the design of a PLC.

- Supportive and shared leadership
- Shared values and vision
- Collective learning and application of learning
- Supportive conditions (physical, human capacities)
- Shared practice (Hord 1998)

Richard Dufour (2004), a leading proponent of PLCs as a tool for educators, emphasizes three "big ideas" for professional learning communities: (1) an emphasis on learning, (2) developing a culture of collaboration, and (3) a focus on results. (p. 6–7). The first and third big ideas point out the need for teachers to be mindful of the impact of their action on student learning. This entails using a variety of assessments to gauge students' prior knowledge and changes in conceptual understanding for both planning of interventions and the evaluation of the effectiveness of the strategies implemented. In the PBL Project, PLCs were formed for this purpose. Teachers planned research on the impact of teaching and classroom management practice on student learning and collaboratively analyzed evidence collected during science activities. Analysis led to revised strategies that could be tested, forming a cycle of reflective and critical learning for the entire group. Evaluative focus group interviews in all four cohorts of the PBL Project revealed that teachers valued the PLCs as a supportive learning environment, and that teachers' classroom practice was changed as a result of their participation (Weizman et al. 2008).

Virtual PLCs

While PLCs have been shown to be an effective tool for shaping teaching practice and influencing student performance (Lomos et al. 2011), creating PLCs that meet the needs of all teachers can be challenging. Teachers often resist attempts to enlist participants in long-term intensive PD programs (Zhang et al. 2008), especially when the commitment includes travel from school to some other site.

Charalambos and Michalinos (2004) cite the many demands of work and family as barriers to the recruitment of teachers in the types of PD program that are most effective (Loucks-Horsely et al. 2003). Other options for fostering collaborations between teachers need to be considered.

A promising strategy for facilitating these collaborative efforts is the use of Internet resources. Ford et al. (2008) use the term *virtual professional learning community* (VPLC) to describe various media and software environments. These VPLCs have been implemented in many different forms, including bulletin board discussion groups, course management software, asynchronous text-based collaborations like wikis and blogs, videoconferencing software such as Skype (Carlén and Jobring 2005; Charalambos and Michalinos 2004; Dede 2004a; Duncan-Howell 2010; Howard et al. 2004; Orill 2002; Sorensen and Murchu 2004), and even Twitter (Trinkle 2009). All of these examples have a similar goal: using technology to support collaborative learning among participants separated by geographic or temporal barriers. Of these tools, the most relevant to this paper is the use of videoconferencing.

Videoconferencing equipment has been used in schools for about 20 years, mostly for courses offered via distance learning technology. Later, virtual field trips provided by universities, museums, zoos and parks were included in a 2nd phase of innovation. An emerging 3rd phase is now underway with an emphasis on student–student or student-expert collaborations (Greenburg 2006, p. 12). These applications are focused on students as the learner; activities focus on providing content and learning activities to the student. However, only a few articles mention using videoconferencing to support teacher learning. One such study describes weekly PLC meetings for specific subject areas facilitated by staff at a regional education service center (Ullman 2010). The virtual meetings target rural teachers who are isolated, and find it difficult to access PD programs that meet their specific needs. This study presents a preliminary attempt to study the effectiveness of videoconferencing as a medium to support teachers PLCs.

During the 4th cohort of participants, the PBL Project elected to utilize Marratech^{TM} (2007), an application that permits multiple users to log into a "room" that supports video and audio conferencing with access to a "whiteboard" for recording typed or handwritten notes and diagrams. Users can also share files to allow collaboration on written artifacts. The software includes an archiving feature to save the information generated on the whiteboard. The meetings of two "Focus on Practice" groups during this cohort illustrate Virtual Professional Learning Communities (VPCLs).

Methods

Context and Participants

The PBL Project is an NSF-funded program that offers professional development for K-12 teachers in the implementation of inquiry-based science lessons (McConnell et al. 2008). Participants in the program included K-12 teachers from across central Michigan who enrolled in the project to improve their science teaching practice. Participants attended a 7-day *Professional Working Conference* (PWC) and an additional 3-day *Focus on Practice* (FOP) session, followed by monthly meetings with a professional learning community during the following school year. (See Fig. 1). The fourth cohort included 54 teachers who participated in the year-long program. This paper focuses on the professional learning communities, or "FOP" groups.

In the PWC program, problem-based learning (PBL) was used as a framework for learning activities that addressed teacher understanding of science concepts from specific subject areas, or "strands," identified by teachers as a need for improving their teaching. Teachers engaged in learning activities in the content areas. Teachers also developed inquiry-based unit plans to implement in their own classrooms during the following school year.

In the Focus on Practice, teachers then used the unit plans they had developed to identify aspects of their teaching practice they felt they could improve. These "teaching dilemmas" served as a focal point for action research the teachers would conduct during the following school year.

Examples of these dilemmas include questions about how to help student organize journals and portfolios, how to ask more productive questions to guide student thinking during lab activities, or strategies to help students understand specific content. Evidence collected from the classrooms was presented to colleagues in the professional learning community who helped to analyze the data collaboratively. Evidence included samples of student work,

teachers' reflections, and video recordings of the lessons as they were implemented.

In this cohort, the 54 teachers were assigned to one of 11 different learning communities. Groups were developed to include teachers from close geographic proximity and similar grade levels taught. Each of the groups met monthly to collaborate on the analysis of evidence of effective teaching. During each meeting, one teacher shared evidence from his or her classroom, and lead a discussion to analyze the evidence and propose actions to improve teaching. A facilitator helped guide the group's collaboration. The facilitators were either science education faculty from a university or community college, or teachers with experience in professional development.

Nine of the groups met face-to-face, while two of the groups (n = 5 teachers for each group) met via a desktop videoconferencing tool that allows multiple users to participate in a video-based conference. The decision to employ videoconference technology was influenced by the need to create groups from geographically widespread areas. Both groups agreed to try using Marratech as a medium in which to meet. Table 1 gives a description of both "virtual" groups, including subjects taught, years of experience, and the number of years each teacher had participated in the project.

One Virtual PLC (VPLC) group (named the "urban" group for this paper) included five teachers from four different schools in a large metropolitan area. While the distance between these schools was not far, a face-to-face meeting would require driving to one location in congested traffic. The first author had facilitated FOP groups during two preceding cohorts, and facilitated the Urban VPLC. For the group's first meeting, the teachers asked to meet face-to-face so they could learn to use the Marratech software. Since the primary facilitator lived in another

Fig. 1 Overview of the PBL project for teachers

Professional Working Conference	Summer Focus Practice	Academic Year Focus on Practice
Science Content Dilemmas	Sample Teaching Dilemmas	Implementing Unit Plans
Developing Unit Plans	Formulating Teaching Dilemmas	Monthly PLC Meetings
Teaching Strategy Seminars	Developing PLCs	Celebration of Practice (public sharing)

Table 1 Participants in the two Virtual PLC groups, Cohort 4

	Teacher	Subject taught	Grades taught	Yrs of teaching	Yrs in PBL project
Urban VPLC	Lois	Life Sci.	7–8	24	0
	Michael	Earth Sci.	10–12	17	0
	Donna	Gen. Sci	7–8	6	0
	Brenda	Earth Sci.	8	4	0
	Rita	Gen. Sci.	6–8	4	0
Mid State VPLC	Kristen	Life Sci.	6–8	8	3
	Stephanie	Gen Sci.	6	5	2
	Julie	Life Sci.	9–10	3	2
	Angela	Gen. Ed.	3	5	1
	Whitney	Chem and Bio	11–12	1	0

state, Joan, a second experienced facilitator was asked to assist with this meeting while Tom joined in via the videoconference software. Joan also facilitated one of the virtual meetings when a later scheduling conflict made it impossible for Tom to join the videoconference.

The other VPLC group (the MidState group) included five teachers from rural and suburban schools separated by more than 30 miles. With the exception of Whitney, the members of this group had met as a PLC for the two previous years. In order to test the sustainability of the PLC model, project planners chose to form the Mid State VPLC as a "self-facilitated" group. As with the Urban VPLC, Tom agreed to work with the group, but his role became that of a contact person, and he did not attend all the meetings. Group members shared facilitation tasks.

The VPLCs met by using Marratech™, a proprietary program licensed by the sponsoring university. Teachers used client software to log into a virtual conference room. The room included video, audio, and a whiteboard for recording notes and comments in text format. During the virtual meetings, teachers shared literature on science teaching, text-based evidence, and video clips using a password-protected collection of files on TeacherTube©, a web-based video-sharing site. The group then discussed the evidence and developed new strategies to improve teaching based on their interpretation of the evidence. Problem-based learning provided a framework for structuring the analysis, with teachers discussing what they knew about the teaching dilemma, information they needed, hypotheses, and resources from books, journals, the Internet, and classroom practice to develop possible solutions to be tested in the classroom. These meetings took place in real time, with teachers logging in either from their classrooms or from home.

While the two Virtual PLCs used the videoconference to facilitate meetings from a distance, the other nine PLCs met face-to-face, analyzing the same types of evidence and using the same PBL analysis framework. After meeting for 8 months, the FOP groups convened for a "Celebration of Practice" to share their research publicly and provide feedback about the design of the PD program. This study attempts to compare the Virtual PLCs to face-to-face PLCs, focusing on the processes and the learning outcomes.

Data Sources and Analysis

Phenomenological perspective and comparative case study methodologies were used in order to compare the experiences of members of the Virtual PLC groups to members of the other groups. Sources of data included sessions from videoconferences recorded, focus group interviews with participants from both groups, and reflections from the ten participants. Responses from previous cohorts of teachers

to the focus group interviews provided a comparison between virtual and face-to-face PLCs. The two group facilitators also recorded their own reflections comparing the nature of the discourse in PLCs from both virtual and face-to-face groups.

The focus group interviews were conducted at the Celebration of Practice meeting held in May of the academic year in which the groups met. Each focus group included members from two or three Focus On Practice (FOP) groups, with 8-10 participants in each focus group. One of the groups included the Virtual PLCs, while four other groups included face-to-face FOP groups. The purpose of the focus group interviews was to gain feedback about the design of the Focus on Practice groups, including analysis of teaching dilemmas, the role of facilitators, and in the case of the VPLCs, the use of videoconferencing. Questions asked to the focus groups included:

1. What did you learn from your research during the FOP?
2. How has your participation in the FOP changed your teaching practice?
3. What did you find most valuable about the FOP meetings?
4. (For VPLC) What were the advantages and challenges you experienced as a virtual FOP group?
5. How did the facilitator help you FOP group?

The data analyzed for this study focus on participants' responses in all five focus groups to questions 3 and 4. These data were analyzed using open-coding and constant comparative methods (Strauss and Corbin 1998). To identify similarities and differences between the two types of PLCs, we then placed data clips from videotaped reflections and focus group interviews in a matrix (Miles and Huberman 1994) comparing responses from each FOP group to emerging themes. From these themes, we developed the assertions reported in the following sections.

Findings

In this study, we compared the experiences of teachers in two different types of professional learning communities: face-to-face PLCs, and Virtual PLCs who met using a videoconference software package. The findings shared here are derived from the reflections of members of the two VPLCs and the facilitators who worked with both groups and responses to the focus group interviews of VPLC and face-to-face PLC groups. Analysis of the data revealed two assertions. In this section, we will share these assertions and discuss the evidence supporting each one. Later we will discuss the implications for professional development providers.

Assertion #1: Teachers in Virtual PLCs Using Videoconferencing Software Experience the Same Benefits as Members of Face-to-Face PLCs

Analysis of the data suggests that videoconferencing is an effective method for facilitating professional learning communities. In their reflections, the facilitators reported that the type of discussions in the Virtual PLC groups was very similar to the discourse that takes place in face-to-face groups. Both facilitators noted that the members of both groups spent part of their first online meeting "playing" with the software, exploring its features and getting accustomed to the interface. This playing was a distraction for the first 20–30 min, then became less of a factor.

After the initial explorations of the software, participants quickly moved into a productive and seemingly comfortable discussion of the teaching dilemmas. Once the facilitator had demonstrated how to use the whiteboard feature as a tool for recording notes, teachers quickly adopted the whiteboard as a convenient place for recording their ideas, facts, and questions. They also initiated the use of the whiteboard as a place to post URLs for useful websites; members used their web browsers to look for sources of information during the conversation rather than between meetings. Other members could then click a link and view the same web site. While this was different from the discussions within face-to-face meetings, teachers in both groups talked about the same types of issues, and spent equal amounts of time on task. The importance of a dynamic discourse between participants was critical for the collaborative analysis. Joan commented that it "was remarkable that when using videoconferencing, the teachers were able to have such rich conversations about their teaching."

Teachers' statements in the focus group meetings provide the strongest evidence that participants in both groups experienced the collaboration in a very similar manner. When asked what they found most valuable about the monthly meetings, responses from all 11 groups were nearly identical. Six key comments appeared in all of the focus group interviews, regardless of the format of PLC meeting:

1. Sharing articles or information found by others
2. Group members giving new perspective on evidence.
3. Hearing practical solutions others have tried
4. Accountability to the group
5. Focus on professional discourse
6. Developing professional friendships

The first three of these ideas describe the benefit teachers perceived in the opportunity to collaborate with their peers. Without exception, each group described their appreciation for being able to share resources and divide the work of finding articles or activities.

> "When you research your own dilemma, sometimes you can't find anything valuable, and then someone comes up with something great." (Angela, MidState VPLC)

Similar comments appeared in every focus group, including those from the previous two cohorts. The teachers also talked about the value of having "a new set of eyes and ears" (Gene, 2nd grade teacher, face-to-face PLC) providing different perspectives on evidence from the classroom or research articles they read.

> I think it was a huge motivating factor to have others to bounce ideas off of. Too often I get so caught up in my teaching and I don't think about what else is going on and take a step back. And to see the video, they're seeing so many other things in your practice that you're not thinking about (Rita, Urban VPLC).

The phrase "have others to bounce ideas off of" has emerged in nearly every focus group interview over all four cohorts. Each group also stated the value of learning about the practical strategies and activities that their colleagues had tried.

> In our virtual meetings, we saw what she was doing and what they were all doing, and were, like, "Oh, yeah! I've tried this, and she's tried this. I should try that." That's real. A lot of times you look at the web site and it's just black and white. And you're thinking, "alright, theoretically I get it," but to see it put into practice, whether it came from the website or just experience… I think the combination was neat. (Michael, Urban VPLC)

Teachers in every focus group also cited accountability to the group as a valuable aspect of the PLC groups. Both virtual and face-to-face groups talked about the importance of having a regular meeting with tasks they agreed to complete. Knowing they needed to find research literature, bring samples of student work, or present their own teaching dilemma forced them to "do research I would not otherwise do without the FOP" (Stephanie, MidState VPLC). Phyllis, a 4th grade teacher from a face-to-face PLC reported, "having a deadline keeps me on my toes."

Teachers from each group also described the importance of meeting with colleagues from other schools as a factor that influenced the nature of the discussion during meetings. Several teachers explained that if they only met with teachers from their own building, discussions tend to be about students, co-workers, and administrators. Participants in both types of PLCs described the group as "keeping things more professional" (Michael, Urban VPLC) or

"more on task," (Tracy, face-to-face PLC). An important component that may have contributed to the professional nature of the discourse is that teachers had become accustomed to the PBL framework for analyzing problems. This framework was used by both the virtual and face-to-face groups, and had been practiced during summer content learning activities and practice teaching dilemmas.

The final aspect that emerged in every focus group interview was the importance of a strong collegial relationship within the group. The term "collegial" was used by teachers in three of the five focus groups, as well as "camaraderie," "social connections," and "friendships." These comments speak to a sense of belonging that researchers feared might not be established in the virtual groups. However, all the groups described this factor in very similar terms.

Assertion #2: Virtual PLCs are an Effective Alternative When Face-to-Face Meetings are Not Practical

Despite reporting the same benefits as members of face-to-face PLC members, the participants in the VPLCs also reported a preference for a face-to-face meeting. Four of the five members of the MidState VPLC had met in person during the previous year, and three of these teachers reported that they found the face-to-face meetings more "personal."

> I felt that our discussions were better when we met face-to-face. I liked that better (Kristen, MidState VPLC)

Angela (MidState VPLC), Michael, Brenda, and Rita (Urban VPLC) made similar comments. Despite this finding, nine of the ten participants had given favorable comments about the videoconferences during meetings and focus group interview sessions.

One possible reason for their preference is that they felt the transmission lag in the audio portion of the conference was a barrier to open discussion. Michael (Urban VPLC) described the impact of "lag" in detail: When asked to explain their thoughts, Michael (Urban VPLC) elaborated.

> There is a clinical nature to the virtual [meeting] where you have the waiting, the lag. But it has its plusses and minuses. It has its limitations. But if I'm working on a unit with someone, and we can't meet face-to-face, that's bad. So I think this (virtual meeting) is a good option for teachers, especially when dealing with teachers from the other buildings… (Michael, Urban VPLC)

Another difference cited by the facilitators between face-to-face and virtual PLC meetings was that the videoconference meetings revolved around a meal that face-to-face groups shared. In the face-to-face PLCs, this time might include discussion of teaching dilemmas and research, but these meals offered time to socialize, and to share news about school and family. Videoconference meetings of the VPLC generally started with a brief discussion of personal news and social connections as the group waited for all the members to log in, but there was less time for this socialization, which seems to be important in building a productive PLC (Chen et al. 2009; Gunawardena et al. 2009; Keown 2009; McConnell 2005).

> One thing I missed most was the food! We all met last year face-to-face, so we were used to that. That time was important to us, and so we chose to meet in person a couple of times, because we were all in close enough proximity and wanted to do that. (Kristen, MidState VPLC)

It is worthy of mention to contrast the preference these teachers expressed for face-to-face meeting to their description of the most valuable aspects of their virtual meetings. They described the same features as the face-to-face groups. The similarity is even more striking when you compare comments by members of the MidState VPLC to their evaluations of the FOP group 1 year earlier when they met face-to-face. The same themes emerged in both interviews.

Implications for Professional Development

Technology has changed how people work and communicate in many sectors of our society. The literature on professional development includes support for the use of online communities for teacher learning (Duncan-Howell 2010; Lock 2006), but these studies do not discuss the value of videoconferencing. Businesses are using videoconferences to cut travel costs while still permitting real-time collaboration. Virtual town hall meetings have found their way into political campaigns and the federal government (Elliott 2009). Education, as well, has seen a rapid increase in the use of distance education as a means for bringing together learners, instructors, and resources. Teacher educators need to make better use of the opportunities presented by videoconference platforms to offer high-quality differentiated collaborative professional development to teachers.

Most of the literature describing distance learning for teachers involves web-based asynchronous conferencing in which teachers access bulletin boards, discussion rooms, and compiled resources such as text files and video clips (Barnett 2006; Broady-Ortmann 2002; Pianta et al. 2008; van Es and Sherin 2002; Wearmouth et al. 2004). The use of videoconferencing for PLCs provides a new use of

technology to support a research-based strategy for facilitating teacher learning.

The promise of videoconferencing as a tool to foster professional learning communities lies in providing easier access to colleagues and facilitators. Just as Kincade (2004) has reported that offering courses via videoconference has boosted enrollment for community colleges, giving teachers a chance to participate in professional learning communities from their schools and homes may attract more teachers to this promising form of professional development. This potential to provide timely PD for teachers is especially valuable for teachers who are isolated in their schools, such as schools in remote or rural areas, and individuals who are the only teacher for a specific subject in their school. Universities, school districts and state leaders in education need to serve as leaders in providing and coordinating these types of virtual PLCs as a way to provide access to quality PD to these teachers with special needs.

For teachers, videoconferencing offers an alternative to face-to-face professional development that demands travel to a distant location while still providing practical learning opportunities in a professional setting. Lois, a middle school teacher in the Urban VPLC described why she felt the videoconference environment met her needs:

> I'm a person who can meet with you anytime during the summer. But now [in the school year], I have to drive. It's going to take me an hour and half to get home tonight, provided there's no construction. I have all these labs to grade waiting for me, and this and that. To have to drive here for a meeting, I'm not able to relax, you know. But at home, no big deal. I really liked the virtual meetings.

While the teachers in both VPLCs expressed their preference for meeting in person, they agreed that videoconferencing was the next best solution. Professional development providers should look to videoconferencing as a viable medium for reaching a larger audience with collaborative sustained PD programs. In the following sections, we share some of the lessons we learned from our implementation of the VPLCs.

Establishing a Sense of "Community"

Research on the elements of effective online learning environments has shown that establishing a sense of community is important to promoting meaningful discussion (Chen et al. 2009; Conrad 2008; Gunawardena et al. 2009; Kreijns and Kirshner 2001; McConnell 2005). Patterns of teacher engagement and discussion, along with teachers' evaluations of the virtual PLCs, suggest that the videoconference groups developed a strong sense of social presence, which echoes finding by Salinas (2005) in a study of collaborative virtual environments. In her study, Salinas found that video-based conferencing was able to create in participants a sense that they were "present" with the other participants, leading to more engaged discussions. Waltonen-Moore et al. (2006) describe in detail the need for members of an online learning community to have a sense of trust and support in order to contribute meaningfully the discourse that leads to deep learning for adult learners.

Building a community was an integral part of the PBL Professional Working Conference and Projects Summer Focus on Practice. During the 10-day summer workshop, content learning activities were conducted in groups that operated much like a professional learning community, with facilitators guiding participants in collaborative analysis of science problems. During the development of teaching dilemmas, participants again worked in the FOP groups that became their PLCs. These activities provided time for participants to get to know each other and begin building the relationships that would motivate shared learning, whether in a virtual or a face-to-face setting.

Teachers in the virtual PLCs then found creative ways to continue the interpersonal relationships developed in the summer. In the Urban VPLC, three members had been in the Earth Science strand for the first 7 days. Brenda and Rita developed the habit of giving a playful slap to the back of the Michael's head when he started joking around. This behavior found its way into the videoconferences:

> The social interactions are important, like these two whacking me in the head when we meet. We'd put their [webcam] windows on each side and pretend whack me in the head. There's this social interaction. Because you do have to build the friendships and the relationships. (Michael, Urban VPLC)

This episode suggests that teachers can find ways to make personal connections across the barrier of distance using features of videoconferencing applications, given a chance to establish a relationship prior to the virtual PLC meetings. This implies that professional developers need to provide some opportunity, if possible, for face-to-face interactions at the beginning of a PD program. If face-to-face meetings are not possible, planners need to explore other ways to build a sense of community. Virtual PLCs offer a viable option.

Technical Considerations

Prior to implementing the Virutal PLCs, the researchers had expressed concern that teachers might not be comfortable with a new form of technology. The ten participants included a range of comfort levels with computers and Internet resources. All the members of the Urban

VPLC were eager to use the technology, and they were quick to test out features and find ways to solve their own problems. Three of the group's members used technology extensively in their classrooms, while the other two use the computer and the Internet for their personal use at home. In the MidState VPLC, Angela was much less confident in her use of the computer than Stephanie, who teaches just down the hall. Stephanie is a technology pioneer in her school, using blogs and wikis with her 6th graders, and helping her co-workers solve computer problems. At Angela's request, they joined the videoconferences from the school, both seated in the same classroom in case Angela wanted help with the software. Still, both teachers were able to navigate the videoconference interface and contribute productively to the group's analysis of evidence.

Researchers were also concerned that dealing with technological barriers would occupy a large part of each meeting, and that teachers would be easily distracted with peripheral chat discussions during the meeting. Both facilitators noted that the teachers who tended to be distracted by side-discussion during face-to-face meetings were actually more engaged and spent more time on-task during virtual meetings.

One of the disadvantages to virtual meetings is that participants logging in from home encountered distractions not present in a face-to-face meeting. Pets, family members, and telephones interrupted conversations occasionally in virtual meetings.

Participants also had to learn to plan for lighting and audio requirements of videoconferences; sometimes the locations of teachers' home computers were not well suited for videoconferences. Michael usually joined meetings from his basement, where the computer sits in a room where the only lights are behind him. As a result, his image was only in silhouette. One meeting of the Urban VPLC also was interrupted with the central Marratech server failed for a moment. But within 3 min, teachers and facilitator had all logged back in and the meeting resumed with only brief mention of the problem.

Another consideration for PD planners wishing to use videoconferences is the applications and hardware required. Polycom™ conference rooms provide high quality audio and video, but these units are expensive, and few schools have facilities equipped with this technology. Universities and libraries commonly have Polycom™ units, but using these conference rooms for teacher PD would require teachers to drive from their workplace to some other local or regional site. When asked if they would be willing to take part in videoconferences hosted at these sites, all ten participants in the VPLCs stated that they were not likely to volunteer unless they could log in from home or from their schools. Providers offering PD programs via videoconference should offer access via web-based applications available to a wider audience. Using these tools along with a web cam and a microphone headset to avoid looping feedback echoes and a computer with an internet connection via cable modem, DSI, LAN or wireless WAN is quite sufficient for the technical demands of the current videoconference technology.

A variety of software packages are available for home computer use. Examples of these programs include Wimba™ and Elluminate™ (both now part of the Blackboard software, and titled Bb IM™ and Bb Connect™), Adobe Connect™, WebEx™, Skype™, Moodle™, and others. As researchers, we need to examine the features of these programs that are most helpful in fostering the "presence" needed to support collaborative discussions, teacher learning of videoconference tools, and the effective facilitation and organizational structure of Virutal PLCs. The findings of this study provide a model that holds some promise for teacher education, and can serve as a starting point for further research.

The preliminary findings of this study clearly support the continued use of videoconferencing as a medium in which to facilitate professional learning conferences can be facilitated. The sample size for this study was small, but the ease with which these teachers adapted to a new learning environment suggests that a more diverse group of teachers might have similar success in a VPLC environment. A next step in the analysis will include examining the changes in teacher knowledge and practice resulting from the PD program, including the VPLC groups.

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