Blended teacher professional development: A synthesis of three program evaluations

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A B S T R A C T

This study synthesized the findings of three program evaluations of teacher blended professional development programs from the perspective of situated design and implementation, development of community, changes in teacher practice, and impact on students. We found that the blended programs were effective in providing teachers with an opportunity for learning on the job and collaborating with other teachers, and they influenced teacher classroom practice moderately and affected student learning to a limited extent. Our study supports the contention that blended learning is a viable model for teacher professional development.

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1. Introduction

Professional schools in most higher education institutions have a commitment to support the continuing education of their graduates once they begin their careers, whether through graduate study, non-credit courses, workshops, or other informal learning experiences. Schools of education, in particular, have long seen continuing professional development of teachers as part of their mandate. In recent years, they have turned increasingly to offering online programs and special projects as a way of partially fulfilling this mandate (Dede, 2006). Research indicates a number of benefits for teachers from online professional development, including anytime/anywhere professional learning (Swenson & Curtis, 2003; Vrasidas & Zembylas, 2004), instant access to a network of professionals with useful skills and knowledge for continuous training and professional development (Charalambos, Michalinos, & Chamberlain, 2004), and the fostering of a professional learning community (Chapman, Ramondt, & Smiley, 2005). Yet developers of online professional learning programs face significant challenges in organizing and maintaining a virtual community. Perhaps the most significant of these is to foster among participants a sense of belonging, trust, and support which are necessary for effective learning in a community (Charalambos et al., 2004). One strategy to address the challenge of community building in online environments is to utilize a blended approach to professional development. This method integrates into the online experience face-to-face components that are intended to strengthen the social cohesion of the learning community and develop a collective momentum for implementing meaningful change in teaching practices.

In this paper, the outcomes of formal evaluations of three different blended teacher professional development programs are synthesized. The main goal of the study was to understand how these programs addressed the primary requisites for the design of effective teacher professional development programs as articulated in the literature. Other goals were to provide guidance to designers of teacher professional development programs and, more generally, to contribute to our knowledge of blended learning as a professional development approach.

2. Theoretical background

The theoretical rationale for employing blended learning in teacher professional development comes from two sources: (1) the literature on blended learning research in higher education and professional learning; and (2) research on the characteristics of effective teacher professional development programs. This section begins by providing a definition of blended learning and discussing the grounds for employing blended learning as a general instructional strategy in higher education. Then the requirements of effective teacher professional development programs are discussed, and it is argued that blended learning lends itself well to meeting these programmatic needs. The section concludes with a statement of the research questions derived from this literature.

2.1. What is blended learning?

There are many interpretations of the meaning of blended learning, or hybrid or mixed mode learning as it is sometimes called, largely because the usage of the term is evolving (Graham, Allen, & Ure, 2005; Oliver & Trigwell, 2005; Whitelock & Jelfs, 2003). Driscoll (2002), in a survey of literature, found four different uses prevalent: the mixing of traditional face-to-face instruction with instructional

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technology; the mixing of different forms of technology such as CD ROMs with web-based technology; the mixing of pedagogical approaches such as constructivism with behaviorism irrespective of whether learning technology is used; and the mixing of instructional technology with specific tasks to be accomplished. Because of the lack of precision of the term Oliver & Trigwell (2005) call for a re-conceptualization of its meaning. They argue that 'blended' implies a differentiation between pedagogical approaches that may not actually exist; they also point out that the term describes an instructional approach rather than learning *per se*. Nevertheless, the term is increasingly being used to designate a combination of face-to-face experiences, in which learners are co-located, with online experiences, where learners are not at the same location.

Even though most now ascribe to this latter viewpoint (including the authors) there are still differences in the understanding of the term. For example, the Sloan Consortium (Allen, Seaman, & Garrett, 2007) sees blended learning as having no less than 20% nor more 79% of the content delivered online, whereas others are not concerned with the apportioning of instructional modes. Some emphasize that technology should not be simply "bolted on" to an existing face-to-face learning program, but that blended learning requires a redesign of the teaching and learning relationship (Bleed, 2001; Garrison & Kanuka, 2004; Richards, 2003). Related to this is the question of whether seat time should be reduced when integrating online technology into a redesigned traditional course (Garrison & Vaughan, 2007). And finally, there are differing perspectives offered on the rationale for blending face-to-face learning experiences with technology: (1) improved teaching and learning outcomes; (2) increased flexibility in and access to learning; or (3) cost effectiveness (Graham, 2006). Typically, the motivation to design a blended learning experience does not rely on just one of these reasons, but more likely with two or all three of them. These rationales are described next.

2.2. Rationales for blended learning

With regard to the first rationale for blended learning, improved teaching and learning outcomes, Garrison and Kanuka (2004) argue that the combination of face-to-face and online learning can result in a transformative learning experience for students. This is because course participants can benefit from being connected to a learning community regardless of whether they are apart or together. They add that when the dynamic of fast-paced, spontaneous verbal communication characteristic of face-to-face learning is combined with the potential for thoughtful discussion and reflection online, the educational possibilities are multiplied. Faculty tend to favor the blended approach and report that they interact more with their students (Dziuban, Hartman, & Moskal, 2004; Waddoups & Howell, 2002; Wingard, 2004) and get to know them better as individuals in blended courses than they would ordinarily in traditional lectures (Owston, Garrison, & Cook, 2006). Student satisfaction is reported to be higher in blended learning courses than in comparable face-to-face courses (Dziuban, Hartman, Juge, Moskal, & Sorg, 2006; Owston et al., 2006; Twigg, 2003), and withdrawal rates are lower (Dziuban et al., 2006; Twigg, 2003). Overall, students tend to achieve higher in blended courses than traditional courses (Dziuban et al., 2006; Twigg, 2003), and both faculty and students report that the online component of blended learning encourages the development of critical thinking skills (Owston et al., 2006). Additionally, blended learning facilitates a climate of student engagement. Students become engaged in the online environment itself, they become engaged in meaningful dialogue with peers, they develop a sense of engagement and identity as a group, and they become engaged in the course content (Ziegler, Paulus, & Woodside, 2006).

Increased flexibility in and access to learning, which together constitute the second rationale for blended learning, are perhaps the most commonly cited reasons for its use. By its very nature blended learning offers more flexibility to learners because some of the learning takes place at scheduled face-to-face times, while other parts of it may occur online at their convenience. This feature is especially attractive to mature learners who have to balance job and family responsibilities with their studying, and to those who do not want to sacrifice entirely the social interaction that comes with face-to-face learning. Blended learning models that have face-to-face components at the beginning and/or end of a course and an online experience in between also allow learners living at a distance to enroll in a program that they otherwise may not be able to.

The third rationale presented for blended learning, cost effectiveness, is more equivocal, and research findings depend on which cost factors researchers choose to include in their study. For instance, the Pew Charitable Trust Foundation sponsored Program in Course Redesign (Twigg, 2003) reported significant cost savings largely through a reduction in faculty and substitution of teaching assistants for faculty; however, the research did not take into account factors related to computing infrastructure. Hartman (2007) on the other hand reports that the University of Central Florida saved $7 million in construction costs and over $277,000 in annual operating costs through implementation of blended courses, although he does caution that cost savings will not be realized if technology is just added onto existing courses without pedagogical change. Cost savings in corporate training environments where widely distributed employees would have to travel to a central location and remain for an extended period seem clearer. IBM, for example, saw as high as a 47 to 1 return on investment (costs of developing and deploying a training module) in a unique blended program for managers (Lewis & Orton, 2006).

2.3. Blended learning and teacher professional development

Most of the above research is based on undergraduate education; however, there is no evident reason why the results would not attain for teacher professional development as well. Moreover, there appears to be a strong rationale for blended learning based on the body of research about the design of effective teacher professional development programs. This research shows that professional development is most effective and can impact student classroom achievement when it is long-term, collaborative, school-based, focused on the learning of all students, and linked to the curricula that teachers have to teach (Cohen & Hill, 2001; Garet, Porter, Desimone, Birman, & Yoon, 2001; Hiebert, Gallimore, & Stigler, 2002; Wenglinsky, 2000). Blended learning lends itself well to incorporating these design principles. For example, blended learning programs can be designed to extend to a full school year or even longer because teachers do not need to be removed from classrooms for extended periods in order to participate. Face-to-face sessions can coincide with district professional development days or teachers can be replaced with substitutes for several days throughout the school year to attend face-to-face sessions. Alternatively, if these arrangements are not possible, teachers can participate in face-to-face summer sessions. In any of these scenarios teachers can continue to participate in the program via online sessions regardless of when the face-to-face sessions are scheduled. The possibility of arranging blended teacher learning programs that extend beyond a school year is particularly appealing because the longer a program functions, the more likely deep change will occur in teacher practice (Shields, Marsh, & Adelman, 1998; Weiss, Montgomery, Ridgway, & Bond, 1998).

Collaborative communities are a hallmark of high quality professional development, whether they meet face-to-face (Little, 2003; Louis & Marks, 1998; McLaughlin & Talbert, 2001) or online (Barab, Kling, & Gray, 2004; Koch & Fusco, in press; Schlager & Fusco, 2004). With blended learning, the collaborative possibilities are numerous. For example, teachers within the same school can collaborate in face-to-face sessions that focus on "hands-on" material development or review, and then share their thoughts and experiences online as they

try out the materials. The online discussions could be with their colleagues in the same school or beyond their school with other teachers engaging in similar activities. The blended model would also appear to support the "critical friends" approach to professional development that aims to increase student learning by creating school-based teacher communities whose members carry out practice centered collegial conversations (Curry, 2008; Dunne, Nave, & Lewis, 2000).

Blended learning allows for the possibility of professional development programs to be based in schools as in the examples given above and to provide opportunities for teachers to share and reflect on their practice. The notion of learning in one's own physical and social context is considered by many as critical for effective learning (Brown, Collins, & Duguid, 1989; Greeno, Collins, & Resnick, 1996; Lave & Wenger, 1991). Thus blended learning that incorporates school-based components would appear to be consistent with this situated perspective on learning. Nevertheless, there are limitations if teacher learning is restricted to studying teaching practice within one's own school. Putnam and Borko (2000) argue that teachers need to study in multiple contexts, especially if the goal is for teachers to think in new ways. This is because the pull of the school's existing environment and culture may be too strong to engender change. Traditionally, summer workshops held in locations other than their own school are used to introduce teachers to new instructional ideas. However, the online component of blended learning can provide teachers access to different contexts in which they can learn. For example, expert online facilitators or guests can challenge teachers' existing practices and introduce alternative perspectives. Similarly, if teachers from other schools and school systems are brought into the online conversations new ideas and suggestions can be introduced and discussed.

The requirement for professional development to focus on the needs of all students and the curriculum teachers are required to teach stems from research linking professional development curricula to improvements in student achievement (*e.g.*, Cohen & Hill, 2001; Garet, Porter, Desimone, Birman, & Yoon, 2001). To be sure, fully face-to-face or fully online professional development programs can be designed with this focus in mind. Blended learning can offer this possibility as well through careful design regarding which aspects will be dealt with online and which with face-to-face interactions. An added advantage of blended learning appears to be that teachers are able to immediately tryout ideas in their classrooms that are proffered in the online community rather than waiting, thus providing the opportunity for "just-in-time" professional development (Northrup & Rasmussen, 1999).

2.4. Research on teacher blended learning

Although in principle the blended model appears to support teacher learning well, to date empirical research on the application of blended learning to teacher professional development is limited. Holmes, Polhemus, and Jennings (2005) analyzed a blended in-service professional development program for K-6 teachers that focused on integrating technology into teachers' practices. The blended approach introduced teachers to affordable and efficient technologies, provided scaffolding for the development of a learning community, and facilitated the autonomy and independence of teachers. Vogt and her colleagues also examined blended learning as a means of helping teachers integrate technology into their classroom practice (Voogt, Almekinders, van den Akke, & Monen, 2005). Their study suggested that blended programs can help teachers better understand and implement technology into their classrooms and, to a lesser extent, adapt exemplary materials for their own settings. In another study, Owston, Sinclair, and Wideman (2008) report that a blended learning program for middle school mathematics and science teachers positively influenced teacher attitudes and content knowledge on specific curricular topics and motivated many participants to transform their classroom practice. This in turn led to more positive student attitudes towards the subjects. Of interest in all three of

these studies was that researchers reported difficulty in sustaining effective online communities citing reasons such as teachers lacking time for participation, lacking familiarity with the technology, and not being accustomed to collaborating with colleagues locally or at a distance, as well as issues related to moderating the online discussions. With regard to online moderation, Henderson (2007), in two case studies of blended programs for secondary teachers, illustrated how critical the role of the moderator is sustaining online communities if teachers are not socially engaged. He concludes that moderators must intervene if engagement wanes, but they must remain at the periphery of the community and avoid creating participant dependence on them to sustain engagement.

The above studies examined teacher inservice blended programs designed with a specific professional development focus in mind. Some research is also available on formal university teacher education courses. This research shows that blended learning provides an effective model for meeting the needs and learning styles of busy teaching professionals because it allows for a more flexible study schedule than a lectures only course (Swenson & Curtis, 2003). Blended learning can help teachers within a university course structure to develop relevant skills through face-to-face sessions, while at the same time provide them with an opportunity to reflect online about their practice (Motteram, 2006). Related to this, blended learning can be designed around authentic online learning experiences to bring meaning and purpose to teachers' activities (Oliver, Herrington, & Reeves, 2006).

2.5. Research questions

From this brief review of the literature on blended learning four issues emerge as central and deserving further investigation to advance understanding of blended teacher professional development. First, it is necessary to know how blended learning programs can be designed and implemented so that they emphasize situated, on-the-job professional learning that focuses on the curriculum teachers have to teach. As discussed above, professional learning that is structured in this way will likely have an impact on teacher classroom practice and student achievement (Hawley & Valli, 2000), yet current research provides little guidance on how teacher blended learning programs can be designed with this emphasis and what outcomes may be expected. Second, there is a need to understand how teachers' sense of community and collaborative skills can be strengthened by integrating face-to-face and online experiences. The literature suggests that blended learning fosters participant engagement and sense of community (Garrison & Kanuka, 2004); however, unanswered are questions such as: How relevant does a program need to be to teachers' professional needs to engage them fully? What are the reasons why teachers drop out or never become deeply engaged in blended programs? Or how can online moderators facilitate teacher engagement? Third, a more detailed understanding of how blended programs can help teachers transform their classroom practice needs to be gained. Owston et al. (2008) found that blended learning can increase teacher content knowledge and motivate them to transform their classroom practice, although unknown is how what aspects of blended programs promote change in practice. The fourth central issue emerging from the literature is how blended learning can be designed to increase their likelihood of having an impact on the learning of teachers' students. Again, Owston et al.'s (2008) study suggests blended learning can foster positive student attitudes toward their learning, however this is the only study to date that considers this key issue so much more research needs to be done on the topic. These four issues led to the formulation of the following research questions:

1. How can blended learning programs be designed so that they emphasize situated, on-the-job professional learning that focuses on the curriculum teachers have to teach?

2. How can teachers' sense of community and collaborative skills can be strengthened in blended programs?
3. How can blended programs help teachers transform their class-room practice?
4. How can blended programs be designed to increase the likelihood of teachers having an impact on their students?

This study sought answers to these four questions by synthesizing the evaluation findings of three separate blended learning programs for teachers. The two senior authors of this paper undertook the original program evaluations. The three programs are described next.

3. Three blended programs

All three of the teacher professional development programs took place at different times, had different teachers involved, and were situated largely in the Greater Toronto Area, one of the most linguistically and culturally diverse urban centers in North America. The project names were: Advanced Broadband Enabled Learning (ABEL) Program, the Teacher e-Learning (TeL) Project, and Learning Connections (LC). ABEL and LC were university-based programs and TeL was sponsored by a non-profit organization. The projects focused on the improvement of mathematics and science teaching at the high school, middle school, and upper elementary levels respectively, particularly in schools with large enrolments of English language learners from diverse cultural backgrounds. ABEL had an additional focus on teaching English and the Arts, and LC also focused on literacy teaching skills. All projects shared the common goals of promoting continuous professional learning on the job through collaboration and sharing with colleagues. Additionally, they emphasized teachers' use of student-centered, inquiry-based approaches in their classrooms that involved all students regardless of ability. Both ABEL and LC continued to operate after the formal evaluations concluded, while TeL was designed as a two year project that was evaluated over its lifespan. Although the three projects shared common goals, they differed in their design and implementation.

3.1. Advanced Broadband Enabled Learning Program

ABEL used a blended learning model that combined online activity throughout the school year with face-to-face summer institutes. Teachers voluntarily joined ABEL because their school districts decided to join the project and the teachers thought that the project would be of value to them. There was no structured program organized for teachers. The underlying philosophy of ABEL was to give teachers access to powerful digital tools and the means to collaborate electronically and then help teachers develop collabora-tive projects. To this end, ABEL provided teachers with a web portal, a set of online tools and resources, and videoconferencing equipment. Additionally, the project leaders organized periodic events for participating schools that brought in via videoconference external experts who presented and interacted with students and teachers. The summer institutes brought participants together for five days where they shared their successes with colleagues and listened to keynote speakers. Some institutes also involved students who shared their experiences from participating in collaborative projects the previous school year.

3.2. Learning Connections project

LC was modeled after ABEL in its design and implementation, but it had a very specific focus on improving the skills of literacy and numeracy lead teachers in Ontario elementary schools. Funded by the Ontario Ministry of Education, LC was a pilot project that was part of a strategy to help the province achieve its student literacy and numeracy goals. Schools were chosen by school district administrators

and lead teachers in the schools were asked by their principals to participate. The project employed similar tools to ABEL's, however it had a more formal structure. Specialist teachers employed by the project organized and facilitated activities to be tried out by teachers in their classrooms and reported on later online. They also facilitated online discussions and assisted the project leaders in organizing online guest speakers. LC summer institutes were similar to ABEL and, in fact, were combined after our evaluation concluded.

3.3. Teacher e-Learning Project

TeL, the most structured of the three programs, used a different blended model. In the first school year the project began with a daylong face-to-face session followed by an eight week session where teachers were in their classrooms carrying out their normal teaching responsibilities but interacting online with other participants. This cycle was repeated three times during the first school year, but only twice during the second year. The shortening of the project in the second year was because TeL leaders believed that the three cycles imposed too heavy a burden on teachers. Year one focused on teaching mathematics and year two, which involved different teachers, focused on science teaching. During the face-to-face sessions teachers typically spent the morning listening to a resource teacher introduce practical ideas for improving subject teaching, and during the afternoon they shared their classroom experiences in small discussion groups. The online sessions provided teachers with weekly readings and activities to try out in their classrooms. Teachers were also expected to participate in facilitated online discussions and to maintain an online reflective journal.

3.4. Program evaluations

The program evaluations took place over three years for ABEL and LC and two years for TeL. The primary sources of evaluative data were semi-structured interviews with teacher–participants, project leaders, and other stakeholders, focus groups conducted with the teacher–participants, teacher and student surveys, transcripts of teachers' online discussions, in-class observations, and observations of the programs' professional development activities such as videoconfer-ences and face-to-face sessions at summer institutes and workshops. Interim evaluation reports were provided each year for each project as were summative reports at the end of the projects. Copies of the evaluation reports may be obtained from http://irlt.yorku.ca/reports. html.

4. Method

4.1. Data sources

The above evaluation reports comprised the primary data source for this study. Occasionally, more detail was required to elaborate on an issue, seek additional evidence to support or refute a claim, or to resolve contradictions. In these cases, the authors examined the original data upon which the reports were based.

4.2. Data analysis

A cross-case comparative qualitative analysis was undertaken (Berkowitz, 1997). Since almost all of the data in the three evaluations were qualitative, this methodology was deemed most appropriate. The steps in cross-case comparative qualitative analysis are essentially the same those in an intra-case qualitative analysis, the difference being largely a matter of the granularity of the analysis. For the current study each of the three program evaluations served as a "case," rather than the individual actors and events within each of the programs. The analysis was guided by Miles and Huberman's (1994) three stage

qualitative analysis process: data reduction, data display, and conclusion drawing and verification.

Data reduction began by a re-reading the evaluation reports in light of the four research questions: (1) How can blended learning programs be designed to emphasize situated, on-the-job professional learning that focuses on the curriculum teachers have to teach? (2) What factors affect teachers' active participation in blended programs? (3) How can blended programs help teachers transform their classroom practice? (4) How can blended programs be designed to increase their likelihood of having an impact on the learning of teachers' students? The reports were read once more and passages that dealt with these questions were coded. All stages of qualitative analysis require judgment and at this stage decisions had to be made about the relevancy of report sections to the research questions. All research team members shared responsibility for coding different themes of the reports. When a research was unsure of the appropriateness of a code, the issue was resolved in a discussion with other team members. To avoid missing important data early on a rule of thumb adopted was to include data under a code even if they had marginal relevancy to the research questions.

For the data display phase matrices were created to compare each of the three programs on each of the four research questions. In the cells of the matrices were the coded quotations from the first phase. The quotations for each research question were read again with the view of creating subcategories, where appropriate. After several iterations of reading and hypothesizing, the following subcategories were created for each research question (RQ):

RQ1: relevance of learning experience, time between face-to-face sessions

RQ2: teacher time, relevance of topics, online facilitation

RQ3: impact on teaching, teacher confidence

RQ4: student attitudes, student achievement.

All quotations were then sorted under each subcategory. An example of one quotation for each program for RQ2-teacher participation subcategory is shown in Table 1.

The final phase of the analysis involved drawing abstractions and conclusions based on the data display matrices. This required frequent re-reading of the categories, hypothesizing about conclusions, and checking for additional confirmatory or contradictory evidence.

Table 1
Sample coded quotations for RQ2-teacher participation subcategory

Program	Quotation
ABEL	Participation in ABEL does appear to lead to higher levels of meaningful professional collaboration between teachers, although the data from the teacher interviews suggest that the great majority of this collaboration is at the school and workshop level. There is little evidence for significant participation by most ABEL community teachers in remote or "virtual" collaboration enabled by either the ABEL portal or technologies such as Breeze, and indeed frustration was expressed by several of those interviewed at the difficulty in making contacts with remote colleagues for collaborative work.
LC	While the Six Plus One book study was deeply embedded in classroom practice and directly addressed teacher needs, a second less successful one examining *The Teaching Gap* by Stiegler and Herbert was not. As one manager noted about the book, "it's an interesting book, a lot of great ideas, but it's not [at] the classroom level." The *Teaching Gap* book study was more formal, and included specific assignments for participants developed by LC staff. Attrition was very high and it was eventually discontinued due to a lack of participation.
TEL	Asynchronous postings were made only on a weekly basis in relation to the articles and other assignments for the course. However, the feedback received on postings (other than the teacher journals) was non-existent. While teachers initially had intentions of reading postings and responding to them, they stated that they did not have the time to accomplish this goal. As a result, the asynchronous postings were generally not viewed as a useful experience.

Occasionally it was necessary to go back to the original evaluative data sources of the three cases to obtain further elaboration or clarification. During this process multiple sources of evidence were sought by a process known as triangulation. For example to draw conclusions about student attitudes toward their subject, student self reports were used together with teacher and principal reports about how students perceived their schoolwork as well as our own observations. This allowed for more robust conclusions than otherwise would have been possible.

Limitations of this study are that each of the three blended learning programs had different professional development goals, the evaluations did not follow identical methodologies, and there were no common data collection instruments. Nevertheless, there was enough in common with the three studies to draw inferences from them.

5. Findings

5.1. Research question 1

The first research question deals with how blended learning programs can be designed and implemented so that they emphasize situated, on-the-job professional learning that focuses on the curriculum teachers have to teach. The two main coding categories relating to this question, relevance of learning experience and time between sessions, are discussed next.

5.1.1. Relevance of learning experience

As pointed out earlier, research suggests that teachers need the opportunity to learn on the job and try out ideas in their classrooms that are directly related to the curriculum they have to teach (Borko, 2004). All three programs that we studied emphasized situated and relevant professional learning, but they varied in the extent to which they were directly relevant to teachers' needs. ABEL by dint of it being teacher-driven was the most relevant because teachers had the freedom to design their own collaborative activities related to the curriculum they were teaching. A consequence of this was that ABEL did not have a broad impact on all teachers registered in the program because only a minority of teachers actually completed projects; the rest started projects but did not complete them or else they just stood on the sidelines not creating any at all. Nevertheless, the teachers who chose to participate appeared to have benefited substantially from their involvement, although the nature and extent of that growth varied. Development occurred in two main areas: level of technology skill, and changes in pedagogical orientation and practice.

First, with respect to technology skill development, even those teachers who already possessed considerable technology skills found themselves developing new abilities in the use of broadband for streaming media and videoconferencing, and expanding their knowledge to incorporate unfamiliar resources and unique software tools that were part of the ABEL Project. For instance, one teacher, describing a video of students performing an experiment that he produced and then uploaded for viewing over broadband, commented, "I thought I was a 'techie' before…but now I'm [really] a techie…I can more readily think outside the box." Teachers with less technology background found involvement with ABEL greatly expanded their capabilities too. They reported learning a variety of software applications that they had never used before such as discussion forums, PowerPoint, and the WebCT course management system.

Second, with regard to pedagogical orientation and practice, teachers expanded their repertoire to include more collaborative and student-centered instructional approaches. In the words of one teacher, her ABEL project "enabled [me] to see there are other ways students can learn and become more involved personally in learning." Many teachers reported undergoing changes in their perspectives on what constitutes good teaching, and were beginning to grapple with the concepts and rationales of inquiry learning and in certain cases to

start implementing many aspects of inquiry pedagogy in their ABEL projects. For several teachers their exposure to inquiry learning models and techniques was a professional awakening that heightened their enthusiasm for teaching; for example, one English teacher revised her entire grade 11 course to incorporate inquiry learning and found the results very rewarding.

On the other hand both TeL and LC functioned more like typical inservice courses. LC had scheduled classroom based activities with deadlines for when they were expected to be completed. The deadlines were flexible and often had to be extended because teachers had not completed their projects on time. This design allowed teachers a measure of flexibility in carrying out the activities in their classes directly related to their curriculum as the deadlines were often a month or two later. TeL was the most structured with weekly assignments and readings directly related to provincial curriculum expectations teachers were required to teach. Teachers in TeL were not all teaching the same topics at the same time, therefore when asked to try out a particular mathematics or science activity most teachers had to alter their curriculum schedule to fit in the activity or else skip it entirely. As a result the program did not have the immediacy that the other two did.

The design of the face-to-face sessions of ABEL and LC were similar, as described earlier. They took the form of summer institutes that lasted several days and had a combination of keynote speakers, teacher sharing, and breakout sessions. In the case of LC time was also spent on hands-on sessions about how to use various technologies since, as a group, these teachers were less skilled in this area. TeL was slightly different in organization because the face-to-face sessions were compressed into one day. TeL differed as well because one day was focused entirely on teacher sharing of culminating classroom projects. While teachers generally appreciated keynote speakers in all three programs, what was repeatedly heard was that they wanted more time devoted to just sharing and discussion of each other's ideas, activities, successes, and disappointments. Even though program designers were aware of this, there was still a strong urge to organize a formal program for participants that left a relatively small amount of time for teacher sharing and discussion.

5.1.2. Time between sessions

A remaining issue that emerged about design and implementation was the length of time between the online and face-to-face sessions. Teachers in ABEL and LC had to wait an entire school year before they could meet, whereas TeL teachers met approximately every eight weeks. This study found that there was a distinct advantage for community building by meeting more regularly like TeL teachers did. In the words of one teacher who talked about the value of getting together face-to-face often:

> I think we feed off each other. Like if they put a bunch of interested teachers in a room which we are only here because we are interested…you feed off of each other's energy and you feed off of each other's cues but I can't do that on a computer.

Both ABEL and LC had introductory summer institutes when the program began and in neither did a sense of community emerge until the conclusion of their second summer institute. This was the case even though within a year teachers in all three programs met for about the same number of days in total. Clearly there are increased costs with the TeL model, but given a choice it is preferable for the face-to-face sessions to be held more often, especially if one is concerned with accelerating the pace of school reform through teacher professional development.

5.2. Research question 2

The second research question asks about what factors affect teachers' active participation in blended programs. Of the three programs studied, TeL had the strongest online participation, LC the weakest, and ABEL was somewhat in between although the project did not focus on online community building per se. Even though TeL had much higher participation rates than the other two programs its rate was not particularly high. For example, in the mathematics course, which was offered in the first year of the project, on average 69% of participants posted two or more reflective pieces online per module. Participation rates rose slightly to 76% in the second year science course. Three reasons were cited in the TeL evaluation report as to why participation was relatively low: lack of teacher time, low relevance of the discussion topics, and weak facilitator skills. The reasons were essentially the same for the other two programs as well, so TeL will be used to illustrate them.

5.2.1. Teacher time

TeL participants were divided up into groups of 12 to 15 teachers with each group being led by an experienced curriculum resource person from a school district. Teachers were expected to post reflections on assigned readings or weekly activities that they tried out in their classrooms. TeL teachers reported that they did not have enough time to make regular postings despite being provided with a (generous) half day of teaching release each week for this and other project activities. Said one science teacher:

> I mean I would like to be online chatting away but realistically I mean I'm taking other courses, we are all teaching, we have kids and what not, so that's difficult, but overall I have to say no real major obstacles except not enough hours in the day.

Upon closer examination, there appeared to be two reasons why teachers did not have the time despite being given release time. First, teachers who were forced to take their release time in their schools found that they could not safe guard their time. They found that they were continually being interrupted by other teachers in the staff rooms or by other school related distractions. Second, many complained that their administrators were not as supportive nor were they as informed about the program as they ought to have been. This led to teachers being called to take over classes and responsibilities within their schools during their allotted teaching release time. Some teachers chose to do their course work at home hoping to avoid these pitfalls, but they too faced challenges. These teachers spoke of feelings of isolation, frustration with their lack of technical mastery, and time pressures due to family demands.

5.2.2. Relevance of topics

Lack of relevance of the readings or activities to their everyday classroom teaching was a second factor affecting participation. This became evident when teachers stated near the end of the project that they should have been grouped by grade level, instead of by more or less random assignment. They suggested that if they had been grouped that way they would have more in common with their colleagues. It appeared that teachers were simply not motivated to discuss issues online when they were not directly related to their immediate needs. The project organizers realized this late in the program and re-organized the website and discussion groupings. One teacher that represented the sentiment of others remarked about this re-organization said:

> I think that if they do post the stuff on the site where teachers could click on activities for their specific grade area [it would be desirable] whereas before they had it where everyone was mixed together and you are in a group and you are just looking at a bunch of stuff that some wasn't relevant to your class.…Now [with the re-organization] it is relevant and you will be clicking on most activities and seeing what teachers are doing or how it is used in the classroom.

5.2.3. Online facilitation

The third reason for low participation is related to the group facilitators. Their role was to stimulate group discussion, ask probing questions, correct any misunderstandings, and overall to keep their group functioning smoothly. During the first year of the project the facilitators did not have any particular facility in performing these tasks, nor were they provided with any training. As a result some facilitators did not react to teachers' postings at all, while a few did make an attempt to comment on each teacher's posting. This was discouraging as one teacher in TeL said:

> The one thing I found about [the online discussions] was that I get all these ideas and I do some writing and stuff and then press the button and it goes. Mentally it goes out there somewhere. I don't know does anyone see it? No response: does anyone care?

Teachers reacted to the overall weak facilitation skills by participating less frequently or by dropping out completely from the online component. At the end of the first year the evaluation report recommended ongoing training of the facilitators in the second year which did occur. Project leaders credited the modestly higher teacher participation rate in the second year directly to the improved facilitation.

Despite the relatively low participation in the online discussion groups, teachers in all three projects regarded the blended experience as very worthwhile. However, they felt that the face-to-face experience was the "glue" that held them together as a community, and many thought that they would not have continued in a fully online environment were it not for the face-to-face sessions. A strong majority of participants in all three programs reported that being given opportunities to share experiences and innovative ideas in face-to-face sessions assisted not only in strengthening their professional connections with colleagues, but also to address the feeling of isolation of being the only teacher in a particular grade or subject at a school. The findings also indicated that the facilitators in the face-to-face sessions were able to assist the participants to develop their expertise in new teaching methodologies and to integrate technology into their teaching practice. They encouraged the participants to take risks and analyze the mistakes made in classroom settings with their students. Such engagement with facilitators, together with practice boosted teachers' confidence and professional growth in innovative pedagogical practice.

5.3. Research question 3

This research question addressed how blended programs can help teachers change their classroom practice. The two coded categories related to this topic, impact on teaching and teacher confidence, are next discussed.

5.3.1. Impact on teaching

Both ABEL and TeL appeared to have the most significant widespread impact on teacher classroom practice, while the impact of LC appeared to be much more focused on a few skill areas. For example in one of the most recent surveys of ABEL teachers ($N=45$), a majority reported making shifts in their teaching practices as a consequence of the program. Approximately 70% indicated that they put greater emphasis on engaging student interest and providing more opportunities for students to take the initiative in their learning; and over 50% said they had students undertaking more collaborative work, were eliciting students' opinions and ideas more frequently, were giving students more opportunities to figure things out for themselves, and were providing more opportunities for students to present and communicate their knowledge and understandings. The use of inquiry-driven discussions and the provision of out-of-school audiences for student projects was said to have increased by about half of

those surveyed. Nearly all teachers reported actively seeking out new ways of teaching their course topics, and rethinking their ideas about teaching and learning as a consequence of their participation in ABEL. One teacher summarized her experience as:

> The satisfaction lies in discovering a new way of teaching that I hadn't ever thought about before. And it has been overall completely and totally beneficial to me and the students. So I am going to be continuing [to participate in ABEL].

These data, together with data from interviews we conducted, strongly suggest that teachers who made use of ABEL resources and technologies made significant shifts towards more constructivist and student-centered teaching practices.

In TeL almost all teachers whom we surveyed were either "satisfied" or "very satisfied" with the professional learning experience the project afforded, regardless of whether they had strong science and technology backgrounds or not. Experienced science and technology teachers found the material in the course to be a helpful refresher for techniques previously learned but had not employed in the classroom, and less experienced teachers valued the subject matter knowledge learned and the insights and ideas gained for effective teaching of science and technology.

For LC we found differences in minor, yet meaningful, aspects of teacher practice over the two years of the project which were consistent with the project's intent. For example, in a pre–post project survey comparison, mathematics teachers ($N=10$) reported that they were significantly more in favor of using mathematics problems that can be solved in a variety of different ways than they were at the beginning of the project ($t=2.714$, $p=0.024$). This suggested that teachers valued mathematical processes (as opposed to students just getting correct answers) more at the end of the project than they did at its beginning. As for literacy practices, the survey indicated that teachers were using phonics instruction less often and using more often interviews/conferencing and benchmark books for assessment purposes ($t=4.583$, $p=0.001$), findings which were consistent with the project's intent. Our classroom observations found evidence of increased skill in a few specific literacy areas such as making accommodations for diverse students and incorporating gender-sensitive practices into their classes; and in numeracy classrooms we observed improvements in the use of open-ended tasks with students and more emphasis on student discovery.

5.3.2. Teacher confidence

Evidence was found in all three projects of increased teacher confidence as a result of their blended professional development experience. An analysis of pre–post teacher survey questions in TeL ($N=33$) indicated that teachers developed increased confidence in experimenting with different approaches to teaching science and technology such as using independent learning in small student teams ($t=2.766$, $p=0.009$), fostering open-ended scientific exploration ($t=3.20$, $p=0.003$), giving students greater autonomy for designing their own projects (2.464, $p=0.019$), and grouping students in mixed ability teams ($t=2.080$, $p=0.046$). For example, one teacher said:

> I'm not as important to their [the students'] learning as I thought I was! I can actually let them "go" and they will learn certain things. I've got to create the environment, I've got to be there to do the controlling of it, but I can let them learn a lot on their own.

LC teachers ($N=10$) reported similar pre–post program increases in confidence to experiment with new approaches in the classroom. For instance, in the area of student assessment, they departed from traditional paper and pencil testing and began trying alternative assessment techniques. Consequently, they reported more use of student journals for assessing mathematics ($t=2.714$, $p=0.024$), and

more use of interviews/conferencing and benchmark books for reading assessment (both $t=2.449$, $p=0.037$).

Teachers in ABEL ($N=45$) also reported increased confidence from their project involvement, particularly in technology use. Some 78% of teachers "agreed" and "strongly agreed" that the way ABEL introduced them to new technologies and supported them in their classroom use of the technologies increased their confidence in using the technologies for teaching and learning. ABEL encouraged teachers to take risks as a way of developing confidence to integrate technologies into their practice. For example, two teachers set up a multi-school video-conference for an arts and multimedia project. The lead teacher commented:

I allowed myself as a teacher to make mistakes, I allowed the students to make mistakes. Sheila and I spent the morning trying to upload everything the day of [the conference], because we couldn't figure it out for the two days [prior, but] I feel that even though that caused stress it was still a really good learning experience. Yeah, we made a lot of mistakes, but I think now I'd walk into it with more confidence.

Although no pre–post surveys were done for the ABEL project evaluation, teacher comments such of this were common throughout the evaluation report.

5.4. Research question 4

The impact of the three blended programs on students was the subject of the fourth research question. Two main categories were coded for this analysis: teacher perspectives and student perspectives.

5.4.1. Teacher perspectives

Over three quarters of ABEL teachers surveyed ($N=45$) stated that their students were more engaged and on-task than usual when resources and tools made available through the project were deployed in the classroom. The teachers whom we interviewed used words such as "excited" and "stimulated" to describe their students' responses to the use of the ABEL tools and resources. Improvements in general literacy skills was one type of student outcome mentioned by a several of the teachers interviewed; also some teachers reported that English language learners who participated extensively in online discussion forums with other students improved their reading and writing skills. The capacity to communicate appropriately in new contexts with others from culturally distinct groups was another literacy skill seen to be developing in one cross-school project. Teachers widely acknowledged that digital literacy skills (see New London Group, 1996) were also being developed as students learned to apply different tools and resources to their learning needs, participate in the larger digital world, and assume appropriate voices for engaging in educational discussion in blogs, forums, and when using email. For example, a high school teacher reported that:

[Students] are learning about the etiquette of how to communicate with people [they've] never met before. And that there is a very professional attitude that has to be, a mature attitude that has to be taken up by them. Which is forcing them to go beyond their MSN Messenger and Facebook, and that kind of dialog. So that they are becoming dual technology users in my mind. Like, there is that one very casual sort of dialog that they have in one realm of their technology world. And then they have the academic technology world. And I am trying to teach them that you can't say this and you can't say that.

In TeL teachers said in focus group interviews that their students started to enjoy science more than they had previously; they were more engaged in and motivated to learn by the inquiry-based approaches that teachers had began to try; students took more ownership in their work; and better teamwork skills had begun to develop. This view is illustrated by one teacher who said:

I have witnessed or noticed that students are more engaged, they are more motivated. They seem to be really into the science, and some of them have chosen science as their favourite subject now whereas it wasn't before.

As for mathematics, teachers reported that students enjoyed the mathematics activities they introduced from the program and that students found them very engaging. Both science and mathematics teachers saw signs of improvements in students' self esteem, attitudes, motivation, and better on-task behavior as a result of TeL activities.

The evaluation of LC did not specifically ask teachers about the impact of their changed teaching practice on students. Instead, school results on provincial literacy and numeracy tests were presented in the report. As a whole students in LC tended to improve their performance between the project beginning and end on provincial reading assessment tests (6 out of 7 schools met the provincial standard) and writing tests (4 out of 7 schools met the provincial standard); however schools mathematics performance decreased for 5 out of 7 schools. The extent to which these changes can be attributed to the project was unclear as LC was only one of several professional development initiatives in which teachers from those schools participated.

5.4.2. Student perspectives

TeL was the only one of the three projects that collected data directly from students. Pre and post program surveys were given to students to assess changes in attitudes toward mathematics in year one and science in year two. Unfortunately, students ($N=427$) did not seem to value mathematics as much at the end of the project than at the beginning as fewer agreed with statements that "mathematics is important in their lives" ($p=0.045$) and that "it is important to do well in mathematics" ($p=0.038$). Also disheartening is that more students agreed with a statement at the end of the project that "mathematics is boring" ($p=0.019$). The one positive sign was that at the end more believed that "it is important to do well in mathematics at school" ($p=0.014$). Analogous questions were asked of the science students ($N=401$) at the beginning and end of the second year and no significant differences were found on the same items. However, one relevant significant difference was found: fewer students felt that science was their weakest subject ($p=0.009$).

6. Summary and conclusions

This study examined the findings of three evaluations of blended professional development programs with the goal of answering four research questions related to situated design and implementation, development of community, changes in teacher practice, and impact on students. The literature suggests that all four of these factors need to be better understood vis-à-vis blended professional development to advance understanding in the field. With regard to the first research question on situatedness, the literature suggests that teachers need the opportunity to learn on the job and try out ideas in their classrooms, as well as in other contexts, that are directly related to the curriculum they have to teach (Borko, 2004). All three programs that we studied provided that opportunity for teachers, but they varied in terms of how successfully they were able to accomplish it. There appeared to be a relationship between program structure, in terms of content and online expectations, and relevance. The more structure that a program imposed, the less flexibility it provided teachers to experiment with activities in the classroom at same time they were planning on teaching them. ABEL, for example, allowed teachers to use the project resources whenever they wanted, whereas TeL had a fairly rigid

timetable for teachers to complete specified activities. At the same time flexibility seemed to be directly related to online participation. In other words, a highly flexible program like ABEL saw weak online participation whereas the most structured program, TeL, saw relatively strong participation. Therefore, developers of blended programs need to be aware of these trade-offs when designing the overall structure of a program.

With regard to the second research question, all participants in all three programs developed a sense of community. However, none of the programs could be characterized as a "community of practice" as articulated by Wenger (1998) *i.e.*, as "a collection of individuals sharing mutually defined practices, beliefs, and understandings over an extended time frame in the pursuit of a shared enterprise." Rather they functioned as a community of teachers striving to improve their professional practice. On the whole teachers did not engage in online discussion very extensively, a problem documented by other researchers of online communities (Charalambos et al., 2004). Therefore, the face-to-face component of the blended experience became critical for continuity and for strengthening the sense of community. This finding is consistent with the work of Rovai and Jordaan (2004) who found that teachers in a blended learning graduate course experienced a greater sense of community than those in either traditional or fully online versions of the course. Furthermore, we found that a shorter period of time between face-to-face sessions resulted in a stronger community, so a blended model that has face-to-face sessions interspersed throughout the school year is likely to be more effective than the same number of days concentrated into a summer institute or similar intense session.

All programs had as a major goal to change teacher practice from a traditional pedagogical orientation to an inquiry-based, student-centered approach which was the subject of the third research question. There was evidence that all three had some impact on teacher practice in directions intended by the program developers, especially the ABEL and TeL programs. The degree of impact seemed to be related to how closely the programs met teachers' immediate needs: the more relevant the programs were to teachers' everyday work, the more likely teachers were to change their practice.

The final research question dealt with designing blended programs to have an impact on students of participating teachers. Anecdotal reports from teachers in ABEL and TeL suggested that students benefitted from their changed teaching methods in terms of engagement and motivation, although students in TeL did not appear to like mathematics or science more as a result of their teachers' practices. There was some evidence of improved student achievement in reading and writing as a result of LC. Thus one might speculate that the extent to which teachers changed their practice is related to the degree of impact on students. This suggests that blended programs designed to bring immediate, "just-in-time," changes to teacher practice are more likely to have an impact on students.

In conclusion, this study supports the contention that blended learning is a viable model for teacher professional development. The approach allows teacher learning to be situated in classrooms where teachers learn best, it provides access to an online community where collegial sharing and discussion can occur, and it offers face-to-face sessions that can strengthen community building. Moreover, blended learning can have a positive impact on teacher classroom practice, and consequently, there is some evidence that student attitudes toward learning and achievement can be enhanced as well. Despite these strengths more research needs to be done to find ways of increasing teacher participation in the online component of blended learning programs. It is also recommended that future research be directed toward examining various designs of blended programs and their impact on student learning as this is the ultimate goal of teacher professional development.

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