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Collaborative Professional Development in Higher Education: Developing Knowledge of Technology Enhanced Teaching

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Abstract

This paper describes a professional development initiative for teacher educators, called the *Digital Pedagogies Collaboration*, in which the goal was to build faculty knowledge about technology enhanced teaching (TPACK knowledge), develop a collaborative learning and research community of faculty members around technology enhanced teaching, and provide opportunities for faculty to serve as future workshop facilitators and mentors for other faculty and students. Using a design-based research approach, data sources included workshop evaluation surveys, photographs of workshops in progress, researcher field notes, and narrative case reports constructed by faculty members actively involved in the collaborative research. Findings indicated that the *Digital Pedagogies Collaboration* was effective because it was: 1) based on faculty members' expressed instructional needs, 2) used a TPACK-based professional learning workshop model that translated TPACK principles into practical classroom application, and 3) uniquely included a research collaboration that provided self-study reflection on participants' changing teaching practices.

Keywords: Undergraduate education, higher education, pedagogy, experiential learning, teaching practices.

With the ubiquity of mobile and digital devices in our daily lives, learning and how we learn has changed (Borko, Whitcomb, & Liston, 2009). Bachmair, Cook, and Kress (2010) argue that "in order to avoid a potential disconnection between the ways young people operate in their daily lives and the ways educational institutions interact with them" (p. 3), all sectors of the educational system must keep pace with these changes in how students learn. However, the focus of professional development (PD) for educators over the past two decades has been on how to improve/enhance inservice and preservice teachers' integration of technology to impact student learning in K-12 schools (Angeli & Valanides, 2009; Harris, Mishra, & Koehler, 2009; Jaipal & Figg, 2010; Niess, 2005). The few initiatives (e.g., Bai & Lehman, 2003; Lan, 2001) that have focused on the instructional practices of higher education faculty indicate that technology professional de-

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velopment for higher education faculty is different; it must be purposeful, perceived as beneficial to their professional practice and research goals, and address course learning goals. This gap in the research is significant as teacher educators are tasked with the teaching of a new generation of teachers; yet they do not have the knowledge and skills to model digital learning in their own pedagogy (Ertmer, 2005).

Research shows that the adoption of technology within instruction by higher education faculty is not widespread (Moser, 2007; Johnson et al., 2013). Even though faculty in higher education are subject matter experts in the content they teach, they are often comfortable with the status quo (established course outlines and instructional practices) and resist change (Otero et al., 2005; Johnson et al., 2013). Some barriers to faculty adoption of technology-enhanced teaching have been identified as time to learn the technology, technical competence with the tools, belief that technology may not be critical for learning, reliability of the technology, and insufficient institutional support (Butler & Sellborn, 2002; Johnson et al., 2013; Otero et al., 2005). Additionally, university policies that value research above teaching for promotion and tenure also contribute to faculty resistance to innovate and experiment with technology-enhanced instruction and contribute to faculty perceptions (of engaging in innovative teaching practices) as being beyond their role as academic researchers (Johnson et al., 2013). In a study exploring the factors affecting technology adoption in higher education, Keengwe, Kidd, and Kyei-Blankson (2009) reported that faculty were "more likely to use technology if they had departmental and peer support, cross collaboration with other faculty using technology, and if there was a rewards program in place to attract and motivate them" (p. 25).

At our university, we are addressing this gap through a collaborative PD partnership between university faculty and a local school board technology team, fostering the exchange of knowledge and expertise in teaching with technology, and providing faculty members with professional learning opportunities to advance personal technology teaching skills. The impetus to initiate this PD program was brought about by our faculty acknowledging a need for enhancing their own teaching practice with technology. Our faculty identified some of the difficulties of integrating technology into their personal instructional practices as: 1) the technologies are not always available; 2) there are not enough PD initiatives; 3) and personally, they lacked the confidence to use it successfully in instruction. Issues such as these have led to a lack of technology enhanced teaching in postsecondary classroom instruction, often leading to student dissatisfaction with their educational experiences in higher education (Matrix, 2012).

The *Digital Pedagogies Collaboration* consisted of a small group of higher education faculty from the same department who were interested in learning about how to teach with technology. A series of workshops was offered at different times in the year that were open to the faculty at large. These workshops were attended by small groups of faculty and provided them with concrete applications of how technology could be effectively applied in authentic contexts in higher education instruction. However, it was acknowledged that these characteristics of effective PD for teachers are not sufficient to create buy-in by higher education faculty to participate in technology professional development.

Therefore, the goals of this initiative, called the *Digital Pedagogies Collaboration*, were threefold:

- to build faculty knowledge about technology enhanced teaching (TPACK);
- to develop a collaborative learning and research community of faculty members around technology enhanced teaching;
- to provide opportunities for faculty to serve as future workshop facilitators and mentors for other faculty and students.

Theoretical Framework

The design of the PD initiative, *Digital Pedagogies Collaboration*, was informed by the literature on teacher PD and technology enhanced teaching. The literature suggests that PD opportunities are effective when they involve collective participation of teachers from the same school or a group of schools, has a high probability of affecting student learning, and is facilitated through study groups, mentoring and coaching (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Hargreaves, 2003; Hung & Yeh, 2013; Ingvarson, Meiers, & Beavis, 2005; Figg & Jaipal, 2013; Joyce & Showers, 2002). Borko, Jacobs, and Koellner (2010) additionally suggest that effective PD for teachers is situated in practice and addresses problems of practice; includes modeling of the instructional practices to be learned; and involves active teacher learning through collaboration. Therefore, these characteristics were incorporated into the design of the initiative.

Additionally, the *Digital Pedagogies Collaboration* initiative was designed to focus the collaborative learning on technology enhanced teaching, especially the building of Technological Pedagogical and Content Knowledge (TPACK) in faculty members. Although teacher knowledge involves understanding the complex interactions between content, pedagogy, and technology, our focus in the *Digital Pedagogies Collaboration* were three components of the TPACK model (Mishra & Koehler, 2006) namely:

- TCK (Technological Content Knowledge), or knowledge about content-appropriate technologies and how "technology and content influence and constrain one another" (Koehler & Mishra, 2008, p. 16);
- TPCK (Technological Pedagogical Content Knowledge), or knowledge about how teachers think about representing content using technology in instructional practice, (Jaipal & Figg, 2010);
- TPK (Technological Pedagogical Knowledge), or knowledge of practical teaching competencies (i.e., classroom management, differentiated support, and assessment) (Jaipal & Figg, 2010).

Specific to this study, was an adapted approach to learning about technology that is reflected in a model proposed for the design of content-centric PD workshops: the *TPACK-in-Practice Professional Learning Design Model* (TPLDM) (Figg & Jaipal Jamani, 2013). The TPLDM model consists of four distinct phases that reinforce a content-centric approach to teaching with technology.

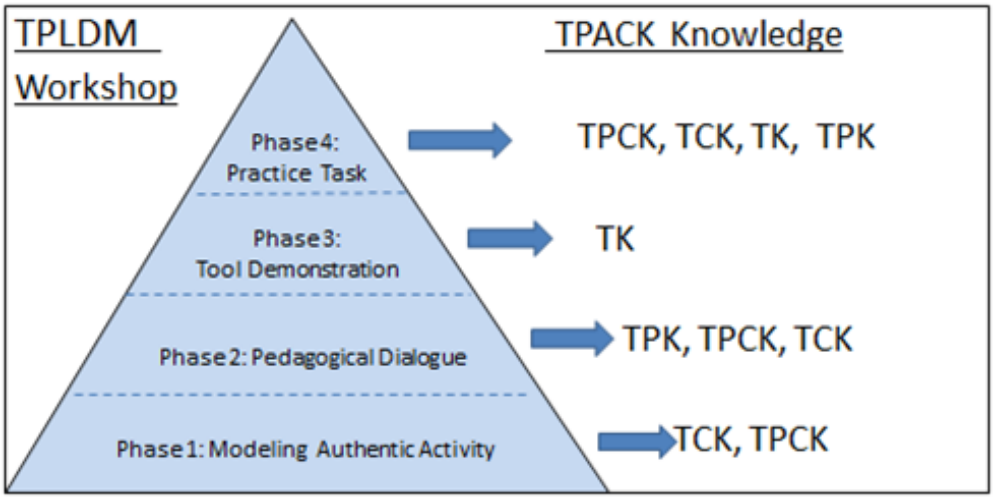

Figure 1: The TPLDM-Based Workshop Model and development of TPACK knowledge.

Figure 1 shows how teacher knowledge about teaching with technology (referred to comprehensively as TPACK knowledge) is promoted by the TPLDM workshop phases. Phase 1 begins with the instructor modelling an authentic technology-enhanced content activity in a higher education course context, followed in phase 2 by a discussion of the pedagogical constraints of the technology-enhanced activity in actual practice. Thereafter, the instructor demonstrates the necessary technical skills required for tool use to create or implement the activity (phase 3). The final phase of the workshop involves participants applying technical and pedagogical skills to an authentic activity/practice task they can apply in their own courses.

The purpose of this research study was to gain insights into faculty members' experiences and the knowledge gained about technology-enhanced teaching as they participated in the *Digital Pedagogies Collaborative*. Accordingly, the following questions guided the research:

- What were faculty members' evaluations of the design of the professional development workshops?
- How did faculty members' teaching practice change through participation in the *Digital Pedagogies Collaboration*?

Methods

The research approach used in this study was design-based research. Design-based research is described by Anderson and Shattuck (2012) as a "practical research methodology that could effectively bridge the chasm between research and practice in formal education" (p. 16). Anderson and Shattuck further characterize the approach as:

1) being situated in a real educational context,
2) focusing on the design and testing of a significant intervention,
3) using mixed methods,
4) involving multiple iterations,
5) involving collaborative partnership between researchers and practitioners, and
6) evolving design principles.

Design-based research was an appropriate method for this investigation because participants were situated in the authentic educational context of learning how to enhance their own teaching practice with technology, through participation in a series of technology workshops and collaborative research opportunities.

The initiative began with a cadre of 13 faculty members who were interested in collaboratively learning about, and researching, how to improve their teaching practices with digital technologies. The two lead faculty researchers administered an informal needs assessment to this group indicating the types of technologies of interest to them. Concurrently, a partnership was developed with the local school board where school board technology experts were recruited to act as workshop facilitators. These facilitators were initially provided with training by the researchers on how to conduct workshops using the TPACK-based workshop model (Figg & Jaipal, 2012). The researchers wanted to emphasize the need for workshops that focus on pedagogy and content-teaching, rather than the teaching of technical skills (Jaipal-Jamani & Figg, 2015).

Based on the needs of the faculty, a first series of TPACK-based workshops were presented in December 2012, and called, "Lagniappe Workshops" because they offered a variety of technology enhanced teaching activities in short focused workshops. The members of the collaborative, as well as other faculty, instructors, and graduate students, attended. These workshops featured a variety of technologies, including teaching with SMARTBoards, digital tools such as Prezi, Pinterest, Google Drive documents, and mobile devices such as iPads and document cameras. The first workshop series was followed by a faculty retreat in January 2013 where faculty members of the technology research collaborative provided feedback on the workshops, and learned how to present a TPACK-based workshop so that they, too, could become future facilitators. Participants also discussed ways to research their professional learning experiences, such as keeping journals and writing a narrative. A second series of workshops, similar to the first, was conducted in August 2013. The third iteration of workshops occurred in the summer of 2014 where some faculty members of the technology research collaborative served as facilitators (findings from this phase are to be published in a subsequent paper). In this way, the research approach involved multiple iterations in a cycle to improve practice and faculty confidence in how to teach with technology. This current paper reports on participants' perceptions of the PD workshops they attended during the first year of the project and how it influenced their teaching practice.

The main data sources were workshop evaluation surveys and narrative case reports. Findings related to the effectiveness of the workshops were triangulated using additional data such as photographs of workshops and observational field notes made by the lead

researchers at workshops. Observational field notes and photographs were coded for characteristics of content (type of TPACK knowledge) and structure (phases of workshop) consistent with the TPACK-based workshop model. The evaluation survey included questions that elicited participants' satisfaction with the structure, pacing, relevance, and content of the 11 workshops respectively, using a Likert scale of 1 (very dissatisfied) to 4 (very satisfied). This evaluation was used to obtain descriptive quantitative feedback and was not validated statistically. Feedback on the scheduling and recruiting process for workshops was also obtained. The practical impact of this design-based intervention on faculty members' instructional practices and perspectives towards technology enhanced teaching was determined by analyzing the three narrative case reports (i.e., Tiffany, Ruth, Katia) based on the following four questions:

1) How did you feel about teaching with technology prior to these workshops?
2) How did you use what you learned from the workshops in your own instructional practices?
3) How has your own personal knowledge and confidence in teaching with technology changed? How would you describe the difference in your instructional practices now compared to those before the workshops?
4) Describe what you would be confident to teach to other faculty members in small groups or workshop sessions.

The narrative case reports were also interpreted by the lead researchers to highlight evidence of change in instructional practices and perspectives towards technology-enhanced teaching. All participating authors then reviewed the interpretations of data, providing further triangulation through member checking (Creswell, 2014).

It should be noted that design limitations of the study were that data were self-reported and the number of participants was small. At the time data were collected, faculty were at different stages of the design, implementation and reflection on technology-enhanced teaching practice which resulted in a small number of faculty being ready to share their reflections in narrative form. Hence, the findings cannot be generalised to the larger population; however, findings do provide insights that may inform the implementation of faculty professional development in similar university contexts

Results

The results are presented in relation to the two research questions which investigated faculty members' evaluations of the design of the PD workshops and explored how faculty members' technology-enhanced teaching practices changed through participation in the collaborative PD initiative.

Design of the professional development workshops

Feedback on the effectiveness of design of the PD initiative was received through the workshops evaluation surveys and field notes. The December 2012 workshop attendees (*n = 48*) rated each workshop in terms of their satisfaction with structure, pacing, rele-

vance, and content of the workshop, as well as some feedback on the scheduling and recruiting process for workshops. The overall rating of workshop participants was 3.8 on a Likert scale of 1 (very dissatisfied) to 4 (very satisfied) for all 11 of the workshops. Attendees indicated that the structure of the workshop, using the *TPACK-based Professional Learning Design Model (TPLDM)* (Figg & Jaipal Jamani, 2013; Jaipal-Jamani & Figg, 2015), in which a technology enhanced learning activity was modeled, provided needed context for adapting the featured technology to their own instructional practice. As well, attendees found the concrete, hands-on application phase of the workshop provided strategies and skills for using the technology authentically. Suggested improvements included scheduling individual workshops over a period of time rather than scheduling five workshops concurrently – they were unable to attend workshops held at the same time; conducting workshops for longer periods of time – they suggested that 1 hour and 15 minutes was not sufficient time to complete the hands-on application phase of the workshops.

As a result of this feedback, a second series of five workshops were scheduled so that only one workshop was held at a time over a period of two days. As well, the length of the workshops was extended to 1 hour and 30 minutes.

Changes in Technology-enhanced Teaching Practice

Vignettes from three narrative case reports are presented to illustrate the impact of the PD initiative on their technology-enhanced teaching practice.

Tiffany's Experience

Tiffany is an Associate Professor, teaching in the field of educational psychology, and she conducts research in the areas of inclusive education and technology use in language and literacy contexts.

> *My personal knowledge is modest, but growing; my confidence in teaching with technology has changed, but there is a long way to go on the continuum. On a positive note, I would have never thought that I would be even considering using such instructional suggestions until taking these [PD] sessions. It was not so much my lack of ideas for the pedagogical possibilities as my lack of understanding of the technological-pedagogical possibilities.*

Here Tiffany shares that prior to attending these sessions, she lacked knowledge of the different ways teaching and learning change when different technologies are used, especially the pedagogical affordances and constraints of technologies in relation to pedagogy, which she gained from the PD sessions. This type of teacher knowledge that she acquired at the workshops is referred to as TPK, which is highlighted in workshops that are content-centric as opposed to workshops that focus on learning of technical skills (Mishra & Koehler, 2006; Figg & Jaipal Jamani, 2013).

> *I have already planned how to implement QR codes and Pinterest in an upcoming session of my Language Arts Methods class. As well, there is an assignment in*

> *this course that requires students to create a digital presentation of a Personal Literacy History. I have already used Timeglider™ to create an exemplar as a model for my students.*

Tiffany had attended the PD workshops on QR codes and Pinterest. She then followed through by incorporating these technologies by planning technology-enhanced activities for her upcoming Language Arts methods course. She also incorporated another technology, Timeglider™, into an assignment, and created an exemplar to show to her students during the upcoming semester. The use of modelling a technology-enhanced activity is an effective strategy for teaching others how to use technology in content areas (Harris, Mishra, & Koehler, 2009; Jaipal & Figg, 2010) and this strategy was also modelled in the PD workshops.

> *At a recent conference, I facilitated a session that featured how certain apps on an iPad could offer ways to differentiate and assess students in literacy to graduate students. I repeated the session with my teacher education students; however, I needed to modify my session to work within IT requirements. I would be confident teaching other faculty members about offering teacher candidates ideas for differentiation and assessment through apps and even exploring how these apps might help them to differentiate and assess teacher candidates.*

Tiffany describes the reflection on her own practice where she identified the need to modify her practice in her second iteration using iPads with her preservice teachers. She also conveys her willingness to teach other faculty how to use technology apps in her content area specialization of differentiation and assessment demonstrating confidence in her abilities to use technology to teach in her content area.

Ruth's Experience

Ruth is a Professor, teaching language arts, and she conducts research into using technology in the language arts classroom, with a special interest in word study.

> *The workshops were part of a smorgasbord of opportunities I have sought out in the past few years to enhance my comfort level with technology. I am definitely a "digital immigrant" but I am willing to take risks and try new applications. I am particularly drawn to presentations and workshops that model or describe the effective implementation of digital technology in elementary classrooms.*

Ruth acknowledged her lack of experience with technology and her willingness to make concerted efforts to enhance her knowledge of and comfort level with technologies that can be implemented in elementary teaching practice.

> *I attended the following workshop sessions: 1. Create an interactive presentation using Prezi; 2. Pinterest for interest; 3. Interactive research using QR codes and iPads (taken later); 4. Visuals galore! Enhancing instruction with the document camera. I found that two of the workshops moved too quickly for me (Prezi and*

> *QR codes). However, I have a better cursory knowledge of their functions than I did before the workshop. I am making use of both Pinterest and an Ipevo document camera in my pre-service language classes. I am creating a growing selection of Pinterest Boards to cover various educational interests of mine. Just today I found the hard copy of a tutorial we received on using Pinterest at the original workshop. I plan to go back over it to refine my use of this popular resource. I purchased an Ipevo document camera as a result of the workshop on this device. This past week I used the document camera while reading a picture book to my teacher candidates.*

Ruth attended a number of the PD workshops on different internet technology applications, iPads, and the document camera, and found the workshops and tutorials useful for enhancing her technical knowledge (TK). Attending the PD workshop on the document camera had an influence on Ruth's teaching practice evidenced by her purchasing her own document camera and using it in a highly appropriate manner for Language Arts instruction. The latter example also demonstrates how these content-centric workshops promoted the development of TCK—knowledge of content-appropriate technologies.

> *I would say that as a result of the workshops and other professional development opportunities, I feel much more confident using such applications in my own teaching. I believe I have a talent for infusing technology into my lessons in a meaningful manner to complement other resources rather than as a "razzle dazzle" stand-alone production. My students are responding in a very positive manner – describing how they are now using these ideas for their micro-teaching and upcoming teaching blocks. I find this extremely gratifying.*

Ruth attributes her growing confidence to using technology in her teaching to professional development opportunities provided in this study. She demonstrates the positive outcomes of this project by reflecting on her relationships with her students, and describing how they have benefited from her use of technology in her teaching. One of the ways to assess the quality of research is reflecting on the benefits of one's practice on others (McNiff, 2013).

> *As I become more familiar with technology, it is easier for me to learn new applications. Many of the same principles underlie various forms of software. The learning is incremental, so that my total knowledge base is not really extensive; it is simply that I am learning to turn the same few principles into multiple uses. I feel confident in working with one or two colleagues on how I use certain applications. However, the idea of creating a workshop and presenting it still feels like a giant leap for me.*

Ruth shows increasing TPACK knowledge as she is able to make connections among technology applications (similarities of functions between applications) and its pedagogical uses in different content areas or contexts. She exhibits confidence to share her knowledge of certain applications by mentoring small groups of colleagues.

Katia's Experience

Katia, a recent PhD graduate, is an instructor teaching courses in literacy and language arts and educational technology, and her research focuses on the integration of multimodality in K-12 literacy learning and motivational processes in learning with digital technologies.

> *As a teacher of digital natives, and a digital native myself, I have always sought to find more effective ways to incorporate technology into a traditional print-based curriculum. Prior to attending these workshops, I used technology (specifically, a desktop computer) in my classes to deliver instruction to my students (i.e., PowerPoint), conduct research on K-12 education topics, as well as distribute course materials and communicate asynchronously with my students via our online learning management system.*

Katia is competent at using various types of technology in her instruction for different purposes such as presenting information and managing her course online.

> *By attending the "Pinterest for Interest" workshop, for example, I learned that this Web 2.0 tool was a great online resource for educators - a hub where my students and I could find everything from lesson plans for different grades to classroom arrangement and decorating ideas, and important topics such as bullying prevention. The "Interactive Presentations Using Prezi" workshop showed me that this Web 2.0 tool was a much more engaging alternative to PowerPoints and is better suited to meet the preferred learning styles and needs of today's 21st century students. This workshop introduced me to new teaching ideas, some of which include the use of Prezi for digital storytelling and creating multimodal autobiographies. The immediacy and hands-on experience with the applications [in the workshops] were important aspects that contributed to my professional learning and increased confidence in teaching with these technology tools. I have subsequently transferred these skills, instructional strategies, and principles of practice to my classroom. As a function of collaborating with my colleagues, I was able to add a repertoire of instructional strategies, resources, and lesson ideas to my evolving technology toolkit.*

Attending the PD workshops gave Katia knowledge of alternative Web 2.0 based applications that she could use in her instruction. Participation in the workshops and the collaborative research enhanced her TPACK knowledge—she learned about how to use technologies (e.g., Prezi) for specific instructional activities (e.g., digital storytelling) in particular content areas (e.g., language arts). The content-centric design of the workshops which included modelling an authentic instructional activity and an application phase where participants designed their own activity enabled Katia to make concrete links between content, pedagogy and technology and helped the visualisation and/transfer of the activity into her practice.

> *I am confident to teach other faculty members about the potentials and pitfalls of electronic books in classroom instruction. In my workshop sessions, I would have faculty members explore and critique a list of eBooks apps, as well as provide them with the opportunity to create their own eBooks that align with the Ontario curriculum expectations.*

Katia is confident in her knowledge of how to teach with electronic books in language arts instruction and volunteered to conduct a workshop.

Discussion

In this study, the experiences of a group of Teacher Education faculty, including instructors and graduate students (n = 48), contributed to changes in the design of the second iteration of PD designed to support technology-enhanced instruction in higher education. As well, the narratives of 3 faculty members reflecting on their professional learning, offered insights into how the PD influenced faculty members' adoption of technology in teaching practice. Overall, the 48 participants attending the workshops indicated that the design of the PD opportunities provided by the initiative were very satisfactory. They expressed satisfaction with the structure and content of the workshops, indicating that they found the modeling and application phases useful for developing knowledge of technology-enhanced instruction that could be transferred into classroom practice. They also provided recommendations for change. Consistent with design-based research, the second iteration of the intervention (the workshop series) was modified per participant feedback. Additionally, faculty members in the *Digital Pedagogies Collaboration* initiative, after participating in the workshops, reported increased confidence and plans to incorporate of the workshop technologies in their instructional practice (retreat field notes and narrative reports). These findings suggest that the TPLDM workshop model was effective for designing PD workshops to develop TPACK knowledge.

The three case narratives further highlight the practical changes in teaching practice and the growth of teacher knowledge about how to teach with technology (TPACK) Although all three faculty member participants demonstrated different levels of technical skill and confidence in using technology, participation in the workshop series enabled them to gain confidence in using specific tools that were relevant to their practice. They were then able to plan for and implement technology enhanced teaching activities in their classroom practice (Tiffany included QR codes and Pinterest into her course; Ruth incorporated the document camera into her language arts instruction; and Katia used Prezi during instruction on digital storytelling). As well, all three faculty members could articulate ways in which they would adapt the technology encountered in the workshops to meet student learning needs. Another goal of this project was to develop leadership skills in the area of technology teaching and provide leadership opportunities for faculty to teach workshops; two of the participants, Katia and Tiffany, indicated a willingness to conduct Lagniappe workshops, and Ruth is willing to mentor others in small groups. These findings reinforce that for this small group of faculty, participation in the research collaborative, the *Digital Pedagogies Collaboration,* enhanced confidence in their abilities to use technology to

teach their students and to also share knowledge of their technology-enhanced teaching practices with other faculty in formal (workshops) and informal contexts (small groups).

Additionally, the PD was initiated and organised by a group of faculty with funding from the Teacher Education department. As such, a supportive peer community was created for faculty to collaborate with other faculty on how to use technology in teaching practice (the literacy professors shared their ideas and experiences with other literacy professors) and to engage in collaborative research and writing. These types of support have been recommended for promoting faculty adoption of technology in teaching practice (Keengwe, et al., 2009) and the *Digital Pedagogies Collaboration* was successful at supporting some faculty in this study to integrate technology into their university courses and conduct research and write about their developing practice. We hope that further iterations of the workshop series with faculty members as workshop leaders will encourage more faculty members to participate in the PD collaborative, increasing system wide impact.

Significance and Implications

Similar to Lan (2001) and Bai and Lehman (2003), our professional development model was designed to be purposeful, beneficial to professional practice, and address faculty members' content learning goals. The choice of technology for the workshops was based on faculty members' expressed needs, as well as what is currently being used by teachers in the local school boards so that teacher educators were introduced to technology relevant to current teaching practices in the field. The model of collaborative professional learning that we implemented is unique in that it uses design-based research, involving a sustainable, recursive action cycle – attending Lagniappe workshops designed with the *TPACK-based Professional Learning Design Model (TPLDM)* (Jaipal-Jamani & Figg, 2015), then planning and implementing technology enhanced activities within personal instructional practice, reflecting and writing narratives about the process, and finally sharing this knowledge with others through facilitating Lagniappe workshops or mentoring. A benefit of design-based research is that the intervention evolves based on participants' experiences and future needs. It is not a static process but is dynamic.

The design of the PD workshops using the *TPACK-based Professional Learning Design Model (TPLDM)* translates TPACK theoretical principles into practical classroom applications. This theory-practice transfer is facilitated through the four phases of the workshop model [For further information on this workshop model, refer to Figg & Jaipal Jamani, 2013).

Consistent with other studies that implemented study groups, mentoring and coaching as effective ways to facilitate professional development (Borko et al., 2010; Hung & Yeh, 2013), our study extends the literature by incorporating a technology research collaborative leading to both professional development (TPACK knowledge for technology enhanced teaching) and scholarly reflection in the form of self-study (Figg, Griffin, Lu, & Vietgen, 2008; Gallagher, Griffin, Ciuffetelli-Parker, Kitchen, & Figg, 2011). Participants, being involved as both learners and researchers, supported each other in the devel-

opment of the technical and pedagogical skills necessary for technology enhanced teaching and engaged in narrative documentation of their changing teaching practices. Such individual stories contribute to better understandings about the experiences of faculty as they adopt technology in practice (Keengwe, et al., 2009). While such findings cannot be generalized, the lived experiences of different individuals as reflected in the self-reported feedback on satisfaction surveys and written narratives of PD experiences in a natural setting, offer insights about how to promote faculty use of technology in higher education instruction and can inform the design of similar PD initiatives in similar settings.

The present study has also addressed some of the barriers raised in the literature to faculty adoption of technology-enhanced teaching (Butler & Sellborn, 2002; Johnson et al., 2013; Otero et al., 2005). The barrier of time to learn was addressed by repeating workshops and offering them over consecutive days and during the year to provide more options for attendance. The belief that technology may not be critical for learning was addressed by designing workshops using the TPLDM workshop model which focuses on how technology meets content learning outcomes rather than technical skill instruction. Reliability of the technology was addressed by selecting software applications that were easily accessible in classrooms via the Internet, and hardware such as a document camera that were available for use at the university with institutional support. Further pedagogical and technical supports were provided to faculty by the lead researchers. Overall, the findings indicate that the peer-supported, collaborative PD initiative, incorporating content-centric professional development experiences (Figg & Jaipal, 2013, Figg & Jaipal Jamani, 2013) where faculty mobilised themselves into action (McNiff, 2013), promoted the development of knowledge about technology-enhanced teaching (TPACK) and the transfer of that knowledge into practical classroom applications.

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