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# **Transforming Mobile Learning and Digital Pedagogies: An Investigation of a Customized Professional Development Program for Teachers in a Hospital School**

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In an initiative to improve learning experiences and outcomes for students, the leaders of a school located in a hospital in Australia implemented a new digital strategy with mobile technologies and relevant digital pedagogies. This study examines the outcomes of a professional development program introduced to effect transformational change by enabling integrated use of mobile technologies in the hospital school. The study examines teachers' views following completion of this customized professional development program, using a mixed methods investigation situated within the unique learning environment of the hospital school. A key finding is that identifying and addressing teacher needs through customized professional development, supported with individualized coaching, can increase the participating teachers' technological pedagogical knowledge to enable the improved use of mobile technology in a hospital school setting. Additionally, hospital school teachers responded to opportunities to collaborate as a professional learning community to implement, support, and enhance mobile learning for hospitalized students. The findings from this study have significant implications for leaders in all schools and systems embarking on similar initiatives to transform pedagogical practices through professional development supporting mobile technology integration in a digital world.

In the unique setting of a school located in a hospital, hospitalized students must be provided with inclusive educational opportunities and learning initiatives equivalent to their regular school peers. In part, these opportunities facilitate a successful transition back to their regular school (Franck, Gay, & Rubin, 2013). Hospital teachers provide learning experiences typical of a traditional classroom environment together with bedside instruction and distance learning.

Mobile technologies in the hospital school, including tablets, smartphones, and online learning and teaching applications (apps), enable teachers to produce tasks that replicate those experienced in the students' regular school. Students can, thus, experience collaboration and communication tools to maintain support as they transition from hospital, to home, and back to school.

At the hospital school where this study was located, transformational change with mobile technologies was undertaken for three purposes (McCarthy, Maor, & McConney, 2017):

1. Improving teachers' technological skills, such as using a mobile device to download education apps from the app store; store, share, and print files.
2. Integrating mobile technologies in teaching, including accessing digital resources from the student's regular school learning system; engaging in projects that utilize productivity and creativity applications.
3. Supporting children's learning while in the hospital; for example, collaborating with a student's regular classroom and teacher using a video chat application like Skype to ensure continuity of learning and connection to peers and the school.

In the first phase of this initiative, we identified and previously reported significant obstacles to teacher preparedness to use mobile technologies in this special learning environment, including lack of Wi-Fi accessibility due to hospital safety policies (McCarthy et al., 2017). The current study investigated the implementation and outcomes of a customized professional development (PD) program, informed by hospital school teacher participant needs, to achieve those three outcomes.

This article reports on an examination of changes in hospital school teachers' views in answer to the following research question: To what extent were hospital school teachers' technological, pedagogical, and personal needs for effective use of mobile technology in a hospital school met following participation in a customized PD program?

The PD program was developed to address hospital teachers' learning needs related to mobile technologies and digital pedagogies (McCarthy et al., 2017). Table 1 lists the three main categories of teachers' needs: technological, pedagogical, and personal support. Nine subcategories of needs were further suggested using an iterative process for analyzing extensive teacher interview data.

## **Literature Review**

An ample literature confirms that well-designed and implemented teacher PD positively influences teachers' practice, and by extension, improves student learning (Botha, Batchelor, Traxler, de Waard, & Herselman, 2012; Gutierrez & Kim, 2017; Hattie & Anderman, 2013; Jensen, Hunter, Sonnemann, & Cooper, 2014; Kools & Stoll, 2016; Saunders, 2014). Furthermore, there seems to be wide agreement in the literature that the PD of teachers is a crucial element in supporting change to enhance learning through mobile and digital technologies (Cavanaugh, Kelley, & McCarthy, 2018; Liu, Ritzhaupt, Dawson, & Barron, 2017; Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016).

**Table 1**  
Categories and Subcategories of Hospital School Teachers' Needs (McCarthy et al., 2017)

<b>Technology Needs</b>	<b>Pedagogical Needs</b>	<b>Personal Support Needs</b>
Personal use, confidence and time	Integrating mobile technologies into teaching and learning	Coaching
Access and IT support	Engaging students, and sustaining their interest	Peer collaboration
Tips and tricks	Understanding and successfully navigating the unique pedagogical context of a hospital [as a site for teaching and learning]	Communication at home and school

Contextual barriers exist, however, to the uptake and integration of mobile technologies in teaching, such as lack of time, access to technologies, or resources (Kopcha, 2013; McCarthy et al., 2017). Barriers also exist at the individual level, including fear of change or lack of vision (Kopcha, 2013; Van der Klink, Kools, Avissar, White, & Sakata, 2017). Dimmock's (2016) research built on Lawrence Stenhouse's work (1975), which argued that to address challenges, schools need coherent, holistic frameworks that support teachers' and students' acquiring knowledge to enable informed decisions.

The potential for positive change through efforts to introduce reform in teachers' technological practices, however, is in danger of being unfulfilled if professional learning fails to inspire teachers to integrate mobile and emerging technologies in their pedagogical practice (Cavanaugh, Maor, & McCarthy, 2018; Kraft & Blazar, 2017). Clinging to familiar but outdated practices can alienate students ready to learn in a technologically rich world, where emerging technologies are ubiquitous outside the classroom (Magen-Nagar & Steinberger, 2017).

A challenge facing education systems, therefore, is understanding how teachers change from "nonusers of technologies to becoming transformative teachers with technology" (Tarling & Ng'ambi, 2016, p. 554). For hospital teachers, knowledge development can be impacted by contextual factors (Phillips, 2017) as well as common barriers to sustaining PD identified by Tondeur et al. (2016), including inadequate infrastructure and lack of use of proven teacher knowledge frameworks like technology, pedagogy, and content knowledge (TPACK) for technology integration (Mishra & Koehler, 2006).

### **Educational Frameworks**

Use and acceptance of educational frameworks is increasing to provide authoritative, evidence-informed research in guiding teachers and providing resources to assist teachers as they increase confidence in the use of technologies (Cavanaugh, Hargis, Kamali, & Soto, 2013; Dimmock, 2016; Haßler, Major, & Hennessy, 2016; McCarthy et al., 2017). Educational models with a focus on integrating technology with pedagogy include TPACK

(Koehler & Mishra, 2009) and 21st-century skills (Kereluik, Mishra, Fahnoe, & Terry, 2013; Mishra & Kereluik, 2011). Each framework has a role in clarifying and supporting the design, implementation, and evaluation of professional learning for effective use of mobile technology in education.

In a recent review of research, TPACK was described as “interdependent, situated knowledge that is needed to integrate the use of digital tools and resources effectively in curriculum-based teaching” (Harris, Phillips, Koehler, & Rosenberg, 2017, p. i). An abundance of research examines how TPACK can support teachers’ development since Shulman’s (1986) research into teacher assessment conceptualized pedagogical content knowledge (PCK; see also Harris et al., 2017).

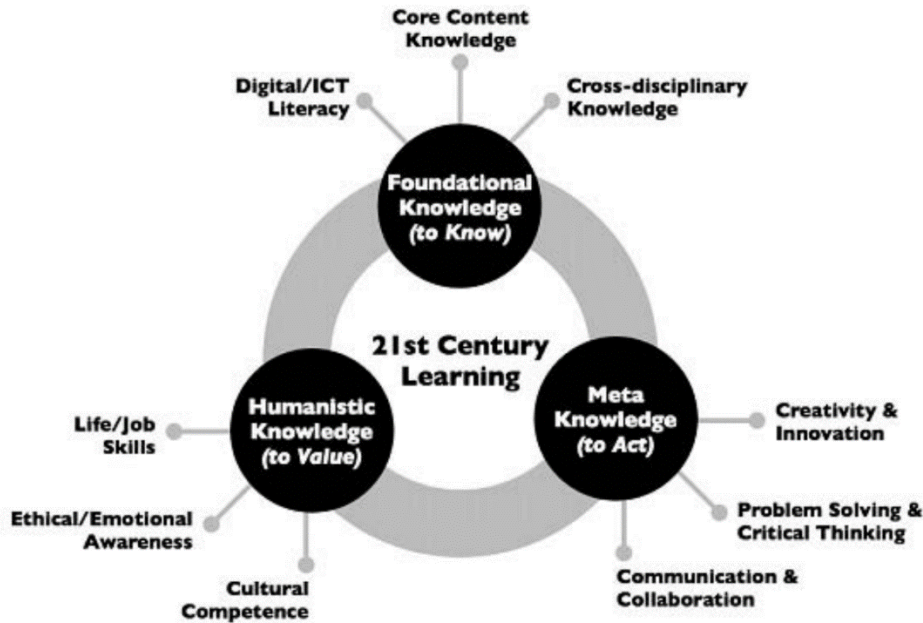
PCK was developed during a period of laying the foundation for teaching reform by identifying “distinctive bodies of knowledge for teaching” (Shulman, 1987, p. 8) and emphasizing “teaching as comprehension and reasoning, transformation and reflection” (p. 13). This foundation has remained relevant with the addition of technological knowledge (TK) to the framework in response to educational technology research (e.g., Koehler & Mishra, 2009).

Further, substantial research has examined ways to apply TPACK, including a recent study by Tondeur, Scherer, Siddiq, and Baran (2017) investigating preservice teacher technology profiles and the implication of these for institutions. TPACK assessment used as a diagnostic tool provides evidence of gaps in teacher preparedness when designing PD for the integration of technology and pedagogy, and reveals the requirement for innovation in digital pedagogies for teaching (Çoklar & Özbek, 2017; McCarthy et al., 2017).

TPACK is a reliable framework for identifying the areas of teachers’ practice requiring support through PD (Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2012). Furthermore, TPACK has “emerged as a representation of the knowledge required to use technology in an educational setting in ways that are contextually authentic and pedagogically appropriate” (Abbitt, 2011, p. 281).

Power (2018) suggested that the TPACK framework can be used as a resource to assess teachers’ knowledge when developing teacher PD, enhancing the effectiveness of instructional design. The framework provides a vocabulary that can be referenced and, through reflection, used to express how practice is transformed (Joo, Park, & Lim, 2018; Koh, 2018; Koh, Chai, Wong, & Hong, 2015). Koh (2018) responded to the criticism of the TPACK framework “as being limited in guiding teachers’ lesson design” (p. 14) by suggesting a need to incorporate TPACK design scaffolds to improve the prescriptive value of TPACK with respect to teachers’ pedagogical change.

In preparing teachers for the 21st-century classroom, examples of typical skills and competencies required are critical thinking and problem solving, collaboration and communication, digital literacy, citizenship, student leadership, creativity, and imagination (Fontanilla, 2016; van Laar, van Deursen, van Dijk, & de Haan, 2017; Voogt & Pareja Roblin, 2012). These 21st-century skills are also needed by students to participate in a knowledge-based workforce (Australian Institute for Teaching and School Leadership, 2019; International Society for Technology in Education, 2019; Organisation for Economic Co-operation and Development, 2018; Peccarelli, 2019).



**Figure 1.** Reprinted from “What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning,” by K. Kereluik, P. Mishra, C. Fahnoe, & L. Terry, 2013, *Journal of Digital Learning in Teacher Education*, 29, 130. Copyright 2013 by International Society for Technology in Education. Reprinted with permission.

When designing PD for teachers, it was recognized that the framework provided by 21st-century skills scaffolds learning, which “ensures that all students benefit from learning about and working with traditional, contemporary and emerging technologies that shape the world in which we live” (Australian Curriculum, Assessment and Reporting Authority, 2019, para. 3). In PD, 21st-century skills helped teachers to understand and appreciate what students required and facilitated alignment with curriculum requirements and capabilities expected for students. In other words, the 21st-century skills framework *supplements* TPACK, acting as a design scaffold (Koh, 2018) using *terminology* that names and describes current and expected teacher technology needs (van Laar et al., 2017).

## PD Design

The need to create adequate opportunities for PD begins with recognizing teachers’ perceptions of the barriers to technology integration (Kopcha, 2013) and an understanding that not all teachers are comfortable with or ready to implement mobile learning successfully into their teaching and administration (Melhuish & Falloon, 2010).

PD initiatives often attempt to convince participants of the need for change, providing a rational argument and the tools to support change (Bryk, 2015; Cavanaugh et al., 2018). However, understanding teachers’ existing pedagogical practices, their needs, and how they change are also critical in effecting sustainable change (Tarling & Ng’ambi, 2016).

A responsibility of technology PD providers is to effectively identify teachers’ needs and tailor PD to meet those needs, bringing about sustainable, effective change. Barrett-Greenly (2013) and Hutchison and Woodward’s (2018) research both demonstrated that

participation in PD increased teachers' confidence and skills in using mobile technology and educational applications for instructional purposes.

Additionally, Gutierrez and Kim (2017) highlighted the importance of context as it relates to teachers interpreting their school culture within a local context to support pedagogical change (Glahn, 2016). Further, Spiteri and Rundgren (2018) described how teachers' knowledge, attitudes, and skills can influence school culture. Unger and Tracey (2013) recommended that technology PD be relevant to teachers' responsibilities and learning be developed through activities created for specific contexts and take advantage of the mobility of teachers.

Hutchison and Woodward (2018) further developed a model of technology-focused PD to examine teachers' proficiency with technology integration and the impact on students' technology literacy in the classroom. Their results indicated that because of the technology-focused PD teachers were "better prepared to envision their roles in the classroom and their purposes for integrating technology" (p. 2) and students performed better on digital literacy assessment.

Leadership support of not only teachers but of the change process is crucial as leaders enable digital innovation and transformation (Roth & Price, 2016). Additionally, teachers have a central role to play in their own professional learning as experts in their profession, with the ability to evaluate the effectiveness of their teaching through reflective practice, self-audits, and recognition of teachers' perceptions of what PD is most beneficial (Marzano, 2017; Unger & Tracey, 2013; Wells, 2014).

Kools and Stoll (2016) recommended that teaching staff be engaged in identifying aims and priorities for their own learning. Improving students' learning through reflective practice and collaboration as a supportive group of teachers (Lave & Wenger, 1991) produces a professional learning community with the capacity to adapt to change (Cavanaugh, Kelley, et al., 2018; Kools & Stoll, 2016). Furthermore, when designing programs for PD, providing opportunities for reflective practice can facilitate new understandings to effect a change in practice (Schön, 1983).

PD supported by experts that targets teachers' needs aligns with a "systems-based mentoring model for technology integration" (Kopcha, 2010, p. 175). A mentor may be able to help teachers overcome barriers to technology integration by modeling technology using the resources available at the school and facilitating a culture of a teacher-directed community to sustain their ongoing use of mobile technologies (Cavanaugh, Kelley et al., 2018; Kopcha, 2010). This mentoring or coaching model for sustaining technology integration supports Tarling and Ng'ambi's (2016) premise that transformative pedagogies engage the learner in analyzing and evaluating their new knowledge.

To address the fast pace of sustainable technology integration, an effective pedagogical PD program must be developed that identifies teachers' needs, acknowledges context and situation, and facilitates a teacher community of practice. This study attempted to increase our understanding of how teachers' needs for effective use of mobile technology can be identified for customized PD design. Additionally, this study examined the role and impact of a technology coach in delivering positive outcomes for teacher's participating in customized PD.

## **Methodology**

### **Research Context**

This research was conducted in a hospital school where teachers face the challenge of providing learning experiences to unwell students of mixed ages in various locations, while maintaining partnerships with parents, regular schools, health professionals, and colleagues (McCarthy et al., 2017). The hospital school in this study operates at 20 government-owned sites across one Australian state, led by one principal based at the largest hospital site (School of Special Education Needs, 2019).

The hospital school provides 60 teaching and liaison programs that support students unable to participate in their regular school program, in urban and rural settings, including a children's hospital from where the school is managed. Staff work in interdisciplinary teams to ensure that students' needs can be supported (School of Special Education Needs, 2019).

The school recently introduced its teachers and students (more than 5,500 per year) to a new strategic plan, which included upgraded information and communication technology (ICT) infrastructure, such as improved Wi-Fi access and provision of mobile devices and digital resources in an effort to enhance teaching and learning. In addition, a PD program was implemented to support needed change and improvement with mobile technologies and relevant digital pedagogies.

The research setting included the hospital classrooms, students' hospital beds, and supporting recuperation facilities. The hospital school operates four terms of 10 weeks each over the course of the school year, mirroring the calendar of regular schools.

We chose the pseudonym Bridge Hospital School (BHS) to represent the research site and to de-identify the location of this study. "Bridge" reflects the role hospital teachers perform in helping students bridge the gaps they encounter between hospital, home, and their regular schools (McCarthy et al., 2017). BHS operates under the charter of children's and young people's rights in healthcare services in Australia, which includes the right for every student "to participate in education, play, creative activities and recreation, even if this is difficult due to their illness or disability" (Children's Hospitals Australasia, 2017, p. 17).

Ethics approval was obtained from relevant authorities (i.e., the university ethics board and state Department of Education) prior to starting the study. This approval was particularly important due to the confidential nature of information held in the hospital setting. Written consent for this research was obtained from the hospital school principal and teacher participants, who were assured confidentiality and that withdrawal from the study could occur at any time without consequence.

We expected that some teachers who began the research process would not continue due to changes in circumstances. Additionally, the school was de-identified to further safeguard participants and hospitalized students. At this stage of the research, students were not directly involved. Therefore, consent from students and caregivers was not required.

### **Participants**

BHS employs 75 educators who are highly experienced based on teaching tenure and professionalism. They work in small collaborative groups supporting specific groups of

hospitalized students and students of different ages and medical requirements. A survey of teacher demographics prior to commencement of the study revealed an average of 26 years' teaching experience and an average of 9 years of hospital school experience. Most teachers were female (82%).

Twenty-nine BHS teachers participated in the initial phase of this research to identify hospital teacher needs prior to PD program design and implementation. Twenty-two of those 29 participated in the post-PD data collection. The attrition was due to changes in circumstances, including long service leave and illness. To facilitate participation in the unique hospital school environment and tailor PD specifically to teachers' needs and those of their learner groups, BHS and the researchers ensured that teachers were provided additional time necessary to be part of this research study.

### **Limitations**

The hospital school had recently addressed some obstacles to teachers' preparedness to utilize mobile technologies, such as allocation of new mobile devices. However, funding priorities meant that not all teachers had access to a mobile device or the coach at the same time, so the PD needed to be staged over time. Additionally, hospital safety policies resulted in limitations to the use of mobile technologies by teacher participants anywhere at any time.

Hospital school teachers instruct unfamiliar students of varying ages with indeterminate lengths of stay, in varying environments, such as the bedside or a classroom. The diversity of learners and environments has an impact on the PD requirements of each teacher. Therefore, a customized PD program was required that included a mentoring coach who analyzed individual needs and created personalized development plans.

Although the teacher participant sample could be considered small, hospital school systems are inherently small. The subject matter expertise of the researchers, teaching experience of the participants, and a review of available research relating to teachers, mobile learning, and the PD design provided the researchers with confidence to gather and analyze data.

### **Research Design**

This study's design leveraged the strengths of both quantitative and qualitative methodologies in a mixed methods approach. Quantitative data were collected using a customized TPACK survey (Archambault & Crippen, 2009). Qualitative data were gathered through researcher-created open-ended survey questions and individual and focus group interviews with participant-teachers (McCarthy et al., 2017).

The appropriateness and value of mixed method approaches for answering multifaceted research questions in challenging contexts is well recognized (McConney, Rudd, & Ayers, 2002). Although mixed methods research may not always provide a perfect solution (Johnson & Onwuegbuzie, 2004), in this study a mixed approach gathered the data required to investigate the effectiveness of PD tailored to participant teachers' pedagogical needs for the use of mobile technologies in a hospital school setting. Purely qualitative or quantitative approaches tend to suffer from the inherent limitations associated with each (Creswell & Guetterman, 2019; McConney et al., 2002), and therefore, combining the two approaches provided a more complete picture that helped us better understand the research problem.



The overall study design enabled the identification of pre- and post-PD technology-related pedagogical needs of hospital teachers and provided insight about the extent to which tailored PD supported teachers' construction of needed knowledge and skills in a meaningful way (Cresswell, 2012; Ruhalahti, Korhonen, & Rasi, 2017). Reflection facilitated by a digital transformation coach provided a deeper understanding of the complex world of hospital school teachers and the PD needed to align teachers' needs with 21<sup>st</sup>-century skills (Kereluik et al., 2013).

## PD Program Design

A PD program was designed collaboratively by university researchers, a digital technology coach, and hospital teacher participants. The program was designed to target previously identified pre-PD technological, pedagogical, and personal needs of hospital school teachers for effective use of mobile technology to improve learning. Reflecting on needs and existing TPACK competencies enabled us to identify gaps and develop a customized program. For example, hospital teachers saw the need to learn how to utilize video conferencing applications like Skype (<https://www.skype.com>) to support students when recuperating at home or communicating with a student's regular school teacher.

**Frameworks used to inform design.** It was important for BHS leadership to align its digital transformation strategy to the growing use of educational models (Andersen, 2018; Hutchison & Woodward, 2018). TPACK defines domains of teacher knowledge and provided BHS leaders with a research-based framework for understanding teacher perceptions of content, pedagogy, and technology skills within a hospital school teaching/learning context and guiding how technology can be successfully introduced into administration and teaching.

Additionally, the 21<sup>st</sup>-century skills framework was used to guide the coach when working one-on-one with teachers to identify focus areas such as collaboration and communication needs. The framework provided concrete, actionable skills and terminology described in the curriculum and expressed as teachers needs supporting teacher knowledge, as outlined in TPACK.

**The role of the digital transformation coach.** Within the PD program, teachers engaged in a coach-facilitated professional learning and reflection process to examine aspects of mobile technologies and digital pedagogies relevant to their personal and teaching needs. The coach is an experienced teacher who had previously been engaged in digital transformation initiatives and 1:1 iPad programs in regular schools. The coach had over 10 years teaching experience, including 7 years integrating information technology in teaching.

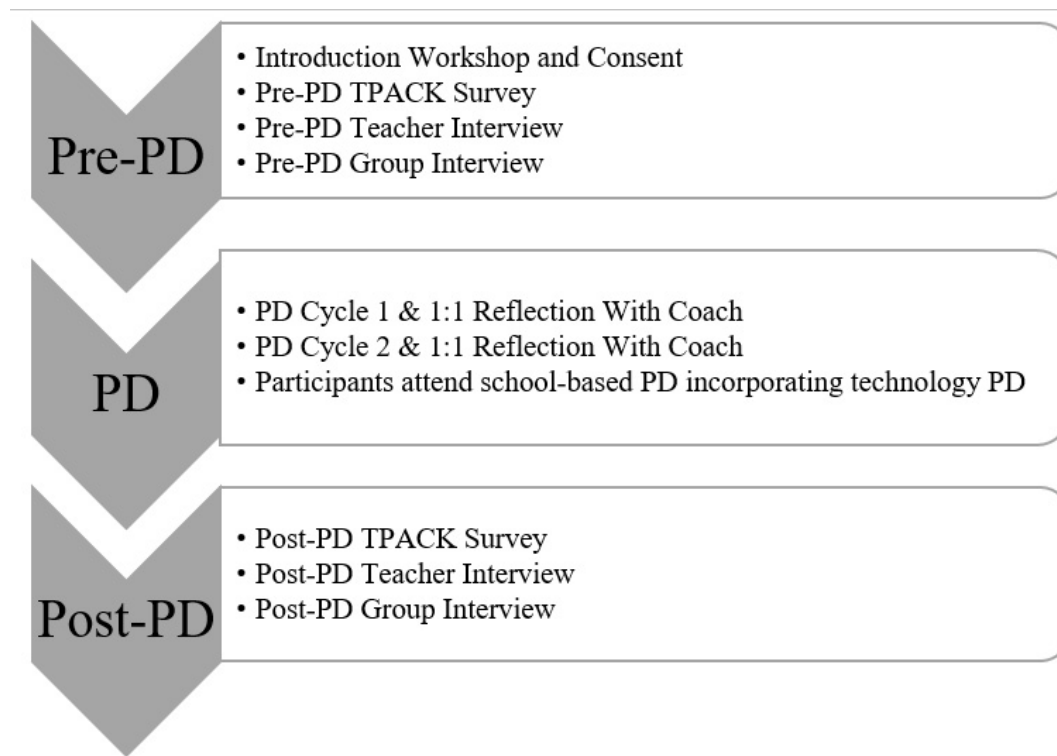
In addition, the coach is an Apple Distinguished Educator (Apple Inc., 2019) with 3 years' experience as the lead teacher in digital pedagogies at a special needs school supporting teachers, parents, and students using mobile devices and apps. The coach was appointed on a part-time contract following recommendation and refereed review.

**The role of iPad as a mobile device.** The proliferation of Apple iPad use in educational settings, boosted by digital access, government funding, and support by the Department of Education procurement process, meant many BHS teachers were familiar with the iPad, minimizing the impact of change (Geer, White, Zeegers, Au, & Barnes, 2017). Additionally, the large app ecosystem curated for education provided teachers flexibility in choosing apps for their learning area, aided by school leadership that provided funding for teachers to purchase apps.

A practical aspect of iPad focus in the hospital school setting was the low costs of the devices, accessibility features, long battery life, offline access when in areas without Wi-Fi Internet connections, ease of deployment, local support, long warranty, and access to training materials provided by the manufacturer (Young, 2016). Research supports the use of the iPad in education as a possible pedagogical “game changer” (Cochrane, Narayan, & Oldfield, 2013; Geer et al., 2017; Jahnke, Bergström, Mårell-Olsson, Häll, & Kumar, 2017; Young, 2016). However, the PD program was a necessary stage to integrate the use of iPads (or any mobile device) into participants’ pedagogy (Hutchison & Woodward, 2018; McCarthy et al., 2017).

## PD Procedure

The following is an outline of how the PD program was designed and implemented (first illustrated in Figure 2).



**Figure 2.** Chronological overview of PD procedures.

**Pre-PD.** Previously, during a teacher PD day, the hospital school’s leadership announced its commitment to mobile learning supported by a vision and strategic plan. Teachers were invited to participate in research related to enhancing mobile teaching and learning and to attend a workshop to understand participant requirements. Participants were introduced to the coach and the role of the coach was outlined.

During the workshop, TPACK and 21st-century skills frameworks were introduced and a consent form to participate was provided. On completion of the consent form, a hyperlink was sent via email to participants instructing them to complete an online pre-PD TPACK survey. Individual and group interviews were undertaken to answer the following question: “How does using technology impact your pedagogical decisions?”

Participants were also provided access to a mobile device and a range of learning apps at an introductory PD workshop. The findings from this initial phase identified hospital teachers' professional learning needs (Table 1) and informed the design of the PD program (McCarthy et al., 2017).

**PD program delivery.** The PD program was undertaken in two cycles, each lasting 4 weeks. Cycle 1 focused on technology needs, such as accessing a new iPad, connecting to a wireless network, printing and storing files, and incorporated personal support needs, such as learning to use communication applications (including email, chat, Skype, and sharing files with students). Accessibility features within applications to support sight- and hearing-impaired students were also shared.

Cycle 2 focused on pedagogical needs, including working with the coach to identify apps relating to curriculum areas such as literacy, 21st-century skills (e.g., collaboration and problem solving), and digital textbook resources. Teachers had opportunities to observe the coach teaching a class or lesson and team-taught with the coach to consolidate the first cycle of PD by integrating mobile technologies into their daily teaching.

During the two cycles of PD, teachers engaged in one-on-one workshops for 1 hour per week that helped the coach guide conversations and align participants' personal needs and target further PD. Each participant experienced 8 hours of personalized PD. Additionally, the coach assisted collaboration opportunities to enable teachers with shared technology needs to reflect on their PD, teaching with mobile technology, and experiences teaching in a hospital learning environment. Participants also had access to the coach via phone and email.

**Post-PD.** We organized post-PD group interviews at the completion of Cycle 2 and via emails invited participants to complete a post-PD TPACK survey. During school-based PD days that occurred at the beginning and end of the school term, we facilitated a post-PD teacher interview. Teacher interview questions are included in [Appendix B](#).

## Instruments

**Pre-PD and post-PD TPACK survey.** Participating teachers completed pre- and post-PD TPACK surveys using a version modified from Archambault and Crippen's (2009) instrument. Modification was required to accommodate the context of a hospital school. This instrument utilized the TPACK framework assessing knowledge that teachers are typically expected to have. The survey included 49 items and was administered online via SurveyGizmo (<https://www.surveygizmo.com>). Seven questions were asked within each knowledge area (Archambault & Crippen, 2009) with an additional open-ended question included in each TPACK survey ([Appendix C](#)).

A post-PD TPACK survey was completed by participants at the end of the research period to compare responses with the pre-PD survey to determine any changes in teacher needs and perceptions. We used descriptive statistics to summarize the data from teachers' TPACK survey responses. Inductive analysis and open coding were used to analyze responses to open-ended questions.

**Pre-PD and post-PD teacher interview.** Individual interviews were conducted, lasting 30 to 60 minutes, focused on teachers' perceived needs for mobile technology to support their personal development and their students in BHS. The opportunity for teachers to explore how technology was integrated with their pedagogy was an important

focus for analysis. Post-PD teacher interviews compared pre- and post-PD teacher perceptions of needs for mobile technology support.

***Pre-PD and post-PD focus group interview.*** Five focus group interviews were conducted with groups of four to five teachers, each lasting between 30 and 60 minutes. These pre- and post-PD group interviews were conducted during staff PD sessions. The purpose of the focus group interviews was to ascertain the needs, progress, and challenges from a collective perspective and to potentially identify particular needs pertaining to these participant-teachers. We developed a list of questions to guide participants; nevertheless, interviews were semistructured, allowing flexibility in the scope and sequence of what was discussed.

## **Analysis**

Quantitative data were collected using pre- and post-PD TPACK surveys. The 49 items from the TPACK survey were placed into seven dimensions. All survey items employed a 5-point Likert scale with “5” indicating strong agreement. These data were exported into Microsoft Excel for analysis. Qualitative data were gathered via pre- and post-PD individual and focus group interviews and open-ended questions on the surveys. A thematic coding approach was used for the analysis of these data, based on TPACK categories.

Descriptive statistical results were tabulated and reported for each subscale of the TPACK framework using all participants. Dependent *t*-tests were then conducted for the 22 participants who completed all measures, including the pre- and post-PD TPACK survey (Table 2). Analysis of patterning of responses and identifying themes in the qualitative data was achieved using NVivo 11 and Microsoft Excel. Themes were coded and refined to reflect terms that described the most consistent type of teacher needs (e.g., peer collaboration). In this way, the first two authors identified three main categories of needs: technology, pedagogical, and personal support. Nine subcategories of teachers’ needs were further established (Table 1).

Two researchers conducted independent iterative and inductive analyses to code transcript excerpts of participant quotes. Categories were determined once 80% agreement for allocation was achieved. Replaying of recorded interview data and reference to accurate transcriptions supported analyses and interpretation of responses.

## **Findings**

### **Overview**

The purpose of this study was to investigate the extent to which hospital school teachers’ technological, pedagogical, and personal needs for effective use of mobile technology were met following participation in a customized pedagogical PD program.

The findings demonstrate that teachers’ technological, pedagogical, and personal needs related to effective use of mobile technology in a hospital school underwent substantial change following participation in a PD program that specifically catered to participants’ needs. Data to support this finding included quantitative pre-PD and post-PD TPACK teacher self-assessment perception surveys, qualitative TPACK open-ended questions, individual interviews, and group interviews.

The dependent *t*-tests support the view that the PD program was effective in improving three aspects of teachers' knowledge: technological content knowledge (TCK), technological pedagogical knowledge (TPK), and PCK. Further, there was no negative impact in the two areas where teachers were already confident: content knowledge (CK) and pedagogical knowledge (PK).

Analysis of the qualitative data from individual and focus group interviews showed that hospital teachers have a wide variety of technological, pedagogical, and personal support needs (Table 1), including the exclusive use of a mobile device, quality infrastructure, and personalized PD. Teachers' technology-related needs included basic technological knowledge and availability of Internet access:

Well, in general I'm not au fait with a lot of the technology that can be used, and some of it is not actually in place, like the Wi-Fi, and sometimes we cannot even use laptops in rooms because of the connection, Internet. (pre-PD Individual Interview, #11)

Another teacher remarked,

Mobile technology isn't something we can just pick up and use. Kids do, I appreciate that, but I think adults are far more fearful of it. They think they're going to wreck something, so I think it was really important to have a strategy in our school plan. (pre-PD Individual Interview, #26)

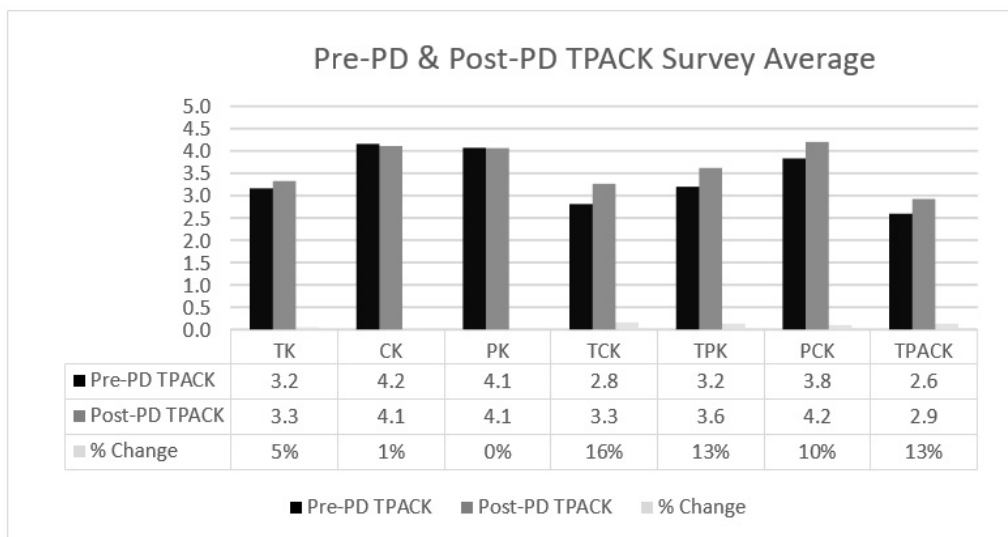
The hospital teachers in this study generally expressed a strong need for learning how they could effect transformational change in digital pedagogical practices and keep abreast of major changes in the use of mobile and other technologies in regular schools. Teacher needs reflected the pressure on hospitalized students to "keep up" with their regular school peers (Franck et al., 2013; Maor & Mitchem, 2015; McCarthy et al., 2017).

### **Teacher TPACK Pre-PD and Post-PD**

Responses from the 22 teacher-participants who completed both pre- and post-PD TPACK surveys (Figure 3) showed relatively high levels of CK ( $M = 4.2$ ) and PK ( $M = 4.1$ ) pre-PD, and there was no discernible change post-PD. This result could be expected for experienced educators, which is a key attribute required of hospital school teachers. However, pre-PD data indicated low levels of TK ( $M = 3.2$ ), which increased marginally after PD ( $M = 3.3$ ).

In the pre-PD surveys, BHS teachers had a low self-perception of TK, confirming a need to improve technology integration in their specified content areas and across their implementation of appropriate (modified) pedagogies. While teachers grew in their self-perceived TK after the PD, they stated that the PD experience showed them many opportunities for growth that they had not recognized previously ([Appendix A](#); #13, 14, 16, 25). Teachers came to the realization that the TK is larger than initially thought and that it required more learning in order to engage students in the full potential of the technology.

PCK increased post-PD ( $M = 3.8$  to  $M = 4.2$ ) to reach a similar level to CK. TCK ( $M = 2.8$  to  $M = 3.3$ ), TPK ( $M = 3.2$  to  $M = 3.6$ ), and TPACK ( $M = 2.6$  to  $M = 2.9$ ) were the lowest of the self-rated dimensions in the pre-PD survey and showed the strongest improvements.



**Figure 3.** Pre-PD and post-PD TPACK survey results for 22 teacher-participants.

Supporting these findings, a paired-samples *t*-test was used to gauge the impact of the PD from pre- to post-PD. With regard to TPACK specifically, the PD program showed a statistically significant improvement from pre- to post-PD on TCK, TPK, and PCK (Table 2). BHS teachers are experienced educators; however, pre-PD responses revealed their technology knowledge was limited. The customized technology PD built on their considerable existing content and PK, producing significant TK improvement in a short amount of time ([Appendix A](#); #6, 11, 21, 22, 26).

Participants’ responses to the TPACK open-ended questions and interviews revealed substantial change in teachers’ self-perceptions about their knowledge and skills following participation in the PD. Example responses to pre-PD and post-PD TPACK survey open-ended questions and pre-PD and post-PD individual interviews that support the findings, and referenced below, are detailed in [Appendix A](#).

Pre-PD open-ended item responses highlighted a lack of TK and limited exposure to mobile technologies ([Appendix A](#); #1, 2, 3, 4). Post-PD responses reflected greater engagement, understanding of, and access to mobile technologies and associated apps ([Appendix A](#); #5, 8, 9).

Post-PD, teachers expressed their use of mobile technology for communication, information gathering, and sharing students’ learning with other hospital school teachers, regular school teachers, and health team members ([Appendix A](#); #14, 25). Benefits of mobile learning were perceived to extend from supporting learning to administration, allowing teachers to “streamline processes and facilitate sharing of information both within the hospital school and across health teams and schools” ([Appendix A](#); #7).

**Table 2**  
Dependent Sample *t*-Test Results for Pre-PD and Post-PD Survey

	Pre-PD Mean	Post-PD Mean	N	Mean Difference	<i>p</i> -Values <i>t</i> -Test
TK	3.1633	3.3265	22	.1633	.12
CK	4.1565	4.1088	22	-.0476	.81
PK	4.0680	4.0612	22	-.0068	.96
TCK	2.8095	3.2653	22	.4558	.019*
TPK	3.1973	3.6190	22	.4218	.03*
PCK	3.8333	4.2007	22	.3673	.003*
TPACK	2.5952	2.9252	22	.3299	.06

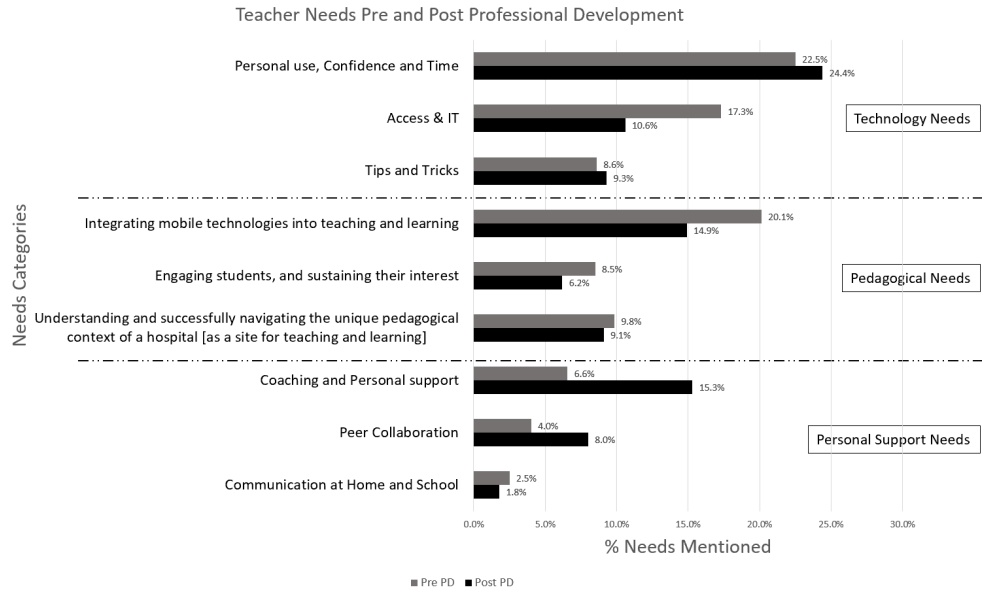
Note. \* = significant at  $\alpha < .05$

### Teacher Needs Pre-PD and Post-PD

Individual and group interviews pre- and post-PD allowed us to gain an understanding of teachers' experiences with mobile learning and pedagogy, particularly as related to participants' views of changes in their teaching and instructional and reflective practices. No category is considered having a higher status to any other need. For this reason teachers' comments about their needs were disaggregated and counted in multiple categories (Figure 4).

For example, *tips and tricks* were mentioned 58 times in the pre-PD interviews, accounting for 8.6% of teacher's needs and then 42 times, accounting for 9.3% post-PD. As teachers engaged in the PD, confidence levels increased resulting in a stronger need to learn more (Appendix A; #13). One participant teacher, for example, asked for more apps to cater to the needs of students with specific learning disabilities (Appendix A; #22).

The higher self-rating in post-PD suggested greater perceived needs of the teachers as a result of a realization that the knowledge and skills were still not sufficient for successful integration of the technology in order to engage students in the full potential of the mobile technology. This interpretation of the data was apparent in the personal support needs. We assigned no value of quality to these constructs; however, we determined that these needs were all important to the success of the PD and the outcomes of teaching the students with technology.



**Figure 4.** Relative frequency of teachers' needs by subcategory.

**Technology needs.** The standout finding in this study revealed that BHS teachers' technology needs (McCarthy et al., 2017), the category of greatest need overall, changed notably regarding access and information technology. Reported needs decreased from a high of 17.3% pre-PD to 10.6% post-PD, as teachers were provided greater access to mobile devices, Wi-Fi, and technical support.

Improved infrastructure is a necessary precursor need for developing the foundational knowledge reflected in TPACK. Teachers' personal confidence increased; it was positively impacted as they were able to compare their school's digital transformation and direction with teachers from other schools, appreciating that the PD program offered them opportunities not available in other schools (Appendix A; #23). The Personal, Confidence, Time subcategory increased modestly (22.5% pre-PD to 24.4% post-PD) as teachers realized the number of skills they still needed to acquire to feel comfortable with technology. Participants suggested that as they engaged in PD, they became more confident in developing their own use of technology (Appendix A; #8, 17); however, they also recognized they had still more to learn (Appendix A; #16).

**Pedagogical needs.** Pedagogical needs were reduced post-PD for this group of teachers who have considerable PK, particularly in the Integrating Mobile Technologies Into Teaching and Learning subcategory (20.1% pre-PD and 14.9% post-PD). The level of prior technology experience pre-PD impacted responses (Appendix A; #24); however, one teacher did not perceive a notable change in digital technology practice post-PD (Appendix A; #19).

**Personal support needs.** The need for personal support as it relates to coaching and personal support increased (6.6% pre-PD and 15.3% post-PD). Teachers also expressed a growing need for peer collaboration (4% pre-PD and 8% post-PD; Appendix A; #20, 25). This increase likely reflected the realization by teachers post-PD that they had more to learn, and personal coaching and peer collaboration improved their learning. Some teachers explicitly mentioned the value of one-to-one technology coaching, recognizing the benefits of being coached (Appendix A; #10, 21, 22), and they considered opportunities for



their own development and career progression by becoming a coach of others (Appendix A; #15).

The importance of teachers' communication needs between the hospital school, students' home, and their regular school was highlighted by some teachers pre-PD and reduced somewhat post-PD. The use of communication technologies and sharing of resources by teachers with students prompted reflection (Appendix A; #14). Additionally, teachers perceived a supportive attitude from the school leadership (Appendix A; #18).

## **Summary**

The interviews demonstrated increased teacher confidence via a purpose-built PD program that identified and addressed teachers' needs, including personal coaching, access to technology, opportunities for reflection, sharing, and building a learning community. This finding is supported by changes in teacher confidence in using mobile technologies. Figure 2 showed positive changes in TPK (13%), TCK (16%), PCK (10%), and TPACK (13%) following two cycles of customized PD each implemented over 4 weeks.

Our findings are consistent with other studies (Fontanilla, 2016; Hutchison & Woodward, 2018; Maor, 2017; Voogt et al., 2012). In particular, Fontanilla's (2016) research comparing beginning teachers and experienced teachers showed "experienced teachers have stronger knowledge of pedagogy and content but they lack the technology knowledge to effectively integrate technology into their curriculum" (p. 105).

As presented in Figure 4, the relative frequency of teachers' needs by subcategory pre-PD and post-PD saw pedagogical needs lowered, including integration of mobile technologies, while coaching and personal support substantially increased as teachers saw value and desired to learn more. One teacher stated, "My confidence and motivation to use mobile technologies has increased this year as a result of working with [the] coach and also watching colleagues and sharing ideas that have been used successfully in our learning area" (Appendix 1; #6, 8). Confidence was boosted through the opportunities provided to collaborate with peers:

That's the skills we're going to need for the 21st century ... what we need to bring into a classroom ... to be able to work collaboratively, with my peers, and then how do we do that with the children? (Appendix A; #12)

This confidence was reflected in Joo et al.'s (2018) research finding: "TPACK is positively related to teacher self-efficacy, perceived ease of use, perceived usefulness of technology, and intention to use technology" (p. 4). It is further supported by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012), as well as Abbitt (2011).

Using conceptual frameworks such as TPACK (Koehler & Mishra, 2009) and 21st-century skills (Kereluik et al., 2013; Mishra & Kereluik, 2011) helped provide context for the PD and facilitated the use of common language for leaders, the coach, researchers, and participants. One participant surmised, "I can visualize very easily how the technology, the content knowledge, the pedagogy, how it all overlaps" (Appendix A; #11). The role of TPACK together with teacher reflection data provided us with strong certainty that the teachers' technological pedagogical and personal needs were met following participation in customized pedagogical PD.

## **Discussion**

The PD program described in this study involved a hospital school's leaders, teachers, a coach, and university researchers, all working in partnership to gain an understanding of hospital teachers' needs to enable mobile technology integration into their pedagogy. Quantitative data based on a modified version of Archambault and Crippen's (2009) TPACK survey and qualitative data from open-ended questions and focus group interviews suggested that BHS teacher-participants embraced technology because of pedagogical advantages. They foresaw the benefits and impact mobile technology can have on hospitalized students' learning. The teachers' developed familiarity and confidence working with technology, collaboratively exploring new apps and content relevant to the curriculum and their teaching.

Identifying teachers' needs supported by PD successfully influenced participants' preparedness to use mobile technology in their teaching. More importantly, based on responses to post-PD open questions and individual interviews, the 4-week coaching sessions coupled with customized PD and access to a mobile technology environment demonstrated a noticeable impact on teachers' technological, pedagogical, and personal needs for effective use of mobile technology.

Moreover, having access to a coach and collaborating with peers allowed teachers to develop a curiosity for technology integration and opportunities for sharing and learning with peers. These outcomes reinforced the notion of fostering a learning community for professional growth described by Lave and Wenger (1991).

Furthermore, the findings in this study suggest that this group of experienced teachers in a hospital school setting saw benefits in collaborating as a learning community working on a common goal, in this case to implement mobile learning supporting their professional responsibilities and student learning. When asked in post-PD interviews what participants would like to see more of, an indicative comment was "reinforcement working with a specialist more often ... and sharing what has been taught" (post-PD Individual Interview, #24). This statement is consistent with the belief that learning as part of a community is more powerful and meaningful than individual learning (Gutierrez & Kim, 2017; Kools & Stoll, 2016; Tondeur et al., 2016; Van der Klink et al., 2017; Wells, 2014).

Pedagogically customized PD that reflects context, supported by technology enriched educational frameworks (TPACK, 21st-century skills), and access to technology with a committed and supportive leadership successfully addressed hospital teachers' needs. Furthermore, the experience can invigorate reflective practice (Schön, 1983) and the pursuit of professional growth through a sense of shared learning and goal setting.

The overall findings in this study suggest identifying hospital school teachers' technological, pedagogical, and personal needs can guide the design of effective PD for use of mobile technology. Teachers' capacity to embrace and adopt new technologies were significantly improved when needs were understood and PD was customized to meet those needs.

## **Conclusions and Implications**

Addressing teacher needs through customized PD, supported with individualized coaching, can in a short amount of time increase TPK to enable the improved use of mobile technology in a hospital school setting. Participants realized the benefits of pedagogical implications, personal learning with a coach, together with the opportunity to share and

collaborate with other teachers about their experiences. The TPACK framework and 21st-century skills were scaffolded during the PD and were instrumental in successfully designing an effective pedagogical PD program.

This study provides hospital schools that wish to embark on technological change a framework for teacher professional learning and technology integration, which in turn, supports students' learning with mobile technologies while in the hospital. Results of this study can guide school leaders implementing mobile learning and related pedagogical strategies to address teacher needs via PD.

More broadly, the study can have implications for all education leaders as they embark on PD programs and technology integration. The effective use of mobile technologies for learning requires that teacher PD has depth to address a variety of identified needs. Opportunities to participate with a coach or with colleagues, at a time and location that suits each individual, is important along with addressing context, each teacher's needs, and providing pedagogical support. The coaching approach to providing PD is one that can be considered and contextualized for all teachers and schools.

A key recommendation for leaders based on the findings of this study is to ensure they are supportive, and the needs of their community recognized, communicated, and integrated in the decision making of a strategic plan. Furthermore, identifying all stakeholders' needs provides opportunities to produce evidence and insights to enhance the rationale for future strategies.

While this research focused on identifying teachers' needs and designing a customized PD to transform mobile technology use, further research is needed to examine how to deliver holistic digital transformation that fully encompasses not only teacher needs but those of all stakeholders and the context within which they operate. Ongoing research should consider ensuring equity of access to technology and support, sustainable funding and resourcing, and ensuring the learning spaces teachers and students operate within are appropriate and contemporary to optimize collaboration and learning.

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## Appendix A Participant Example Responses

### Pre-PD TPACK open-questions

#	ID	Comment
1	4	One of my students periodically goes on-line to do group research with members of her class.
2	5	With the limitations I used YouTube to demonstrate the devastation created by tsunamis (2004) and (2011) after studying content in the written form (text book).
3	14	I used a program on the smart board (Prehistoric Sentence Builder) which describes sentence building, then the children took turns at building silly and sensible sentences.
4	16	As I run an Art Program, I mainly use technology for searching images of particular artists and their work. These are then used to provide students with some background information about the artist and some examples of their work.

### Post-PD TPACK open-questions

#	ID	Comment
5	3	it appears that the more one-on-one IT coaching that i engage in, the higher my confidence & competence in using mobile technology increases. additionally, when i have chosen to focus on only one aspect of this technology (until i feel proficient), the greater my skills level of understanding/competence are.
6	8	My confidence and motivation to use mobile technologies has increased this year as a result of working with [the] Coach and also watching colleagues and sharing ideas that have been used successfully in our learning area.
7	10	Attempting to use mobile technologies in all phases of teaching and to address all levels of thinking vs simply engaging in low level/recall apps or games, eg: emphasizing use of creative apps; using mobile technology for communicating with others – ie: sharing students' learning with enrolled school/teachers/other HSS staff/health teams/themselves, emailing to student account to share or follow up/continue working on themselves, and using mobile technologies to gather student information (self-assessment) to streamline processes and facilitate sharing of information both within HSS and across health teams and schools.

#	ID	Comment
8	14	I began at zero - having never used an iPad before - to now being confident with using a variety of apps, searching for and assessing apps for further use, and realizing the usefulness in a hospital setting.
9	16	I am currently developing audio-visual learning resources using SnagIt and dual monitors to enable students with memory and recall difficulties to learn how to use computer applications in conjunction with an online learning resource at <a href="http://www.gcflearnfree.org">www.gcflearnfree.org</a> . I have used feedback from students to modify the audio-visual materials that can be downloaded onto USB memory sticks and utilised at home by the students.

### Post-PD Individual Interviews

#	ID	Comment
10	1	A very powerful thing to be able to have a session tailor made for what your needs are.
11	1	I can visualize very easily how the technology, the content knowledge, the pedagogy, how it all overlaps.
12	3	That's the skills we're going to need for the 21st century . . . what we need to bring into a classroom . . . to be able to work collaboratively, with my peers, and then how do we do that with the children?
13	6	It's quite daunting as there's a lot to learn but having an iPad personally has helped me. Because they have that push and they've been giving us options like today has been fantastic because you get time to explore and use and be hands on with it.
14	6	It's a lot easier to have a connection with schools through technology. To engage children, technology is always a good thing, and I find a lot of schools are using technology, especially in high schools. . . . Twenty years ago when you were just thrown in and you didn't do a lot of researching and finding of resources. Teachers were quite protective of what they'd found because of all the work that went into it so to give that freely, . . . I'm just finding that people love to share and it's what we do in our primary network meetings. We, people have actually asked to have a sharing time and I find that really valuable.
15	11	. . . And they've asked those of us who have had the benefit of a coach, to be mentors in IT [information technology] as well . . .
16	12	So, for me, just being able to use one piece of technology that then opened up a whole different, other way, of looking at things, that was quite important. That was a game changer in a sense.
17	14	Initially you felt that if you used an iPad it was deemed as perhaps an easy option whereas now you feel confident that everyone realizes how broad

#	ID	Comment
		the apps are and how subject specific curriculum and pedagogically minded and so you feel that there is definitely going to be some subject area of interest to engage and so it's made you feel more confident and comfortable.
18	15	[The school] is very supportive of anyone who wants to do professional learning in an area they need extra information, a very supportive environment, regardless of whether you are an EA [education assistant] or a teacher, it is a very fair environment. It's very respectful, from my point of view.
19	16	I use them more frequently, but I don't often work with groups online and only use mobile technologies as I see appropriate for the learning context. Mobile technologies are not my "go to" preferences.
20	19	. . . Going from generic PD, to very targeted, and going now to how you can share and collaborate or where you can get more ideas from.
21	24	With the introduction of such technologies and some excellent coaching I am excited about the variety of opportunities and the expansion of teaching techniques available through mobile technologies.
22	22	There are lots of different apps and they're fine, but what I was finding was that in my team, the pediatric adolescent medicine team, there was a run of students . . . I actually did not feel confident in engaging these students, so with [the coach] I was able to ask for specific apps that would suit the students, that I wasn't comfortable with, more than the ones that I do know.
23	25	They [other school's teachers] can't believe that we have things like ILT [instructor-led training] coaching, so I've always thought it was good, but talking to people in schools I realize how lucky we really are. We get a lot more help and a lot more information than they do.
24	25	I am using [technology] a lot more than I used to, to be honest. I'm probably not using a lot more things, I'm just using it more often as I'm getting more familiar with what works. I've got my fave [favorite] things that I do.
25	25	We're showing each other how to do things: "have you seen this?" a lot more than we ever have before.
26	26	I am always trying to think, well what am I doing about trying to redefine a curriculum? . . . I don't want to just substitute everything I do, I actually want to augment what I do, to redefine.

## **Appendix B**

### **Teachers Interview Questions: Teaching With Mobile Technology in Hospital Schools**

#### **Interview Questions**

- How long have you been teaching?
- How long have you worked in the hospital schools service?
- What is your content area?

#### ***Current situation***

- What is the current use of mobile technology in your hospital school?
- Do you use it in your work? If so, how? (i.e., smartboard; laptops; iPad; iPhone)
- What is your perception of the use of technology in hospital schools and how important do you believe technology is in the learning of hospital schools students?

#### ***Professional development***

- How are teachers guided and developed in the use of mobile and learning technologies?
- How does the professional learning and development provided to you deal with the integration of technology into your learning program?
- What are your expectations on professional learning and development opportunities?
- Do you feel you have the right access to people, resources, and time?
- When is the most appropriate time for you to engage in Professional development? Before school, after school, school holidays, just in time?

#### ***Teaching***

- How does using technology impact on your pedagogical decisions?
- What changes have you noticed in your teaching with the growth in technologies? What brought about these changes?
- How do you manage the use of technology by the students so they achieve the goals of the lesson/topic?
- How important are 21st century skills such as problem solving, use of technology or creativity for curriculum development and use by students?
- Do you feel you have enough access to professional literature on the use of learning technologies?
- What are your current needs in order to better integrate technologies in your teaching?
- Have you heard of the following research models, and if so:
  - Can you see how the TPACK model assists in your PD and teaching?
  - Can you see how 21st century skills assists in your PD and teaching?

***Additional questions***

- What have you learnt from other teachers, and from students (in relation to mobile technologies usage)?
- Is there anything that you would like to add?

## **Appendix C**

### **TPACK Open-Ended Survey Questions**

The following question was delivered in the pre-PD TPACK survey:

- Describe a specific episode where you as a teacher demonstrated or modeled the combination of content, technologies and a particular teaching approach in a lesson. Please include in your description the content that was being taught, the technology being used, and the teaching approach(es) that was implemented.

The following question was delivered in the post-PD TPACK survey:

- As you reflect on your personal and professional development, can you elaborate on your experiences in using mobile technologies this year.