Pre-service Primary Teachers' Use of iPads to Support Teaching: Implications for Teacher Education

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Abstract

In this article the use of iPads in primary schools by a group of pre-service teachers completing their professional experience is reported on. The study was developed as part of the university's activities in the national Teaching Teachers for the Future (TTF) project. The study is a qualitative case study and the data gathering tools consist of participant journals, pre-service teacher focus groups, and staff interviews. Participants consist of 16 fourth-year Bachelor of Education (Primary) pre-service teachers completing a Maths Education subject, and two Maths lecturers at an Australian university. The results indicate that the teachers in the study used a variety of apps as well as inbuilt features of the iPad to support learning across a range of subjects. The teachers also used the iPad for self-reflective and assessment purposes. The implications of iPad use by pre-service teachers for teacher training in universities are discussed.

Keywords: iPads; Mobile Learning; TPACK; Primary Schools; Pre-service Teachers; Pedagogy.

Introduction

Tablets such as the iPad have only been available since 2010 and the uptake of these tablets into the general population has been rapid. Results of a survey called "A Portrait of Today's Tablet user, Wave II" (Frank N. Magid Associates Inc, 2012) indicate that in the US for example, during 2011, 12% of the population aged between eight and 64 years old were tablet users. This figure was 31% in 2012 and is expected to reach 47% by 2014. This rise is similar across other countries. To support iPad use, there are over 140 000 apps to choose from specifically for the iPad (Bonnstetter & VanOverbeke, 2012). This increased use of mobile technologies is changing the way that young people learn outside of the classroom

with access to vast amounts of digital content, easily shared photo viewers, cameras, and "rich full featured game platforms" (Johnson, Adams, & Cummins, 2012, p. 16).

As a result of the use of iPads and other tablets by young people in their homes, schools are responding by purchasing sets and integrating their use into teaching. However, iPads and other tablet devices, like many technologies, were not developed with classroom use in mind (Williams, Wong, Webb, & Borbasi, 2011). The opportunities for supporting educational outcomes are currently being explored by teachers as they adapt apps to suit their needs and the needs of their students. As a result of this exploration, iPads are beginning to be used in novel ways in primary school classrooms (Reid & Ostashewski, 2011).

The introduction of the iPad and associated apps has the potential to change educational and social practices in schools as well as in pre-service teaching courses. Understanding the parameters of such change is important for educators and researchers.

The contemporary uses of mobile learning technologies in schools and teacher education in an Australian setting is outlined which in this article which sets out the study in the context of a national Australian project—Teaching Teachers for the Future (TTF) project—aiming to develop pre-service teachers' Information and Communication Technology in Education (ICTE) proficiencies. All 39 teaching institutions in Australia participated during 2011–2012 to help implement the use of technologies into subjects. Maths was the focus area for this study.

The aim of the research project was to gain an understanding of the way mobile technologies are being used by pre-service teachers whilst on professional experience in schools which would then help the introduction and on-going use of them in a university teaching course. The research question relevant to this study was: How do pre-service primary teachers use iPads to support their teaching?

Sub questions included:

- What apps do the pre-service teachers use?
- How do the apps contribute towards educational outcomes?
- What implications does the use of iPads in schools have for pre-service teaching courses?

In answering these questions an outcome of the study was to identify ways in which teaches are using the iPads for teaching and learning within the classroom as well as way that they use them to support non-teaching related areas.

Literature on iPad use in schools

Whilst iPads have only been available since 2010, their uptake into schools has been rapid and there have been a large number of research projects carried out—both large scale projects and smaller case studies. Some of the studies indicate strong interest by Education Departments in the use of iPads to support learning, and are examined below.

Early studies by Education Departments have been conducted on touch-sensitive mobile devices across a number of states in Australia. One of the earliest studies was undertaken in Victoria, Australia, and focused on three primary schools. Here the authors examined the use of the iPod Touch, focusing on the "impact on

student learning, on teacher pedagogy, curriculum and assessment, and on external technical issues involved in implementing emerging technologies" (Murray & Sloan, 2008, p. 1).

A smaller study involving one primary and one secondary school in Australia was undertaken by the Queensland Department of Education and Training (DET) in 2011. Here it was found that "The iPad was viewed unanimously by participating teachers as a cross curriculum device that is not constrained to a specific subject area" (DET, 2011 p. 25). A trial was also undertaken by the Department of Education and Communities (DEC) in Sydney, Australia, in the second half of 2011 involving three primary schools (Goodwin, 2012). Findings indicated that both teachers and students believed the iPads supported and enhanced student learning.

One recent larger scale study was conducted in Scotland (Burden, Hopkins, Male, Martin, & Trala, 2012) during early 2012. Eight schools ranging from primary through to secondary level were involved in the study. An outcome of this study was that "The device also encouraged many teachers to explore alternative activities and forms of assessment for learning" (p. 9).

In a study conducted during 2012 at Longfield Academy in Kent, students in the secondary school, their parents, and teachers participated in an iPad research project (Heinrich, 2012). One of the outcomes of the study was that appropriate use of apps aids learning. Henderson and Yeow (2012), in conducting semi-structured interviews with key school personnel at Redoubt North Primary School in Auckland, New Zealand, focused on the use of apps and found that one of the most compelling features of the iPad was the range of apps available.

Research on the use of iPads in primary schools has also been carried out in the United States where in one study, six Pre K–4th grade classes participated (Milman, Carlson-Bancroft & Vanden Boogart, 2012). Results of the study showed high student engagement, which is one of the hallmarks of iPad use. Differentiation of content to address various learners' educational needs and interests was also noted. The apps on the iPad can support differentiation to meet the learning topics and themes that an individual requires (Melhuish & Falloom, 2010)

Theoretical framework

Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009) is used as a theoretical framework to understand the types of knowledge that the pre-service teachers were drawing upon during the study.

As the image in Figure 1 shows, the TPACK model is made up of three sections which include Technological Knowledge, Content Knowledge, and Pedagogical Knowledge. It is the intersection of these three areas that provides for Technological Pedagogical Content Knowledge (TPACK) The TPACK framework builds on Shulman's (1986; 1987) Pedagogical Content Knowledge framework.

As suggested by Koehler and Mishra (2009), and drawing on from a sociocultural theory of learning (Vygotsky, 1978), all resources such as a pencil or an iPad are technologies. There are some differences between these two technologies. Primarily, a pencil has a specific use: it has stability over time and its function is clear. New technologies such as the iPad, on the other hand, "are protean (usable in many different ways; Papert, 1980); unstable (rapidly changing); and opaque (the inner workings are hidden from users; Turkle, 1995)" (Koehler & Mishra, 2009, p. 61). These features of new technologies present both new opportunities and challenges to teachers.

Figure 1

TPACK framework (http://tpack.org)

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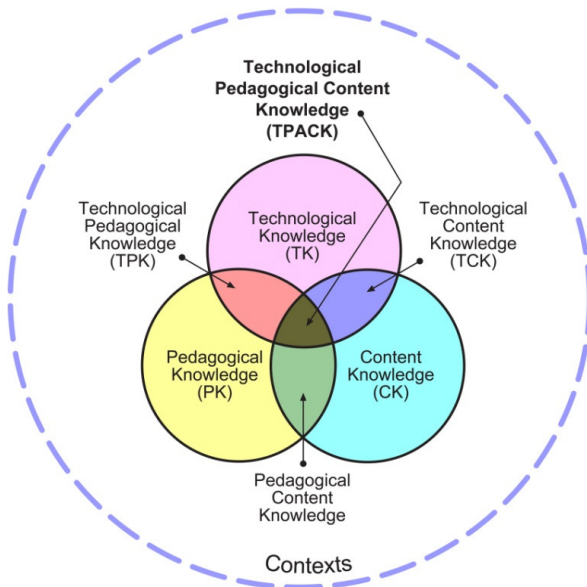
The TPACK model, as discussed above, has intersecting areas that bring together the three knowledge concepts in different ways. In drawing on the TPACK framework as a way of conceptualising pre-service teacher choices, some of the major components and the intersecting knowledges are drawn upon.

Methodology of the research

Because the use of iPads by pre-service teachers in their classroom practice is examined, this research requires the subjectivity of a qualitative framework. As suggested by Patton (2002), case studies are predominantly relevant to researchers in the qualitative domain because they provide extensive details of the experiences or phenomena being studied. Another of the advantages of a case approach is that its use allows close collaboration between the researcher and the participant, which provides opportunities for participants to tell their stories (Crabtree & Miller, 1999). The "case" in this study is bounded by pre-service teachers, primary school students and iPads.

Participants were 16 fourth-year Bachelor of Education (Primary) pre-service teachers completing a Maths Education subject and two Maths lecturers at an Australian University. Most participants were issued with an iPad2 purchased by the University for the duration of the semester three pre-service teachers and one lecturer used their own devices). The project focused on participants' use of their iPads to support their teaching whilst undertaking professional experience in primary schools. Many of the classes the teachers taught were in the early years, K–6, which included kindergarten (the first year of primary school) and ranged up to Year 6 which is the last year of primary school in New South Wales (NSW). These teachers' use of the iPads reported on here took place in schools, in their homes, and in informal settings.

Data were collected during Semester 1, 2012, using participant journals, pre-service teacher focus groups, and staff interviews. The pre-service teachers were asked to keep a journal reflecting on their experiences throughout the period of the research. They were asked to write one entry each week which many of them did. Some students chose to write their journals whilst other students recorded themselves speaking. The

journals were then provided to the researchers at the end of the study on the iPads each student used. The journals were also supplemented with artefacts the students created to support their teaching.

There were eight focus group sessions which were held towards the end of the study after the pre-service teachers had completed their professional experience placements. A series of questions were prepared to guide the focus groups which lasted for about 30 minutes. Two students were in each group along with the two researchers. The purpose of having two teachers and the two researchers was so that ideas that were discussed could be explored in greater detail.

The interviews with staff took place on a one-to one basis with one researcher interviewing one staff member and lasted for about 20 minutes. These were semi-structured interviews and were audio recorded. Each interview was analysed by the researcher that ran it and key themes were developed. The decision to interview on a one-to-one was based on staff availability.

Analysis

The data were analysed using thematic analysis. This approach to analysis involves categorising data through "careful reading and re-reading of the data" (Rice & Ezzy, 1999, p. 258). The research required that a number of different types of data be read which included spoken text, written text, images, and video. As is shown in the analysis and discussion section, one of the main themes to emerge was the focus on maths which was not surprising given that the teachers were engaged in a maths subject. They did use the iPads for other Key Learning Areas (KLAs) and purposes. Other themes that emerged through analysis of the data include using iPads for English and Drama as well as for English Second Language (ESL) students. Non teaching use of the iPads was also a focus, and included assessment and self-evaluation.

Limitations of the study

In many of the classrooms that the pre-service teachers taught, there was only the teacher's iPad or there were a limited number of up to five iPads to be shared. Another limitation of the study was that there was no Wi-Fi access in most of the schools in which the pre-service teachers taught. Both of these factors reduced the activities that could be carried out in classroom using the iPads. A further limitation of the study was the small number of pre-service teachers that participated in the study. The small number of participants limits the findings to a broader school setting.

Results and discussion

As a result of using the iPads in a maths university subject, a great deal of the apps were focused around Maths although other KLAs or subjects were also supported. The teachers also used built-in features of the iPad such as the camera to assist with learning. The iPads were also used for non-teaching purposes by the teachers. In this first section of results and discussion, the focus is on how the iPads were used to support teaching practices.

Maths

The main apps that the teachers used to support learning in Maths included Show me, Virtual Die and Songify. Some of the areas of Maths covered included number, fractions and symmetry.

Although many teachers were restricted to having only one iPad in the classroom they were able to design group activities that enabled the students to gain maximum educational benefits. In focusing on Maths, the use of Show Me is examined.
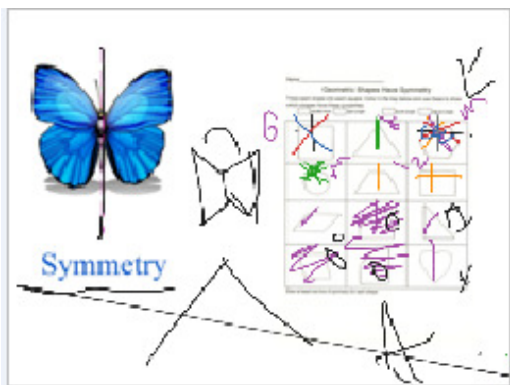
Using Show Me

The use of Show Me was used by the pre-service teachers involved in the study in a variety of different ways. Show Me is a whiteboard app which can be drawn on using multiple colours. Pictures can be imported and audio allows voice-over to be recorded. When playing back the file, the drawing unfolds in real time along with the narration much like a movie.

Sally used Show Me to help her Year 2 daughter understand the concept of symmetry as part of the school work she was doing. Her daughter located an image of a butterfly which she then imported into the app. Sally explained in her journal: "She then recorded her explanation whilst drawing in lines of symmetry on the two-dimensional shapes shown to support her explanation." Figure 2 shows a screen shot towards the end of the file.

Figure 2

Screen shot of Show Me

The Show Me app in Figure 2 can be used in two different ways: the first with the teacher explaining the process, and the second with the student explaining the process. In the figure, Sally's daughter was explaining the process. Using Show Me allows teachers to understand the process involved in students' thinking when working on problems which in turn allows the teacher to understand where errors are occurring and then to remediate the errors. Allowing students to record their work on Show Me would then mean the teacher could review their narrative later, which would assist in assessment.

Suzie used Show Me to explore the concept of equivalent fractions with a Year 6 boy in her class who was having a great deal of difficulty with the concept. As she stated in her journal: "I was able to use show me to physically demonstrate how to work out equivalent fractions." Suzie also used Show Me to investigate fractions of the moon with her class.

Suzie noted the potential of using Show Me to differentiate for students in the class where she described the functionality of the app allowing for differentiation. As noted by Tomlinson (2001) differentiation can occur in three ways: content—what students learn; process—how students learn or make sense of the content; and product—how students show what they have learned. Here, the Show Me app allowed for differentiation of process. Research carried out by Milman, Carlson-Bancroft, and Vanden Boogart (2012) supports this notion where it is demonstrated that the iPad can be used effectively to differentiate for process.

Suzie demonstrated Technological Pedagogical Knowledge (TPK), by adapting the use of the app to accommodate the needs of the Year 6 boy. "Technological Pedagogical knowledge is knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies" (TPACK, n.d.). The iPad was able to support the individual learning needs of the student. This knowledge is confirmed by Jaipal and Figg (2010) who state that TPK is characterised by practical teaching competencies such as differentiated support resources.

Other apps that the teachers used for maths included: Colouring Smart for addition, Compass for position, Evernote for algebra, Maths Trainer for revision, as well as Hungry Fish, Number Math, and Splash Math which were used for numbers.

Teachers' understanding of maths through using iPads

The use of the iPads was able to support the teachers in their understanding of maths in a more in-depth way as explained by one of the teachers in her journal entry:

> The iPad is helping me 'see' maths. I have always been aware of the issue of children not 'seeing' maths in their worlds. They often do not seem to see the connection between algorithms, maths concepts and generally maths in the classroom and their lives and worlds.

In her interview, lecturer Isabelle stated she believed this type of mobile learning exercise allowed pre-service teachers to generate artefacts depicting rich contexts that enhanced their recognition and observation skills and developed more positive attitudes towards Maths. The iPad allowed them to follow-up and discuss the maths associated with these artefacts. As she stated: "Seeing it [the phenomenon] was spectacular. Having the facility to do something about it was also important."

It is clear both from the student's journal entry and the lecturer's interview comments, that the noticing of maths is important for pre-service teachers so that they can then support the maths learning and noticing of their students. The use of the iPad was able to support this noticing for the teachers. This noticing has also been reported on in an earlier publication by the researchers (Kearney & Maher, 2012), focusing on pre-service teachers' use of the iPad in the real world.

Other Key Learning Areas

The teachers used the iPads across many other KLAs which included English, Drama, Human Society and its Environment (Geography, History, Environmental studies), Art, and Physical Education. ESL students were also able to be catered for. In this section the use of Puppet Pals to support English and Drama is examined as well as the use of flash cards to support for ESL learners

Puppet Pals

A number of teachers used Puppet Pals to support narrative writing in English and Drama. The Puppet Pals app allows the user to make a short movie and the free version comes with backdrops and characters. The app allows voice-over to be added. The teacher who worked with Puppet Pals in English wrote about how her children used the app to write a story. In describing the process of constructing a movie, the teacher set out in her journal: "They chose their own background and characters for their story and included a voice recording to tell the story." Figure 3 is a screen shot of a movie made by one of the children.

Figure 3

Screen shot from Puppet Pal movie

The use of Puppet Pals is able to support a multimodal way of learning. A multimodal approach (Jewitt, 2006; Kress & Van Leeuwen, 1996) is used to examine how a variety of resources including written text, image, animation, sound (spoken words, sound effects, and music), and colour can be drawn upon by students to make meaning. Culén and Gasparini (2012) reported on a research project with fifth-grade students where Puppet Pals was used on the iPad to write a story. They found that the "app engaged multiple senses (touch, sound, vision) in an easy to master storytelling process" (p. 2).

Multimodality can be considered using the TPACK framework focusing, in part, on Pedagogical Content Knowledge (PCK) which is defined as knowledge that includes "knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching" (TPACK, n.d.). Kang, Wu, Ni, and Li (2010) have mapped PCK from a multimodal perspective and state "pedagogical practice itself is taken as a design activity: teachers make choices all the time about what texts to work with, how to work with them, how to interact with the students and how to assess their semiotic work" (p. 1985).

Other apps that the teachers reported using during the research project included Singing Fingers for English, Map Pad and iBooks for Human Society and its Environment (HSIE), Jumbo Watch for time management, and QR Reader.

Supporting ESL students

One of the other KLAs that the teachers wrote about in their journals was English, which also included English as a Second Language. The apps that the teachers used to support ESL students included Flashcards, Futabla, and Puppet Pals.

One teacher discussed the use of Flashcards in her journal where she created a list of words ending in "ght". The functionality allowed the teacher to shuffle cards to ensure children weren't memorising the order of the words. Figure 4 shows one set of cards she created.

Figure 4

Flash card of "ght" words
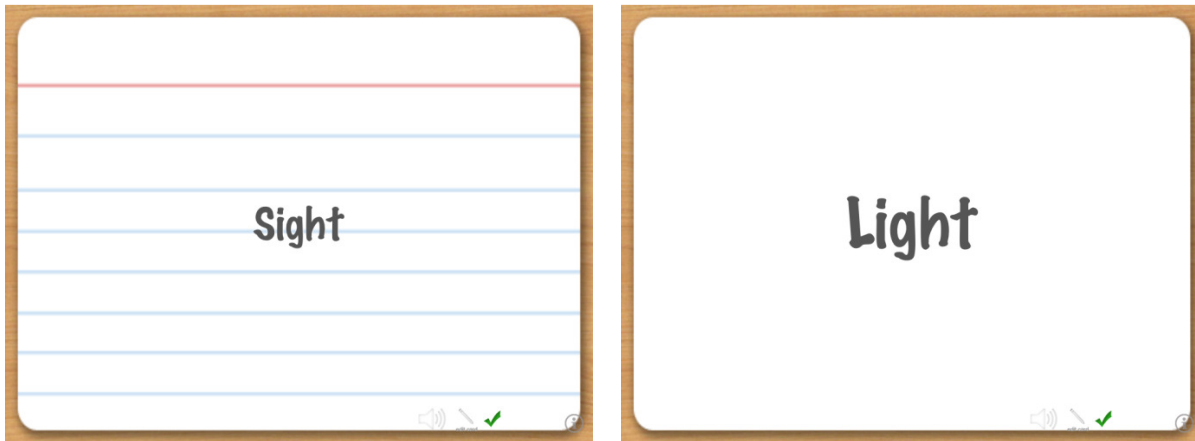
The teacher recommended that the app would be beneficial for ESL students. She suggested that: "I would integrate the added functionality which enables the teacher/student to record the word shown so that students can hear the word as they see it."

According to Meurant (2010), "the primary uses of English by non-native speakers will increasingly be computer-mediated" (p. 230). The simple interface of the iPad should be easy to learn without a great deal of instruction, allowing the English content to be focused on (Hicks, 2012). These uses of apps also offer ESL students the ability to engage with visually appealing content beyond textbooks and pencil and paper (Woods, 2011).

The teacher involved with the flash cards demonstrated Technological Knowledge through using the app and the iPad. "Technology knowledge is knowledge about standard technologies such as books and chalk and blackboard, as well as more advanced technologies such as the Internet and digital video" (TPACK, n.d.). She displayed Content Knowledge of words by focusing on phonics that are appropriate for ESL students. Content Knowledge is the "knowledge about actual subject matter that is to be learned or taught" (Mishra & Koehler, 2006, p. 1026). These two knowledges coming together to form Technological Content Knowledge was also evident where the use of the app allowed content to be delivered in new ways.

Using the camera

One of the significant changes from the iPad1 to iPad2 models is the inclusion of a built-in camera. The teachers used this is a variety of ways to support learning in the classroom and capture evidence of learning.

The KLAs that teachers reported using the camera for included art and physical education. The camera was also used on excursions and to provide feedback for students. As reported by Elliott, Livengood, and McGlamery (2012), the use of the iPad's camera can be integrated into the curriculum to "challenge students to use higher order thinking skills, as well as to reinforce content" (p. 4085).

The main theme that emerged in looking at the teachers' use of the camera for learning was that it allowed students to receive immediate feedback on their actions. Helen used the video feature of the iPad with a

student who was learning to do cartwheels. As she explained: "I took a video of her to give her immediate feedback and so she could see where she was going wrong. It also helped me analyse where she needed to improve." The teacher noted that the immediacy of feedback that the iPad provided, allowed for students to improve their learning.

Feedback has two important functions for students. First, it can motivate students and second, it is able to provide information that they can use to correct or improve their learning (McClenaghan & Ward, 1987). Immediate feedback is able to help learners to alter their style so that incorrect behaviours are not established which leads to improved achievement (Zahorik, 1987).

In allowing students to videotape or capture still images of activities they were undertaking, the iPad was able to facilitate immediate feedback. From a TPACK perspective, the teachers showed an understanding of Technological Knowledge where they adapted new technology for use in the classroom (Koehler et al., 2011). There was also Technological Pedagogical Knowledge evident where the teachers used the iPad to provide new possibilities for learning for the students.

Non-teaching use of the iPad

There are many uses the iPad can be put towards that do not directly relate to student use in the classroom. This section focuses on how the pre-service teachers used the iPads to support non-teaching areas. The teachers commented in their journals that they were able to use the iPads to support activities such as assessment of students. Being able to use the iPads for self-reflection was also a major theme commented on by teachers and is examined in this section.

Assessment

Quillen (2011) noted that most apps:

> don't allow teachers to monitor student progress or garner student data   in the same way that's typically possible with educational programs operated   through a laptop or desktop computer. . . . Most app developers are gearing more   of their educational content toward the parent-child interactions rather than the teacher-student interactions.

Despite this limitation, the teachers were able to use the iPads in innovative and varied ways to assess students.

Grace discussed both through her journal and in the interview how she used the iPad to assist with assessment of students' work. Her supervising teacher sent her a class list on Excel via Drop Box which she downloaded onto her iPad. She did a pre-assessment on division with her students which she then used to group students. Figure 5 shows the colour coding she has used for the different groups.

Figure 5:

Screen shot of an Excel spreadsheet

Based on her assessment of students she then devised differentiated learning tasks for each group. As the students were doing the work sheets Grace was carrying the iPad around with her. She was able to refer to her assessment of the students which enabled her to focus on students who needed extra assistance. She was also able to supplement her notes on students based on her observations. Because Grace did not have an in-depth knowledge of the students' abilities, having access to assessment data whilst working with them in the class enabled her to have a greater insight into their mathematical understanding and to record changes to this understanding.

Here the teacher was displaying Content Knowledge which Schmidt et al, (2009) state includes "knowledge in classroom management, assessment, lesson plan development, and student learning" (p.125).

Self reflection

The iPad was also able to be used as a vehicle for self reflection as described by Anna:

> I find the iPad useful to write my reflections on. . . . I like that I can take my ipad into the staffroom and write my reflections straight after I have completed the lessons, while it is fresh in my mind.

Jay and Johnson (2002) suggest that the role of reflecting for pre-service teachers is vital in that they learn to think like teachers. It also helps them to deal with the inevitable uncertainties and tradeoffs involved in everyday decisions that affect the lives of students (Larrivee & Cooper, 2006). It has been recognised that reflection in teaching is a growing and evolving practice and that it is important to be motivated by this in order to create effective teaching (Jay & Johnson, 2002). In Australia, for example, a national curriculum is in the process of being established which provides a "framework by which teachers can judge the success

of their learning and assist self-reflection and self-assessment" (Australian Institute for Teaching and School Leadership, 2011).

The iPad can assist in the important process of critical reflection by allowing teachers to use a variety of media for example, images, video, text, and audio to capture their reflections at a time when their thoughts are fresh in their minds. This was noted by Anna in the quote above and by Sally who stated in her journal that the iPad offers immediacy to the teacher. The use of video for reflection by pre-service teachers allows them to reflect effectively on their teaching as well as develop valuable skills involving new technology (Cunningham & Benedetto, 2002).

Having their reflections in one place allows teachers to easily combine the different media to strengthen their reflections using different apps and built in features of the iPad. These reflections can then be easily shared with lecturers and peers at university and then with colleagues and supervisors when the teachers start teaching in schools.

Using the iPads to capture evidence and for self-reflection was evidence of the teachers' Technological Knowledge. In relation to self-reflection, Gao, Tan, Wang, Wong, and Choy (2011) found that to a large extent, their "interventions for engaging the preservice teachers in reflection had an impact in the initial development of TPK" (p. 1009).

Implications for pre-service teacher education

The discussion here is based on personal reflections on the ways pre-service teachers used the iPads in their professional experience and some of the implications this has for the current and developing practice in pre-service teacher courses.

As stated in the NMC Horizon Report: 2012 K-12 Edition, tablet computing has a Time-to-Adoption Horizon of one year or less (Johnson, Adams, & Cummins, 2012). The pre-service teachers of today will be working in primary schools increasingly mediated by mobile devices such as tablets. This necessitates that pre-service teacher courses do develop their programs to include the use of mobile technologies.

Norris and Soloway (2011) suggest that mobile devices enable, or even require, new pedagogies.

As was shown earlier in this paper, the pre-service teachers were making pedagogical decisions but they were not consciously doing so by drawing on a particular framework. The pre-service teachers would benefit by learning to use the iPads through a framework such as TPACK. Having such a framework would allow them to more critically understand the affordances of the iPad and what knowledges they need to develop to support their teaching. A key implication of their research on teacher education stated by Finger, Jamieson-Proctor, and Albion (2010) is that there needs to a greater understanding and strengthened use of TPACK as a shared language among teacher educators and their pre-service teachers.

The pre-service teachers reported on varying levels of infrastructure in relation to the amount of iPads that were available in the classroom and access to Wi-Fi. In some instances there was only one iPad and no Wi-Fi. This resulted in some feelings of frustration as highlighted by a pre-service teacher with the following journal entry:

> To be honest, I am surprised at how little I used my iPad over the practicum placement I think the reason for this was the difficulty with the logistics of having one iPad and 26 eager kindergarten students. The class I was in conducted all maths lessons in a group scenario, which meant I was able to use the iPad on some occasions when working with these small groups.

This situation will face many pre-service teachers once they enter schools as in-service teachers so it is important that they are prepared to use iPads in different ways throughout their teacher training.

Results of the study demonstrated that the pre-service teachers were using the iPads for a range of purposes—some which related to teaching, and others which were non-teaching related purposes. Pre-service teachers will need to be trained to use mobile technologies in the learning areas such as Maths and English as well as for supporting students with special needs, for assessment, and for critical reflection. These are only a few of the purposes for which the teachers might use them.

In order to successfully support pre-service teachers' training in the use of iPads, the training of university teaching staff in the use of the iPads is also necessary. As suggested by Ananiadou and Rizza (2010), to integrate ICT in teacher training institutions, the teacher trainers need to feel confident in using ICT themselves but this is not always the case. In recognition of this, staff training with the iPad is crucial and needs to be sustainable. Training should include both full-time and casual staff. As stated this training needs to be developed around TPACK as a shared language as well as on pedagogical practices in the classroom.

Conclusions

The pre-service teachers displayed a good understanding of working with the iPad using the TPACK framework. They were able to quickly learn how to use the iPad and incorporate it into their teaching by having good Pedagogical Knowledge and Content knowledge. They also demonstrated a good understanding of Pedagogical Content Knowledge and Technological Pedagogical Knowledge.

The use of the iPads and the apps were able to contribute towards a variety of learning outcomes in the mainstream K–6 lessons the teachers taught during their professional experience. Through supporting differentiation the apps were able to support ESL learners and students having difficulty in areas of maths. Through the use of multimodal resources, the apps allowed students to learn in different ways to achieve learning outcomes.

The iPads were also able to be used to support non-teaching activities by the teacher such as assessment and self-reflection. The iPads and the associated apps were able to be used equally by the students and teachers which makes it a versatile tool.

The implications of iPad by pre-service teachers were also discussed. It is clear that introducing them into teacher-education subjects requires careful planning with regards to pedagogy. As suggested, a shared framework such as TPACK allows both pre-services teachers and higher education tutors to develop a shared language which can support an understanding of how mobile technologies can support teaching. The importance of on-going training for staff to facilitate such a shared understanding was highlighted.

Acknowledgements

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