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iTE:
Student Teachers using iPad on a Second Level Initial Teacher Education Programme

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ABSTRACT

Research on the use of iPad in initial teacher education is limited. This paper outlines a study to examine how the professional learning and pedagogical knowledge development of student teachers could be supported following 1:1 iPad deployment on a second level initial teacher education programme in Ireland. Findings show that iPad can be utilised both as an effective pedagogical tool and as a medium for the creation of new learning spaces where student teachers' professional and pedagogical knowledge development is supported through feedback, peer-learning, resource sharing and critical reflection. Creating resources with and for iPad as part of a collaborative design process can also support student teachers in developing and integrating technological, pedagogical and content knowledge (TPACK) within their approaches to teaching, learning and assessment. Implications for initial teacher education providers and the integration of technology within schools are outlined.

KEYWORDS

iPad, Mobile Technology, Teacher Education, Technological, Pedagogical and Content Knowledge (TPACK)

INTRODUCTION

Information and communication technology (ICT) is now embedded in everyday life and offers a wide range of possibilities for teaching and learning in schools. In Ireland, its importance and potential in an educational context is acknowledged in the National Digital Strategy (Department of Communications, Energy and Natural Resources, 2013) and explicitly outlined in recent major national policy on education. For example, the National Strategy to Improve Literacy and Numeracy among Children and Young People (Department for Education and Skills, 2011) includes digital media in its definition of literacy and stresses the role it can play in all aspects of education from early childhood to adulthood. At post-primary level a new Framework for Junior Cycle (Department of Education and Skills, 2012a) positions digital media as a key medium for student learning, while the development of ICT skills is identified as a central element within the recently outlined self-evaluation process for schools to ensure that students become active learners "during lessons and outside of lessons" (Department of Education and Skills 2012b, p.33). ICT is now also a mandatory element of all initial teacher education (ITE) programmes, with student teachers expected to use it "effectively to aid pupil learning" (Teaching Council 2011, p.27). Most recently, the National Digital Strategy for Schools 2015-2020 (Department of Education and Skills, 2015, p.33) provides an action plan for integrating ICT into teaching, learning and assessment practices in schools over the next five

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years to "ensure that ICT is embedded in the planning, design and delivery of all teacher education courses and programmes".

This paper outlines a research study which examined 1:1 (one-to-one) iPad deployment on the Dioplóma Gairmiúil san Oideachas (Professional Diploma in Education), a one year, Irish medium, initial teacher education programme for post-primary teachers in Ireland. Irish medium schools are to the forefront in adopting iPad for use by teachers and pupils. Consequently, iPad was a course requirement for all student teachers accepting a place on the programme in 2013-14, making it the first initial teacher education programme in Ireland to adopt iPads 1:1. The specific purpose of this study was to investigate if, and in what way, iPad supported the professional learning of student teachers on the programme and to examine its role in the development of their pedagogical knowledge and approaches to teaching and learning.

IPAD IN INITIAL TEACHER EDUCATION

The availability of technology in schools does not automatically impact on the pedagogical practices of teachers, and even when used, can be cast in a supportive role to traditional teacher-transmission of content knowledge (Butler, Shiel, Leahy, & Cosgrove, 2013; Chai, Koh, & Tsai, 2010; European Commission, 2013; Petko, 2012). Mobile technology, however, is more difficult to ignore. With its emphasis on social interactivity and connectivity, it has the potential to transform practice in schools by reshaping how, when and where learning takes place (Melhuish & Falloon, 2010). Pegrum, Howitt, and Striepe (2013, p.464) define mobile learning as that which is "mediated through digital mobile devices" and Apple's iPad has emerged in recent years as a field leader among mobile tablets. The importance of integrating mobile technology within initial teacher education programmes cannot be overstated, as this in turn can promote its future use by teachers in student learning (Hammond et al., 2009; Maher, 2013). Research, however, on the use of iPad in the context of initial teacher education is limited, and among those studies undertaken there is an emphasis, furthermore, on initial teacher education at primary level.

Ayres, Tyrrell, and Poon (2013) for example, examined the impact on school placement tutors and found that iPad facilitated the provision of visual and audio feedback to students and the sharing of files through cloud storage. Pegrum et al. (2013) focused on the learning of pre-service student teachers and similarly found that iPad facilitated resource sharing, as well as enhancing personal organisation. Furthermore, it enabled student teachers to access programme content from "multiple real-world spaces" and to critically reflect on audio recordings of their own teaching (Pegrum et al., 2013, p.475). The facility of iPad as a tool for reflection is likewise highlighted in recent studies outlining how pre-service teachers used a variety of media, incorporating video, images, text, and audio, to capture evidence of professional learning (Kearney & Maher, 2013; Maher, 2013). Limitations with regard to using iPad have also been outlined, however. These include difficulties in the transfer of materials between PCs, Macs and tablets, where different formats can result in layout, fonts, graphics, tables and columns being changed or lost, as well as student teachers' preference for using the keyboard on desktops and laptops to generate documents and resources (Ayres et al., 2013; Pegrum et al., 2013).

CONTEXT OF STUDY

This study was undertaken with student teachers on the Dioplóma Gairmiúil san Oideachas, a one-year, postgraduate, initial teacher education programme for second level teachers, which is provided through the medium of the Irish language in the National University of Ireland, Galway. Traditionally, the one-year professional diploma has been the most popular route into post-primary teaching in Ireland, although these programmes have since September 2014 been extended to two-years. IPad was a course requirement for all student teachers on the Dioplóma Gairmiúil san Oideachas in 2013-14 and a total of 38 student teachers (24 female and 14 male) registered on the programme. All agreed

to participate in the study and provided written informed consent (N=38). Ages ranged between 20-24 yrs. (25 participants), 25-29 yrs. (10 participants) and 30+ yrs. (3 participants) and all but 2 had previously owned a personal computer, 31 of which were PCs. Of the 5 student teachers who used the Mac platform, 4 were already iPad users. The researchers, who work as lecturers on the Dioplóma Gairmiúil san Oideachas, also use iPad in their teaching on the programme and in their role as Placement Tutors when supporting, mentoring and evaluating the practice of student teachers on school placement. However, the impact of iPad on the practice of lecturers/Placement Tutors is not the focus of this paper.

The study covers the period from programme commencement in September 2013, to its conclusion in May 2014. During that time, student teachers completed 16 weeks of lectures and workshops on campus, as well as a further 16 weeks of teaching experience on school placement in Irish medium schools throughout Ireland, several of which were in remote locations. School placement was undertaken in 3 separate block periods, the first over 4 weeks in September and October; the second block of 5 weeks in January and February; and the final block of 6 weeks in March and April. IPad was deployed 1:1 with pupils of student teachers in just 2 of the school placement schools.

As part of the Educational Technology module on the programme, student teachers took part in 16 workshops, each of 1.5 hours duration. These focused on iPad functionality and use as a management tool; the production of teaching resources using iPad; and the possibilities offered by a range of apps to support teaching and learning. Prior to the first school placement, each individual student teacher was required to create and share with their designated Placement Tutor, a personal cloud storage file using Dropbox (2013), into which all materials, resources and reflective exercises relating to school placement were deposited. Before the final school placement, student teachers received training in the use of iBooks Author (Apple Inc., 2013b), an authoring tool for creating digital, multi-touch, interactive books. They were then required, as part of coursework, to work collaboratively in small groups in order to design and produce resources on topics within their teaching subjects for use on iPad.

RESEARCH QUESTIONS

Two principal research questions were addressed:

1. Can 1:1 iPad deployment on an initial teacher education programme support the professional learning of student teachers and if so, how?
2. What role can iPad play in the development of student teachers' pedagogical knowledge and approaches to teaching and learning with pupils?

THEORETICAL FRAMEWORK

To understand the nature of knowledge required by student teachers to use technology effectively in teaching and learning, this study drew on the TPACK framework (Koehler & Mishra, 2009) which illustrates the transactional interplay between content, pedagogical and technological knowledge. While content knowledge indicates an understanding of the subject matter to be taught and learned, pedagogical content knowledge represents teachers' ability to interpret and represent this knowledge in order to facilitate student learning (Shulman, 1986). Incorporating technological knowledge within this dynamic requires teachers to understand how technology can be employed in support of pedagogical goals and the manner in which teaching and learning can change when particular technologies are used in particular ways. Koehler and Mishra (2005, p.94) maintain, however, that stand-alone, skills-based approaches to technology instruction on teacher education programmes do not "provide future teachers with the kinds of experiences necessary to prepare them to use technology effectively in their classrooms". Engaging in collaborative pedagogical design activities using technology, can on the other hand, facilitate the integration of each element of TPACK, particularly when set in the context of specific subject content goals (Koehler et al., 2011).

METHOD

A mixed-methods approach was adopted in the study, incorporating qualitative focus groups along with quantitative data from questionnaires. Supplementary qualitative data was also gathered from student teachers' reflective commentary on video recordings of their own teaching in the classroom and from written feedback on these reflections provided by the 3 researchers/Placement Tutors.

Given the number of participants involved, focus groups, of between 9 and 10 participants, were used as the principal research method in preference to individual interviews. A qualitative approach was adopted "to make sense of…phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2000, p.3) and each student teacher consequently took part in 2 focus groups. In total, 8 focus group sessions were conducted, with the first series of 4 (groups A to D) held in December 2013 following completion of the initial block of school placement. Issues probed included the use of iPad as a tool for their learning, both as students and as teachers, and the limitations that had been encountered. A second series of 4 focus groups was held prior to programme completion in May 2014 (groups E to H) to investigate student teachers' views on using iPad, both within the context of pedagogical design and their approaches to teaching, learning and assessment with pupils. All focus groups were conducted in Irish and lasted for an average of 45 minutes. Audio recordings were made using moderators' iPads and these were later transcribed verbatim to provide a permanent written record. Transcripts were then translated into English and checked for accuracy by all 3 researchers against the original Irish medium recordings.

Quantitative questionnaires were also completed by student teachers at 3 intervals to gauge use and attitudes towards the technology at entry level, mid-level and exit level on the programme. This allowed student teachers to reference applications (apps) which had supported their teaching and to rate iPad's effectiveness as a tool for resource development and contact with fellow student teachers. Data from questionnaires also indicated how iPad was received by teachers and principals in placement schools.

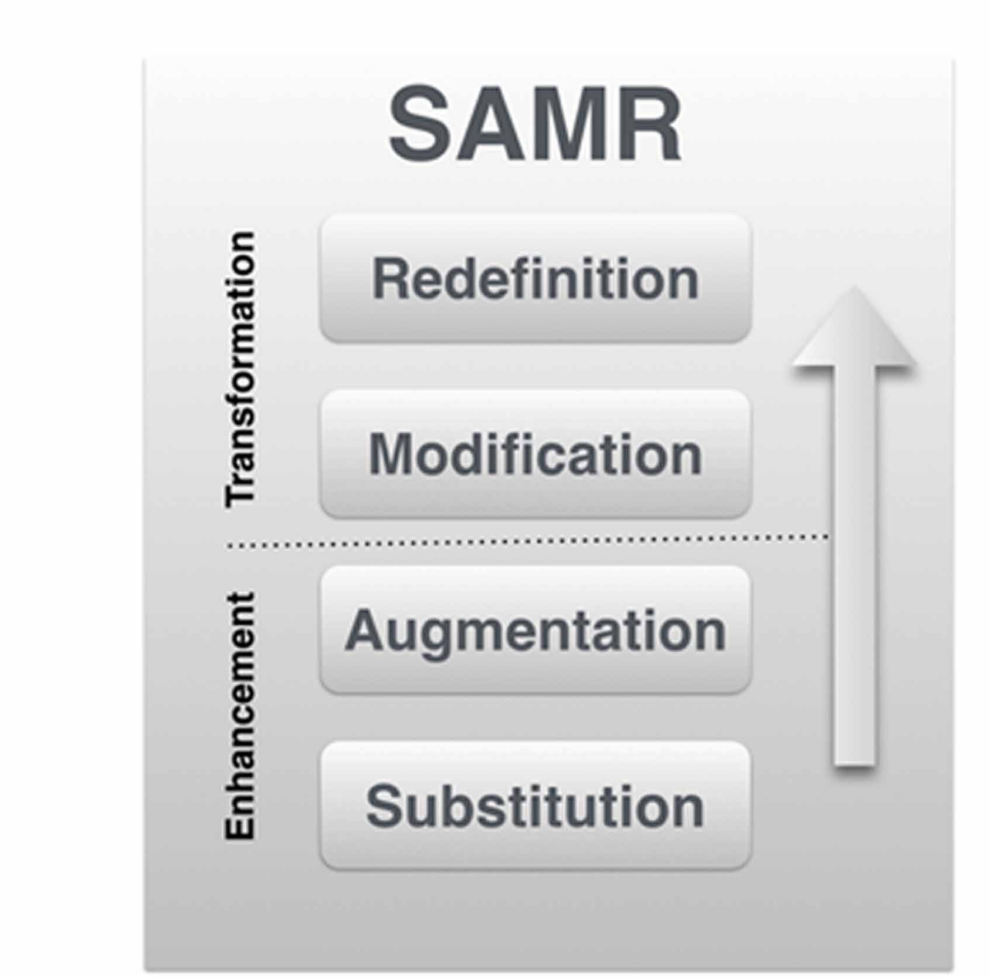
In addition, non-participant classroom observations of student teachers were conducted by the 3 lecturers/Placement Tutors on the programme and each student teacher was observed while teaching on at least 3 occasions during the year. Puentedura's (2012) SAMR Model (Substitution, Augmentation, Modification, Redefinition) was used as a framework to compile fieldnotes on student teachers' use of iPad in lessons (see Figure 1). This model proposes four levels of technology use, ranging from substitution and augmentation of tasks at the lower level, to modification and redefinition at the highest. In this progression, technology can be conceptualised either as a direct tool substitute to enhance practice, or as a creative tool for the transformation of practice.

Student teachers also used iPad during the final school placement to capture video recordings of their own teaching in the classroom. From these they each selected a short extract for analysis and using iMovie (Apple Inc., 2013c), an iPad application for capturing, editing and sharing video, added a voiceover containing critical reflection on the sample. Photo Stream (Apple Inc., 2014), a cloud-based service which allows sharing between devices, was then used to share extracts on iPad with Placement Tutors who were able to add and return immediate written feedback.

DATA ANALYSIS

An inductive, thematic analysis approach was used with focus group data, using open and axial coding to identify repeated patterns and emerging themes, both within and across all transcripts (Strauss & Corbin, 1998). Individual transcripts were at first read and coded individually by each researcher and interpretations compared to develop and clarify shared understanding. Field notes from classroom observations and written feedback provided by Placement Tutors on student teachers' video analysis were included in the analysis. Likewise, all video recordings containing student teachers' critical reflection were read, viewed and discussed collectively by the 3 researchers. Data from questionnaires

Figure 1. The modified SAMR model from Puentedura (2012)



were coded and logged into an SPSS Statistics file (Version 20 for Mac) and correlation and cross tabulation tests were carried out between associated variables. Following Miles and Huberman (1994), a meta-matrix was used to assemble data from all sources into a thematic framework which allowed the following themes to emerge.

RESULTS

Organisational Tool

A strong finding to emerge from this study was the effectiveness of iPad, when used in association with cloud storage files and selected apps, as a tool for enhancing student teachers' personal organisation. Cloud and iPad storage meant that lesson plans, resources and materials for teaching on school placement could be "with you always and much easier to carry around on an iPad rather than a huge folder" (Group C). As hard copies were no longer necessary this represented a considerable saving in terms of "time and printing costs" (Group B), with the result that student teachers from other programmes were 'envious' (Group A). In addition, TeacherKit (TeacherKit, 2013), an application to aid personal organisation, was used by all student teachers to support classroom management and to maintain and access on iPad details on pupils' attendance, behaviour, test results and homework.

New Spaces for Learning

A central theme emerging from the study was iPad's utility as a tool both for creating and accessing new spaces where learning could occur. For example, student teachers stated that iPad could be used

to access immediately online, content referenced in lectures or workshops for further understanding and with greater ease than by phone or laptop which "could be indiscreet…tapping on a keyboard in class" (Group B). Similarly, iPad's portability and mobility meant that it could be "in your bag and with you always" (Group A) enabling access to course content and resources "on the bus or in the queue for the doctor" (Group D).

In particular, shared access to school placement cloud storage files placed iPad as the central medium in an "ongoing conversation" (Group C) between student teachers and their School Placement-Tutors, allowing tutors to monitor and provide immediate and ongoing feedback on lesson plans and resources as they were created and added to the file. More significant, however, was the manner in which peer-learning was facilitated within this learning space also, with student teachers using iPad to access and share resources in a communal cloud storage file which they themselves had created while on school placement. Resources could then be reconfigured to suit a student teacher's particular classroom context by "putting your own stamp on them" (Group A) and questionnaires show that 84% of participants shared materials in this manner. Similarly, both the video application Facetime (Apple Inc. 2010) and an online social networking page created by student teachers had a role in the development of professional knowledge within a new learning space also, with student teachers using iPad as a medium to provide support and advice on "what did and didn't work in the classroom" (Group A):

…we would ask one another 'Have you done that? How did you use it?' It was interesting to see the slant people put on things (Group G).

Questionnaires completed in February show that 59% of student teachers regularly used Facetime to maintain contact with one another while on school placement and this had increased to 70% by May. It is noteworthy that resource sharing also facilitated the development of student teachers' content knowledge by providing opportunities to look at subject content in new ways:

We used Dropbox…and everybody put their best resources into it, they shared them…you were learning about the subject, maybe new things that you did not know before and you had a new technological resource also (Group F).

iPad as a Pedagogical Tool

Questionnaires completed following the first school placement show that iPad was used in teaching by all student teachers, with 66% stating that they used it "very often" or "in every class". Although the student teacher's iPad was the only one available for use in lessons within the scope of this study in all except 2 schools, impact was leveraged by connecting to an interactive whiteboard or projector.

A key theme to emerge from data is the effectiveness of iPad as a pedagogical tool for motivating pupils' interest and engagement in lessons. When used in association with apps which can be employed to select pupils randomly such as Spin the Wheel (Lettus ApS, 2013) or Random Name Selector (Walsall Academy, 2014), student teachers found that they could focus pupils' attention and engagement when assessing learning in class. In addition, design tool applications such as Keynote (Apple Inc., 2013d) and Pages (Apple Inc., 2013e), as well as the screencasting and interactive app Explain Everything (Morris Cooke, 2013), enabled student teachers to create and present on iPad, multi-modal lessons visible to all on the interactive whiteboard. This allowed "variety instead of the same approach" (Group D) and was seen as "cool" by pupils (Group A).

Classroom observations during the first school placement, however, reveal that this resulted in student teachers predominantly using iPad as a direct tool substitute at the lower levels of the SAMR Model in order to enhance the presentation of subject content information using traditional teacher-centred approaches. This approach was influenced to some degree perhaps, by the lack of suitable

Irish medium textbooks which resulted in student teachers creating their own texts and resources to introduce subject content to pupils. Dependance on a single iPad in the majority of lessons was also an influence. Nevertheless, classroom observations also provide evidence that some student teachers made creative use of iPad during the first school placement. In a French language lesson for example, one student teacher connected iPad to the interactive whiteboard and made a pre-arranged Facetime call to a class of pupils in France to enable communication and exchange between the two groups. In Irish language lessons, access to Apple TV (Apple Inc., 2013a), a wireless media streaming capability, allowed one student teacher's iPad to be passed wirelessly among pupils who took turns to engage with an interactive exercise simultaneously visible to all on the whiteboard.

More interactive and pupil-centred teaching approaches with iPad, however, emerge as a significant feature in data gathered during and following the final school placement. In English lessons for example, pupils used the student teacher's iPad to work collaboratively in groups to create and make their own presentations as part of Media Studies:

I allowed pupils to use the iPad to make a video as part of Media Studies in English…they made an advertisement, acting and directing, and showed it as a presentation (Group F).

Within language lessons, pupils used iPad in conjunction with the animation app Puppetpals (Polished Play, 2013) to create, script and record conversations between animated characters in the target language which were then presented to the class by connecting iPad to the interactive whiteboard. There was evidence also that iPad was being increasingly used to assess pupils' learning. For example, Popplet (Notion Inc., 2013), a mind-mapping app, was used to establish prior-knowledge and assess pupil learning by circulating iPad within the class and asking "every pupil to add one written point" (Group G) visible to all on the whiteboard. The recording facility on iPad was also used in language classes "to record pupils while they were debating" (Group G) or to afford opportunities to listen back to "pronunciation in French classes" and "to let them hear how they came across" (Group H). Likewise in Science and Music classes, pupils researched topics collaboratively in groups and made multi-media presentations which were then peer-assessed by the other pupils:

…we did a project on world music and I gave topics, they broke into groups and used their iPads to gather recordings, videos, sound files and make presentations to the class which were peer-assessed (Group E).

It was clear that student teachers were at this point "more comfortable" (Group F) using iPad in the classroom. Questionnaires, for example, show that the number of student teachers feeling "anxious" or "very anxious" about their capability of using iPad in their teaching had dropped from 27 at the start of the DGO programme to just 1 in the final survey. Student teachers stated also that the emergence of pupil-centred approaches at this stage was influenced by them having developed a greater understanding of their pupils and of ways to motivate them using iPad in lessons that were 'different' and that used "variety rather than the same thing always" (Group E):

What kept me using the iPad was the pupils' reaction…if you don't make an effort they will be asleep in front of you" (Group F).

However, data from focus groups reveal that the process of collaboratively developing and designing interactive multi-touch resources for use on iPad, using the e-book authoring application iBooks Author (Apple Inc., 2013b), had allowed student teachers to engage in dialogue on learning from their pupils' perspective. On one level, this facilitated the exchange and development of pedagogical knowledge though learning from "the ideas of the others who were with you…things I wouldn't think of myself…all of us learning from one another" (Group D):

It really helped. Cooperating together and working things out...when I had a problem I asked someone a question and found better ways to teach it (Group F).

More importantly, however, collaboratively designing resources for iPad provided a framework within which student teachers could draw on the rich context of their school placement experience and accumulated knowledge of using iPad with pupils in lessons. This meant "thinking of [one's] own class and tailoring the resources to them" (Group E) while considering "which elements would be difficult for them and where I needed to spend more time" (Group H). More importantly, it allowed student teachers "to break it down step by step" (Group G) and to approach learning from the pupils' viewpoint:

…certainly it helped because you had to think through or from the perspective of the pupil…how they learn…you are designing from that perspective (Group F).
…you were serving the needs of pupils, for example those who learn better with pictures or with reading or with writing. They all had to be accommodated in that iBook. You were responding to them all (Group D).

The process also supported student teachers in developing and integrating technological and content knowledge (TPACK) within their approaches to teaching and learning:

The way pupils learn and how to motivate them…there are videos, images, multiple-choice questions… and you had to draw all that together in one iBook so that process helped to bring everything together (Group D).

Echoing findings outlined earlier, it is significant that student teachers felt they were also gaining content knowledge as part of this process:

It helped me a lot…when we were creating iBooks I was learning about the syllabus as well as ways to teach the kids…you have to get down to their level (Group H).
I learned that much when I was putting text and slides together…you learn about the subject…if you know it well it's easier to teach. With Geography I had to work out a way to teach it to the students …interactivity…the best way for them to learn (Group F).

iPad as a Tool for Reflection

The utility of iPad as a tool for reflection and the consequent influence on pedagogical knowledge development is another recurring theme within this study. Student teachers engaged in a variety of reflective exercises throughout the year using written, audio and video formats. During the first school placement, for example, student teachers used iPad to make two voice recordings giving their reactions to an incident which had posed challenges for them, the first immediately after the incident and the second a number of days later following reflection. In the final school placement, iPad was used to capture video recordings of their own teaching in the classroom. From these, each student teacher used iPad to edit a selected sample extract and to add their reactions and critical reflection as a voiceover. These were then shared through iPad with Placement Tutors who in turn attached immediate written feedback to video extracts.

When asked in questionnaires which method they found most effective and helpful in promoting reflection, over 80% of student teachers chose video reflection with iPad. It was stated also that the process of editing, analysing and commenting on their video extracts was "much more realistic" (Group H) because "it was as it was…there was no pretense" (Group E). This had a consequent influence

on the development of professional and pedagogical knowledge as it allowed "another perspective" and enabled student teachers to observe "the things that were good and not so good" (Group E) such as "talking too fast, not explaining something correctly or pupils talking in the class" (Group F). Likewise, pedagogical knowledge development was facilitated by storing on each student teacher's iPad all video recordings of peer-teaching and micro-teaching sessions completed by them on the programme throughout the year. Accessible in one learning space, this portfolio of video clips allowed student teachers to "view progression" (Group E) and the difference between "the style I had at the beginning of the year in comparison to the last day of school placement" (Group H).

Impact on Host Schools

As well as impacting on their own practice, it is clear that student teachers' use of iPads made an impression on the wider teaching community in host schools also and this is confirmed by 86% of student teachers in questionnaires. In particular, apps such as TeacherKit (TeacherKit, 2013) and Explain Everything (MorrisCooke, 2013) attracted attention from teachers and principals who were "very impressed and eager to use them" (Group B).

However, while reactions were predominantly positive, less than favourable responses were apparent also among a minority of teachers in host schools. Dismissive comments such as "who does she think she is" (Group A), or "that's all well and good but we didn't have iPads…all we had was a marker" (Group B) were also reported. There was consensus in focus groups that that "the older teachers in school have a negative attitude" (Group E), while younger teachers were eager to learn from student teachers about the affordances of iPad and related apps, or in some cases had actually bought mobile devices during the year to use in their classrooms. Wider issues relating to dominant teaching approaches in schools and the pressures of preparing pupils for examinations were also evident from focus group discussions. In Group G it was stated that teachers "were more concerned with the syllabus and examination papers than with [pupils'] understanding". For another student teacher, the deeply engrained attitudes of teachers did not "set a good example…their attitude is ok you will learn a lot of new things while you are doing your [teaching] diploma but when you get your own job you won't bother with that stuff" (Group F). An interesting observation made by some student teachers, however, was that once their pupils became used to multimodal lessons as an affordance of iPad, they became disengaged when textbooks or teachers' notes alone were used.

Limitations and Challenges

In addition to the many affordances, several limitations with regard to using iPad were also experienced. Many student teachers were not comfortable typing on the screen and preferred using the keyboard on desktops or laptops which were "quicker" and "easier to write with" (Group B). Working across several platforms also meant that documents in different formats created problems with access. For example, the applications Keynote (Apple Inc., 2013d) and Pages (Apple Inc., 2013e) were difficult to open on desktops or laptops and this had implications for resource sharing. Over-reliance on iPad for teaching in the classroom was similarly problematic, with equipment such as projectors, whiteboards, suitable cables and Wi-Fi not always available or functioning in classrooms. Furthermore, student teachers noted how their movement in classrooms was restricted when iPad was connected by cable to the whiteboard and reported that they would have benefitted from having access to wireless systems.

DISCUSSION

The purpose of this study was to investigate if 1:1 iPad deployment could support the professional learning of student teachers on a second level initial teacher education programme and to examine if iPad can play a role in their pedagogical knowledge development and approaches to teaching and learning. Findings show that iPad, used in association with cloud storage and a variety of apps, can be utilised as an effective pedagogical tool and can facilitate the creation of new learning spaces

where student teachers' professional and pedagogical knowledge development is supported through feedback, peer-learning, resource sharing and critical reflection. Setting iPad within the context of a collaborative design process can support student teachers also in developing and integrating all elements of TPACK.

Similar to earlier findings by Pegrum et al. (2013), iPad's effectiveness as an organisational tool emerges as a strong feature in this study, enabling student teachers to store, arrange and access resources relating to classroom teaching and course content on one device. On a wider level, a key affordance of iPad was the manner in which its use facilitated a "liberalisation of learning" (Melhuish & Falloon 2010, p.2), making possible the creation of new learning spaces and networks for student teachers to share and develop knowledge in a variety of real-world contexts and "seamlessly connected learning experiences" (Looi et al., 2010). Using iPad as a medium for shared access to cloud storage files meant that Placement Tutors were able to provide ongoing and detailed feedback on student teachers' lesson planning and reflection during school placement which, in turn, supported the development of pedagogical knowledge. However, what is particularly significant is the manner in which student teachers as a group, independently of programme lecturers/Placement Tutors, utilised these new spaces and used iPad as a tool for sharing support, resources and advice with one another throughout the year. As a result, peer-learning with iPad played a significant role in their pedagogical and professional knowledge development as teachers and was particularly beneficial for those on placement in schools in remote locations. This illustrates clearly the manner in which mobile technology can reshape when, where and how learning takes place (Melhuish & Falloon, 2010), and challenges initial teacher education providers to recognise, support and develop these new avenues for learning.

Similarly, peer-learning was a feature in the collaborative, pedagogical design activities with technology. However, the process of designing resources with and for iPad, culminating in the creation of multi-modal iBooks, allowed student teachers to draw on their experience of using iPad on school placement and to engage in "deep" conversations about their own pedagogical practice and pupil learning (Koehler et al., 2011, p.152). Pegrum et al. (2013, p.464) maintain that mobile devices enable learning that is "situated and contextualised" as well as "personalised and individualised", and it is evident from this investigation that the process of pedagogical design facilitated a dynamic interplay between student teachers' learning with iPad, both as students on the programme and through their experience gained in the classroom. Initial classroom observations and focus groups had indicated that student teachers were at first adopting traditional, teacher-centred, pedagogical approaches and using the iPad as a direct tool substitute at the lowest level on the SAMR model. However, a move to more participatory, pupil-centred and interactive approaches with technology was apparent in the latter part of the programme, illustrating student teachers' evolution from an initial default position as technology-consumers to one where they became technology-users in ways that transformed their approach to learning. It is not being claimed that using iPad alone was responsible for this progression. However, when iPad was used as a context for the design and use of resources it can be seen to have had a potent influence.

There is a strong argument, therefore, for initial teacher education providers to move away from "traditional methods of technology training" which assume that student teachers "will be able to apply this general knowledge to solving problems particular to their classroom situations" (Koehler & Mishra, 2005, p.94), in preference for approaches which involve learning through design with technology which also provide a context for integrating the elements of TPACK. The fact that Irish medium resources were the product of the design process in this study highlights also the importance of adopting this approach within teacher education for minority languages, where the lack of teaching resources in the target language is an ongoing difficulty. Providing student teachers with the knowledge and skills to produce their own resources empowers them, not just to be authors, but to be publishers as well.

Professional learning is also supported through reflective practice and student teachers in this study found the immediacy and authenticity of using iPad to capture, share and receive feedback on video analysis of their own teaching, the most effective form of reflection. Similarly, Placement

Tutors used iPad to provide instant feedback on the quality of this reflection, in essence, reflection on reflection. However, a recommendation for future practice, particularly in the light of findings above, would be to incorporate and utilise peer-video analysis which Harford et al. (2010, p.59) believe can be "transformative".

Findings overall, therefore, highlight the role that can be played by iPad in developing the professional learning and pedagogical knowledge of student teachers on initial teacher education programmes and for integrating technology within teaching, learning and assessment in secondary schools. Student teachers can act as an effective conduit for change by bringing technological pedagogical knowledge to schools, which in the majority of cases in this study, reacted very positively to the possibilities offered by iPad. Pupils in the classroom also acted as drivers for the integration of technology within pedagogy, as student teachers found it easier to motivate and engage them in learning by using iPad in multi-modal, interactive approaches which in many cases were contrary to dominant practices evident in Irish schools (Mac Mahon, 2014). As one student teacher in Group F stated:

I like what I have learned…there is more to school than a teacher standing in front of a class talking, transmitting. Learning must be happening also and now I understand that you must use the new approaches for learning to occur.

CONCLUSION

To date, research on the use of iPad within initial teacher education is limited. The findings outlined in this paper will add to the research base by showing how iPad can be utilised within second level initial teacher education in particular, to develop student teachers' professional and pedagogical knowledge through the creation of new spaces which facilitate peer-learning. It illustrates also that using iPad within design-based approaches can enable student teachers to develop and integrate technological, pedagogical and content knowledge (TPACK), and furthermore, can promote the integration of mobile technology within pedagogical approaches to teaching, learning and assessment. Challenges to the use of iPad were encountered, among them infrastructural and attitudinal factors among teachers in schools. However, this study illustrates that when the genie of mobile technology is released from the bottle, expansion within schools can be driven by student teachers and pupils themselves. The onus of initial teacher education providers is to embrace, facilitate and accelerate this process.

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