



‘Where do you switch it on?’ A Case Study of the Enhancement and Transformation of University Lecturers’ Teaching Practices with Digital Technologies

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This paper reports on a two-year case study of university lecturers’ professional learning about digital technologies, and their development of associated innovative teaching practices. During this time, new hardware and software, as well as planned professional development (PD) opportunities, were made available to assist lecturers in a Faculty of Education at an Australian university to integrate digital technologies into their teaching. Results indicate that participating lecturers succeeded in integrating a range of digital technologies over the 2011-2012 period, with some lecturers transforming their teaching practices substantially. A key finding was that the provision of formal PD was only a springboard – much unplanned and unanticipated professional learning occurred through informal interaction, with lecturers co-learning with colleagues, and indeed with students, in an environment of discovery and experimentation. Formal learning was thus complemented by a networked, or even viral, model of the spread of knowledge and skills among colleagues, students, and indeed wider educational communities. The paper concludes that educators benefit greatly from a combination of formal and informal professional learning strategies when it comes to integrating digital technologies into their practices in pedagogically innovative ways. Two vignettes are included to illustrate and authenticate the findings.

Introduction

This study occurred under the auspices of the Australian Teaching Teachers for the Future (TTF) initiative. This nationwide project was implemented in 2011-2012 to support lecturers in teacher education – that is, teacher educators – in teaching with and about information

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and communication technologies (ICTs), with an emphasis on pedagogically effective use of these tools (Romeo, Lloyd & Downes, 2012). The initiative was in response to a requirement in the new Australian Curriculum that ICTs be taught across all school curriculum areas as one of seven ‘general capabilities’ (ACARA, n.d.), with a focus on the five elements incorporated in Figure 1. In addition, ICTs are interwoven in subject-specific ways into the new curriculum documents in English, Maths, Science, History and Geography.

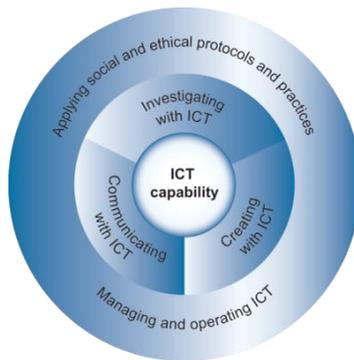


Figure 1. ICT Capability: Organising Elements. Source: ACARA (n.d.), under CC BY-NC-SA licence.

At the same time, a new set of teacher standards, namely the Australian Professional Standards for Teachers (APST), mandates that all newly graduating teachers should be competent in using ICTs to support their teaching (AITSL, 2012). Among the seven standards, each of which comprises a number of focus areas, there are three that specifically reference ICTs, as seen in Table 1, which also includes descriptors of the level expected of graduating teachers.

Thus, in order to prepare pre-service teachers to teach the new Australian Curriculum, and ensure their attainment of the graduate stage of the APST, lecturers in Faculties of Education throughout Australia were required to upgrade their own knowledge and skills in the use of digital technologies.

Table 1. References to ICTs in the APST. Extracted from AITSL (2012).

Standard	Focus Area	Graduate Stage
2: Know the content and how to teach it	2.6: Information and Communication Technology (ICT)	Implement teaching strategies for using ICT to expand curriculum learning opportunities for students.
3: Plan for and implement effective teaching and learning	3.4: Select and use resources	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning.
4: Create and maintain supportive and safe learning environments	4.5: Use ICT safely, responsibly and ethically	Demonstrate an understanding of the relevant issues and the strategies available to support the safe, responsible and ethical use of ICT in learning and teaching.

The TTF initiative, which was designed to support this process and which funded the professional learning described in this paper, had Mishra and Koehler's (2006) TPCK, later renamed TPACK, framework at its core. TPACK focuses on teachers' integration of their technological, pedagogical and content knowledge to design teaching and learning experiences for students. The TPACK framework is often used in conjunction with Puentedura's (2011) SAMR (Substitution, Augmentation, Modification, Redefinition) model, which challenges teachers to integrate new technologies into their classrooms in increasingly transformational ways (Dudeney, Hockly & Pegrum, 2013). While SAMR was not officially endorsed by the TTF project, it offers teachers an intuitively appealing way to put the TPACK principles into practice. Both TPACK and SAMR are described in greater detail below.

This study took place within a Faculty of Education at an Australian university and focused on lecturers in a two-year Master of Teaching programme which prepares students, all of whom already have a degree in a relevant area, to become early childhood or primary teachers. At the time of the study, there were several new Faculty initiatives, including the introduction of wiki-based student e-

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portfolios (Oakley, Pegrum & Johnston, 2013); the installation of interactive whiteboards (IWBs) in the main teaching rooms; and the loaning of iPads to all lecturers and first year students in the Master of Teaching programme (Pegrum, Howitt & Striepe, 2013). It was within this context that staff members were asked to engage in an ongoing PD programme, structured around the TPACK and SAMR frameworks. It comprised presentations and workshops by faculty lecturers who were more experienced in using ICTs in teaching and learning, as well as one-on-one development sessions facilitated by an ICT Pedagogy Officer (ICTPO), a seconded school teacher who was highly accomplished at using ICTs in the classroom.

Literature review

The ways in which people can access, engage with, communicate and transform ideas and knowledge are expanding thanks to new types of hardware, such as smartphones and tablets; new types of software, such as social media platforms and mobile apps; and improving wired and wireless connectivity. Educators around the world are harnessing and repurposing these ICTs, using them as tools that can enhance and transform teaching, learning and assessment (Puentedura, 2011). In the context of higher education, the use of ICTs can be advantageous for practical, social, cultural and intellectual reasons (Laurillard, 2006).

However, it has been argued that lecturers in higher education are often resistant to changing their teaching practices (Ellis & Goodyear, 2010), for a variety of reasons including the inhibitive ‘traditions, values and infrastructure’ of universities (Laurillard, 2002, p. 3). Furthermore, when lecturers employ ICTs in their teaching, the underlying pedagogical strategies are frequently unchanged, except that they operate in digital formats (Laurillard, 2006). While this generally represents a restricted use of new technologies by lecturers, it is of particular concern when it comes to lecturers in education. The latter are tasked with preparing future generations of teachers and therefore need to be able to model pedagogically effective uses of ICTs in meaningful contexts (Lim, Chai & Churchill, 2011; Steketee, 2005). This involves teaching

through as well as about the use of ICTs, a point which has become all the more salient in the Australian context thanks to the new Australian Curriculum and the APST. The use of ICTs to further learning is often referred to as e-learning, which is described in the next section of this literature review, along with m-learning.

Digital technologies and learning

There are varying conceptualisations of e-learning (e.g., Haythornthwaite & Andrews, 2011; Horton, 2012; Mason & Rennie, 2006; Pachler & Daly, 2011), with an emphasis being placed in recent years on socially constructed learning through the use of ICTs (Garrison, 2011). Yet, as Haythornthwaite and Andrews (2011) observe, e-learning is dynamic and constantly changing. This means that educators must be flexible and innovative, always keeping abreast of new technological developments and their pedagogical possibilities. This has implications for PD, which must be ongoing and customised to educators' needs.

A key development in the past few years has been the rise to prominence of m-learning (mobile learning), which refers to 'any form of learning that is mediated through a mobile or, more precisely, mobile handheld, device' (Pegrum, Oakley & Faulkner, 2013, p. 66; italics in original). Because it allows learning to be integrated with everyday life, and to take place across a range of spaces and times at students' convenience, learning enabled by mobile devices is in some ways qualitatively different from learning bounded by traditional learning spaces and schedules (e.g., McCaffrey, 2011; Sharples, Taylor & Vavoula, 2010). There are both points of continuity and points of difference between e-learning and m-learning. Ultimately, they may be seen as components of a wider ecology of learning facilitated by a range of fixed, portable and mobile devices which, when harnessed appropriately, can work in synchrony (cf. Pegrum, Oakley, Clarke & Sligar, 2013; Pegrum, in press). In the current study, we focus on the pedagogically effective use, by teacher educators, of a whole ecosystem of ICTs which have the potential to be used, in line with the SAMR model, to enhance or transform learning.

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TPACK and SAMR

Perhaps the best-known teacher development model involving ICTs is Mishra and Koehler's (2006) TPACK framework, which consists of interlocking circles representing teachers' technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK), as seen in Figure 2. Used to underpin the work of the Australian TTF project, it advocates the need to integrate understanding of technology with understanding of content and pedagogy, which have long been regarded as teachers' core competencies. Placing equal importance on all three areas, it suggests that the most effective teaching may occur in the areas of overlap between the circles, with technology being an integral part of TCK, TPK and, of course, TPACK as a whole. The technology involved may include tools drawn from the whole ecosystem of e-learning and m-learning described above.

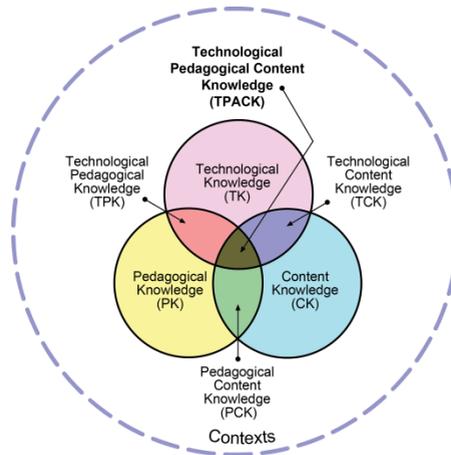


Figure 2. The TPACK framework. Source: tpack.org, © 2012, reproduced with permission.

The TPACK framework, as noted earlier, can be usefully complemented by Puentedura's (2011) four-level SAMR model, as seen in Figure 3. When teachers and teacher educators first begin to work with ICTs, they are likely to start on the lowest level,

substitution, where, for instance, they might simply ask students to email in essays instead of submitting them on paper, leading to efficiency gains but no learning gains. Small learning gains begin to appear at the next level, augmentation, as ICTs are used to add functional improvement. To transform rather than simply enhancing learning, however, teachers need to work at the upper two levels of the SAMR model, involving modification or redefinition of learning tasks. The latter might entail, for example, replacing an essay task with a digital video task where students' work is subject to peer feedback and editing before being publically shared; thus, ICTs can facilitate an increase in multimodality, collaboration and co-construction of understanding, with a real-world target audience lending the task greater significance. (For a fuller discussion of the SAMR levels, see: Pegrum, in press.) Puentedura (2012) estimates that a full-time teacher might need around three years of experience with ICTs to move from tasks which simply involve substitution to tasks which involve some redefinition.

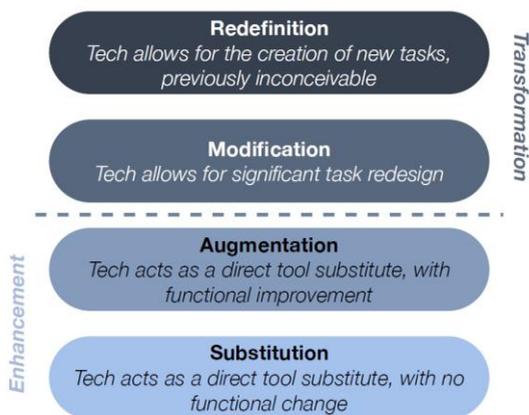


Figure 3. The SAMR model. Source: Puentedura (2011) under CC BY-NC-SA 3.0 licence.

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In the current study, both TPACK and SAMR were introduced to staff in presentations, and discussed in workshops, in order to give lecturers theoretical frameworks to help contextualise their thinking about, and integration of, ICTs in their classes. The seconded ICTPO was also available to help lecturers improve their TK and consider how it might be integrated with their PK and CK, as well as how they might shift their technology usage towards the higher SAMR levels.

Professional learning and changing practices

There is no guarantee that PD in educational settings will lead to real change. In fact, Guskey (2002) has pointed out that it can be extremely difficult to design and implement PD that results in educators changing their teaching practices. In the context of ICTs, one barrier to change could be that the PD typically emphasises the teaching of skills (how to use new hardware or software packages) rather than the meaningful embedding of ICTs into the curriculum (Pachler, Preston, Cuthell, Allen & Pinheiro-Torres, 2010). Ward and Parr (2010) have suggested that there is, in fact, no one best way of providing ICT-related PD for educators because of their diverse needs, and because of the varying ways in which ICTs can be used in teaching and learning. Indeed, traditional PD in this area is often ineffective (Brinkerhoff, 2006) and it appears that new modes of professional learning are required to enable educators at all levels to cope with constant changes in the available technologies and associated pedagogical potential.

As in many other PD initiatives, staff development in the area of ICTs often takes the form of presentations, sometimes accompanied by hands-on workshops where participants can receive guidance as they begin to experiment with new technologies, and it may also involve one-to-one coaching. This largely reflects a top-down 'training' model (Kennedy, 2005) of knowledge building and upskilling. In recent years, increasing attention has been paid to alternative, but complementary, development models which focus on bottom-up rather than top-down learning. In the well-known 'community of practice' model (Wenger, 1998), community

members ‘share a concern or a passion for something they do and learn how to do it better as they interact regularly’ (Wenger, n.d.). A related model with a specific educational focus is the ‘community of learning’, which may be defined as a ‘group of people working together to facilitate the learning process’ (Hill, 2012, p. 269); a community of learning may be either ‘bounded’ (having a limited lifecycle associated with a specific learning need, and often being directed by a person in a position of authority) or ‘spontaneous’ (emerging when a group of people with a common learning interest work together to improve their knowledge and practices) (Wilson, Ludwig-Hardman, Thornam & Dunlap, 2004). Of late, there has been growing interest in a networked or viral model of learning. While there have been some attempts to combine the concepts of communities and networks (e.g., Earl & Katz, 2007; Katz, Earl, & Ben Jaafar, 2009), these are generally treated as separate lenses, each of which can highlight particular aspects of professional learning. Given the strong links between new technologies (such as mobile phones and social media platforms) and networking, it is the latter lens which has been applied here.

The notion of networked learning is linked to the wider development of network theory in the sciences and social sciences (Barabási, 2003; Buchanan, 2002; Watts, 2003), and to the increasing emphasis on personal learning networks, or PLNs, in education (Ferriter, Ramsden & Sheninger, 2011; McElvaney & Berge, 2009; Richardson & Mancabelli, 2011). The viral spread of ideas among staff, which Cluett, Skene and Pegrum (2011) term ‘viral leadership’, entails:

the promotion of ideas, knowledge and skills on an ad hoc basis via informal personal connections based on mutual interest and enthusiasm Unlike the kind of leadership associated with more formal training and a cascade model of knowledge and skills dissemination, it can be seen that the viral model builds on the interconnected links between participants, with ideas, knowledge and skills spreading ‘like a virus’ through the network. (p. 3; italics in original)

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Such a model allows staff who are not in official leadership positions to ‘lead change in ways that are not predetermined or even entirely predictable’ (p.1). This echoes the widely stated observation in the ICT literature that it is important to have staff leaders – though not necessarily with official leadership positions – who can ‘infect’ other staff members with enthusiasm for using new technologies (Pegrum, in press).

It should be noted that there is no commonly accepted distinction between networked and viral learning in the literature. Both can involve ideas spreading rapidly and widely. However, it might be argued that networked learning shades into viral learning when ideas are disseminated not only quickly and broadly but often in multiple directions at once. These ideas may also take on mutated or changed forms as they are adopted, adapted and repurposed to suit different areas and needs.

While the professional development of lecturers in the current project was originally organised in a traditional training manner combined with coaching/mentoring (Kennedy, 2005), without any specific focus on developing a community of practice or learning, or a learning network, a key insight of this study was that, in an appropriately innovative environment, a bottom-up learning process can spontaneously emerge among staff members. To the extent that learning flows through a variety of personal connections, whether face-to-face or technologically mediated or both, and to the extent that it flows in multiple directions through a network which is effectively unbounded, it can be helpfully viewed through the lens of a networked learning model.

Method

PD programme

This study was launched in tandem with a formal PD programme to upskill Faculty of Education staff in the pedagogically effective integration of new technologies into their classes, informed and

partially funded by the Australian TTF initiative. Key components of the PD programme included:

- Delivery of a presentation by one of the authors of this paper to introduce staff to TPACK, SAMR, and a range of web 2.0 and social media tools and techniques – for example, blogs, wikis, folksonomies, podcasting, vodcasting, and digital storytelling platforms – and showcase examples of their use in schools and universities (2011);
- Delivery of a presentation and workshop by both authors of this paper on how ICTs might be built into course units, with staff bringing their unit outlines for a discussion with colleagues about how they could push their use of new technologies towards the higher SAMR levels (2011);
- Delivery of two workshops on using wikis, and specifically the Wikispaces platform, to enable staff to assist pre-service teachers in building wiki-based e-portfolios (2011);
- Delivery of two workshops on using IWBs, specifically Smartboards, given that these had recently been installed in the main teaching rooms (2011);
- Delivery of two workshops on using iPads for teaching and learning, given that all first-year students on the Master of Teaching programme had been loaned iPads for the duration of their first year of study (2011);
- One-on-one mentoring by the ICTPO, available on request for 12 months (2011);
- Development of a repository of tools, ideas and instructions, built and made available to staff through the university's learning management system, Moodle (2011-2012).

Data collection and analysis

This research used a case study methodology to examine changes in teaching practices among staff. Case studies allow researchers to examine a phenomenon 'in its natural setting, recognising its complexity and its context' (Punch, 2009, p. 119). As Gay, Mills and Airasian (2009, p. 427) point out, case studies are appropriate when

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researchers aim to study processes, such as change processes. This case study set out to investigate the question: *How do teacher educators change their pedagogical practices as a result of formal and informal professional learning about using digital technologies to enhance and transform their teaching?*

Data collection took place primarily in late 2012, towards the end of the two-year staff development period. It comprised an online questionnaire (whose purpose was to provide an overview of staff learning; it included Likert scale questions as well as open-ended questions), a focus group (to allow collaborative development of key themes associated with the whole group's learning) and semi-structured interviews (to provide insights into individual staff members' learning trajectories). In addition, unit outlines were examined to ascertain how lecturers were integrating ICTs into their teaching and into students' assignments. Inductive data analysis, based on Miles and Huberman's (1994) framework, was used. Because of the small number of participants, questionnaire data were collated, tabulated and represented graphically; statistical analysis was not appropriate.

Participants

All unit co-ordinators involved in teaching core units of the Master of Teaching programme in the Faculty of Education were invited to participate. Nine out of a possible ten lecturers completed the questionnaire, although not all answered all questions. Four of the lecturers also participated in the focus group discussion, and four participated in semi-structured interviews. The vignettes below were derived in large part from the interviews. The research complied fully with institutional ethics requirements and permission was granted by the university's Human Research Ethics Committee. Participants were aware that they could withdraw from the research at any time, and confidentiality was assured. Pseudonyms are used in this paper to protect participants' anonymity, and some details about their teaching areas and other identifying information have been omitted for this reason.

Results

Formal professional learning

Five of the nine lecturers who completed the questionnaire attended at least one presentation on the use of ICTs, where TPACK and SAMR were introduced. In the combined presentation and workshop, participants brainstormed and annotated their unit outlines to begin the process of change, referring where relevant to TPACK and SAMR. The latter found particular resonance among lecturers, as an intuitive way of conceptualising the pedagogical effectiveness of their current and planned uses of ICTs. All nine lecturers attended either one or two e-portfolio workshops, where they learned how to incorporate the wiki-based e-portfolios into pre-service teachers' assignments. Four attended at least one workshop on how to use IWBs, and most attended at least one session on the use of iPads and/or received individualised instruction and coaching from the ICTPO about these devices.

Despite the presence of the ICTPO, who was also involved in the presentations and workshops, not all the lecturers drew on his availability for one-on-one customised coaching. Only one received regular coaching throughout the year, with five others requesting and receiving one or two sessions on specific topics. Three did not draw on the ICTPO's expertise at all, but these lecturers already saw themselves as reasonably competent and confident in the use of at least some ICTs and, indeed, were involved in delivering or co-delivering the presentations and workshops for colleagues.

Informal professional learning

It was found that all lecturers engaged in a variety of informal learning activities which were not planned or predicted. The learning often took place through a process of staff experimenting or 'playing' with the technologies, generally in pairs or small groups. This process typically involved investigating how different hardware and/or software could be used to teach particular content areas, and

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then passing on emerging insights to others. One lecturer put it this way:

I just wanted to find out what people were doing and [see] what they were doing. We talked about this great app – I would like to see it. It is not the formal sharing, it is more an informal sharing. (focus group)

As staff enthusiasm for and engagement with digital technologies increased over time, some chose to attend PD sessions outside the university and then quickly spread key ideas to their colleagues in the faculty, sometimes face-to-face and sometimes through sharing digital links to websites or apps. Others used social media platforms like Facebook, LinkedIn and, particularly, Twitter to find and pass on ideas about teaching with ICTs. One stated: ‘I share innovative ideas used by my colleagues across [Western Australia]’ (questionnaire).

Staff also frequently found themselves learning from and with the pre-service teachers who were their students, as seen in these comments:

It’s also really useful to see ... pre-service teachers as ‘learning partners’ who are engaged alongside us in a pedagogical exploration of new technologies. (questionnaire)

We saw [the pre-service teachers] doing things we never expected ... We learned from them, showing us apps and things. (interview)

One lecturer spoke of how she learnt about technology from pre-service teachers, while simultaneously helping to deepen their and her own TPACK through critical analysis of digital resources and their pedagogical applications. Thus there was a fertile reciprocal sharing, with the lecturer’s knowledge about pedagogy and content, and the pre-service teachers’ knowledge about technology, being drawn together in an almost symbiotic way:

We did the apps. I don’t know very much. But I had the students share and I learned so much more. They know these apps and the video You Tube things as well. But they are not critical and some of those [video clips] are totally against what we have been

learning about the ways students' concepts develop. We actually did a critique of guys in a video clip, it was a You Tube [clip] rapping maths. They all thought it was wonderful but in the end they all realised that it was just bells and whistles. (focus group)

Thus, learning occurred through blended networks consisting of both non-digital and digital connections. Within the faculty, learning transcended the staff-student divide, with ideas being passed back and forth within and between the two groups. Moreover, learning often transcended the boundaries of the faculty and university, especially once digital tools were employed. Given that ideas were spread in multiple directions to multiple people, and took on varying forms suited to different areas and outcomes, we might say that in this case networked learning became viral learning, according to the definition suggested earlier.

Changing practices

All nine lecturers discovered ICT tools or ICT-based pedagogical strategies that enabled them to deliver their unit content in new ways. For example, one lecturer went 'paperless' to encourage the pre-service teachers to utilise their iPads as personal learning devices. Through trial and error, she taught herself how to use a PDF annotation app and encouraged her students to use the same app, or find an alternative if they preferred. Another lecturer focused on the use of the IWB to improve her teaching. She extended her knowledge through experimenting with learning objects from the Learning Federation (subsequently renamed Scootle and now managed by Education Services Australia; see www.scootle.edu.au), as well as a number of interactive websites. A third lecturer explored the use of wikis with her students, inspired in part by the introduction of wiki-based e-portfolios as a central component of the Master of Teaching programme (see Vignette 1 – Ursula, below). A fourth lecturer spent time exploring the use of blogs in her classes (see Vignette 2 – Bronwyn, below), assisted by the ICTPO.

In short, staff reported that they had changed their teaching in a variety of ways but, as seen here, this was not always as a result of

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planned professional learning. Interestingly, they displayed a range of views about the degree of success they had experienced in the process of change. In response to the questionnaire item, ‘In general, with what degree of success would you say you are integrating ICTs into your teaching?’, only one participant claimed to have had a high degree of success. Of the eight who answered this question, the majority, five (63%), responded that they had experienced moderate success, while two respondents said that they had experienced only limited success.

When asked specifically about the integration of their TK, PK and CK, as per the TPACK framework, only one of the seven respondents to this question reported a high level of success, with three reporting moderate success, and three limited success. One respondent saw a lack of appropriate hardware in some teaching rooms as an issue; one admitted a personal tendency to stick to more familiar, static web 1.0 tools; but four specifically mentioned time as an inhibiting factor, with one noting:

It's important to take lots of time to play with new technologies, build up your familiarity with a few key pieces of software, then gradually expand your repertoire. (questionnaire)

When asked about their success in using ICTs on the four levels of the SAMR model, the results were telling, as seen in Figure 4. Of the eight respondents to this question, one selected ‘Don’t know’, reflecting unfamiliarity with or lack of recollection of the SAMR model. The remaining seven all had sufficient awareness to rate their success at different SAMR levels, although only five had attended formal PD on this model, suggesting that the others might have learned about it informally through interactions with colleagues. Among the seven, the overall trend was towards a perception of greater success at the two lower levels, namely substitution and augmentation (enhancement), and less success at the two higher levels (transformation), especially redefinition. Indeed, redefinition was the only level where some respondents – in this case, two – indicated that they had experienced no success at all. Given Puentedura’s aforementioned estimate that full-time teachers would need three years to develop the ability to implement tasks at the

highest SAMR level, this should come as no surprise in the two-year framework of our study. The fact that some teachers experienced low or even moderate success at the redefinition level may reflect prior experience with ICTs, personal willingness to engage with them, and/or varying ways of assessing their own ICT use. According to respondents' answers to an open-ended question about the reasons for their degree of success with SAMR, key issues listed as hampering changes to practice were: lack of familiarity, or very slowly increasing familiarity, with web 2.0 and other software (6 mentions); a lack of time (3); and inadequate hardware (2).

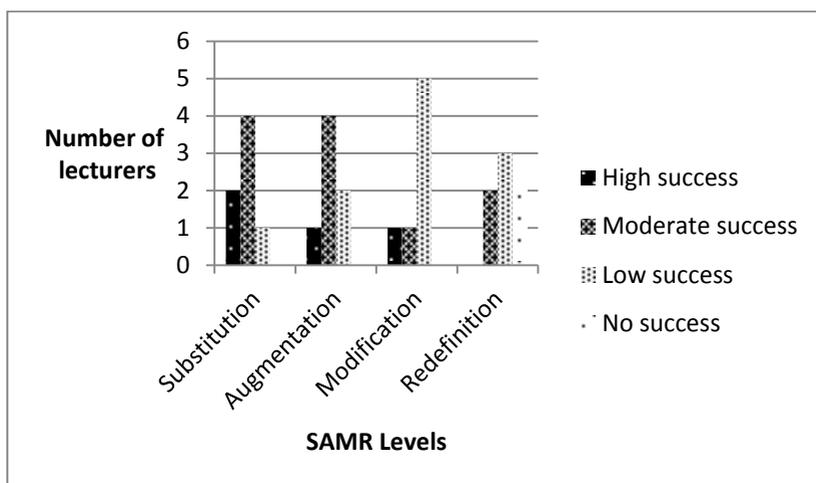


Figure 4. Lecturers' self-assessment of their levels reached over 2 years on the SAMR model (N=7).

The evidence of some progression towards modification and even redefinition may also reflect the wide range of influences on lecturers' learning about and integration of new technologies in their classrooms. Lecturers were asked whether each of nine factors – derived from informal discussions – had 'great influence', 'some influence', or 'no influence' on their use of ICTs. The results for 'great influence' and 'some influence' are captured in Figure 5. It can be seen that the external driver of new course accreditation requirements, which came about as a result of the new Australian

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Curriculum and the APST, found most traction among staff (of seven respondents to this question, six said it had great influence, and one said it had some influence; none said that it had no influence). In second place was the ability to discuss ICTs with colleagues (three said great influence, four some influence), fitting neatly with a networked model of the spread of new ideas. Despite the fact that limited or inadequate hardware was noted as an inhibiting factor in some responses to the abovementioned TPACK and SAMR questions, the presence of new technologies in the Faculty was the equal third most important influence, along with lecturers' own intrinsic interest in ICTs (in both cases, two said great influence, and five some influence).

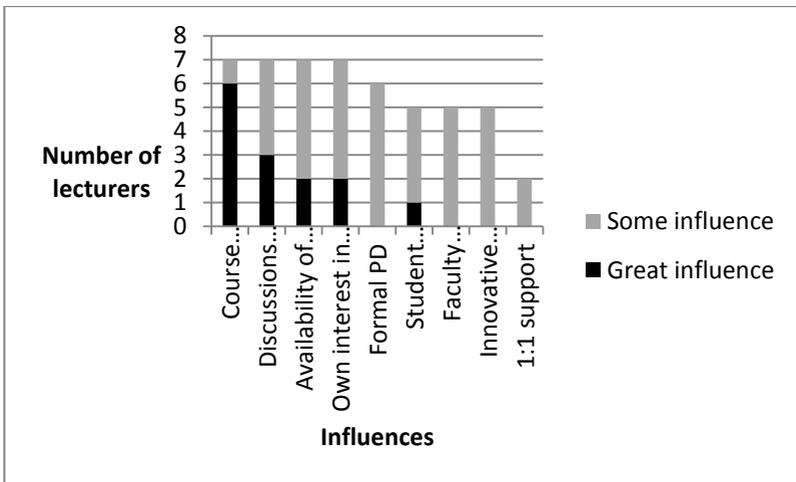


Figure 5: Lecturers' self-reported influences on their use of ICTs (N=7).

Formal PD, the centrepiece of most initiatives to extend ICT use, came next, in exactly the middle of the field, suggesting that such an approach might well be insufficient as a standalone strategy (especially as all six who recognised its influence said it had some, rather than great, influence). Nevertheless, lecturers' general familiarity with TPACK and SAMR, as captured in earlier questions, demonstrates beyond doubt that it played a role. Faculty and student

expectations, and the Faculty's reputation, were less important, with 1:1 support rated as being least important of all – and yet, as revealed in the vignettes below, for those who needed it, when they needed it, it proved absolutely pivotal. Indeed, although Figure 5 reveals the range of influences which coalesced to produce a shift in the direction of greater ICT use in the Faculty, what it does not reveal is the extent to which individuals were affected by varying combinations of these factors, or engaged in varying combinations of formal and informal learning. To further elucidate this, we turn now to our two vignettes, which have been based in part on our institution's 'Most Significant Stories', which were submitted to the TTF project for analysis. These draw in part on the focus group but mainly on the individual semi-structured interviews.

Vignette 1: Ursula

Ursula (all names are pseudonyms) had many years of experience as a primary school teacher, and had subsequently worked in teacher education for more than a decade. She specialised in teaching English and Humanities units in the Master of Teaching programme, although she also taught in other areas such as Science and the Arts. She had considerable CK and PK in the units she taught and had built up a certain amount of TK before the TTF project commenced. For example, in 2010, she required her pre-service teachers to create a multimedia showcase of their school-based teaching as an assessment item for a Science and Humanities unit. In the first iteration of this innovation, many of the pre-service teachers used PowerPoint to produce technically rather unsophisticated showcases. Yet when viewing the assignments by those pre-service teachers who took the opportunity to go beyond PowerPoint, and especially those who used their assignments to demonstrate innovative classroom uses of digital technologies, Ursula herself was exposed to new ideas and possibilities for using ICTs. She came to the conclusion that the pedagogical applications of ICTs were considerably more extensive than she had originally thought:

I probably started out thinking that there would be a limit to what I could do with the technologies; I was even against iPhones in classrooms because of a limited awareness of their application

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beyond a phone, so in that respect I have shifted my thinking considerably. Considering my awareness of what works with kids in classrooms, I have had my eyes opened wider; that is, I have seen a number of sensible applications that could be applied in a classroom. (interview)

The multimedia showcases were, for Ursula, an exciting influence on, and complement to, her own TPACK. In 2011-2012, in light of her developing understanding and in the context of the TTF project and the PD which was available, Ursula began to build increasingly sophisticated technological requirements into the assignment. By the end of 2012, she had tasked her pre-service teachers with using a range of web 2.0 tools – some of which she had seen past pre-service teachers use, and some of which she had encountered in the PD presentations and workshops – to create their multimedia showcases. The deliberate integration of additional multimodal and collaborative elements helped push this task towards the higher, transformational levels of the SAMR model.

In the six months prior to the commencement of the TTF project, Ursula had also started to experiment with new hardware such as IWBs and iPads, which the Faculty had just acquired, and new tools such as stop motion software and wikis, the latter having been introduced as part of the Faculty e-portfolio initiative. Despite the fact that Ursula had started to innovate with ICTs before the TTF project, she still considered her TK to be in need of development. In addition to attending PD sessions, she found it advantageous to draw regularly on the support of the ICTPO, Jamie, as well as technologically experienced colleagues. For instance, her wiki implementation came to rely heavily on the ICTPO's personalised support. She pointed out: 'Having Jamie at the [Faculty] meant that you actually did seek help and engage with the ideas' (interview).

While recognising that she was in many respects a co-learner with her students, Ursula also needed to be able to assess pre-service teachers' learning about the use of ICTs for teaching children. Thus, she drew on her own developing TPACK to design an appropriate wiki-based assignment. This task required the pre-service teachers to

appropriately embed the use of a wiki into a sequence of lessons, which they then implemented in schools. Given the capabilities of wikis to support multimodality, collaboration, and co-construction of knowledge, they were an ideal tool to facilitate tasks at the modification and redefinition levels of SAMR – both for the students taught by the pre-service teachers, and the pre-service teachers themselves.

When asked about her motivations for bringing in a wide variety of ICT-based innovations, Ursula stated that the main drivers had been external pressures such as the requirements of course accreditation and the need to prepare pre-service teachers for the modern classroom. However, she was also intrinsically curious and interested in trying out new technologies. She was enthused by the ideas spread through the PD sessions at the beginning of the TTF project, was supported by Jamie in translating this enthusiasm into action, and was stimulated to try more ICT-based strategies as a result of informal conversations with colleagues as well as, crucially, interactions with pre-service teachers.

Two years after the commencement of the TTF project, when asked to reflect on challenges and successes, Ursula felt that she had experienced only limited success in developing and applying her TPACK, although she had certainly succeeded in designing some learning tasks for the pre-service teachers which could be seen as transformational according to the SAMR model. She cited time and a lack of appropriate technological resources as having impeded her development. She also indicated that she had not integrated the e-portfolios into her units as fully as she would have liked because of her uncertainty about how best to link them to unit outcomes. Nor had she fully utilised the affordances of the iPads as m-learning devices, since she had not encouraged pre-service teachers to use them to communicate with each other in real time, or to facilitate the use of non-traditional learning spaces.

Thus, Ursula had already begun developing her TPACK prior to the TTF project, but this development increased greatly during the project, partly thanks to the innovative, co-operative environment

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fostered in the Faculty. In time, she found herself beginning to set tasks which made pedagogical use of new technologies in ways consonant with the higher SAMR levels, despite the barriers to innovation mentioned above. Nevertheless, whenever she used ICTs, Ursula always had a Plan B, indicating that she did not yet fully trust the technology. Although she had travelled a considerable distance on her journey with digital technologies, she recognised that there was still some way to go. One challenge she had set herself for further growth was to experiment with the use of augmented reality apps to transform pre-service teachers' learning on field trips. Ursula, like Bronwyn, whose story is outlined below, tapped into the ICTPO's expertise on a regular basis for the first year, but also networked informally with colleagues and students. Once the ICTPO was no longer available in the second year, she continued to network to improve her TPACK.

Vignette 2: Bronwyn

Bronwyn was another highly successful teacher educator with a sophisticated level of CK and PK, developed over many years of classroom practice, personal reflection, and involvement in teacher education, primarily in the areas of Science and Mathematics. At the beginning of the TTF programme, she felt she had relatively limited TK. Unlike Ursula, she had not yet found time to begin to address this in any systematic way. Up to that point, she had used only a limited number of ICTs in her teaching, generally on the lower SAMR levels; for instance, showing YouTube videos to illustrate concepts and provide a context for discussion, which might be seen as a substitution or, at best, an augmentation of content transmission.

Bronwyn had never used a smartphone or tablet before receiving her Faculty-issued iPad. In fact, she noted: 'When I got the iPad I asked, "Where do you switch it on?" [My colleagues] laughed at me, and then I asked, "Where do I switch it off?" And they laughed again' (interview). When, through TTF PD, she was challenged to think of ways of using iPads in her teaching, she was initially unsure that she would be able to integrate them effectively within the context of her units. As she and the pre-service teachers experimented with the

iPads together, however, they found various ways of using them and connecting their growing TK with their CK and PK. Like Ursula, she soon found that she and her students were co-learners. The pre-service teachers would often find apps and show them to Bronwyn and, together, they would develop ways to exploit them to teach content, whilst maintaining a focus on the underlying pedagogical principles. Bronwyn made sure that she, and the pre-service teachers, took time to critique apps and construct a rationale for using them in particular ways. She felt it was essential that the use of ICTs had ‘meaning’ for her and the pre-service teachers. She indicated that this meaningfulness was dependent on an appropriate convergence of technology, pedagogical strategy and content.

A highly significant learning event for Bronwyn came about as a result of a conversation with a colleague:

Where I feel we really did use the iPad in a way that enhanced the students’ learning was when we decided to incorporate mind maps. The minute it was suggested to me I think [my colleague] Maddie actually saw the lightbulb above my head go off I could see this was something that [the pre-service teachers] could actually learn about. They could use it themselves individually; they could then take it into a classroom situation if they chose to do so It had meaning to me and to them. (interview)

This connection of TK and PK – effectively TPK – thus resulted not from formal PD (although that had helped frame Bronwyn’s understanding of new technologies through TPACK and SAMR, as well as presenting some possibilities for iPad use), nor from 1:1 support from Jamie (although this was always available), but from informal networking with a colleague. She went on to identify, and teach her pre-service teachers how to use, a free mind-mapping app for Apple iOS called SimpleMind+. Having understood the need to take time to experiment with new technologies, she concluded a brief demonstration of the tool to her pre-service teachers with an invitation for them to ‘just play’ with it. This involved talking to each other about it, before beginning to use it for serious educational purposes. It didn’t take long for the pre-service teachers to understand its value:

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Some of the students were just [saying], ‘This is so good, this is how I learn, this is what I need to summarise my information’. It was so positive that immediately they were commenting that they could use it to help them in their own learning. (interview)

The use of the mind-mapping software spread among many individuals, with networked learning shading into viral learning as they each began to employ it in their own ways and share those ways with others, so that the knowledge and skills being exchanged shifted and mutated in the process. What is more, as students started to work with the capabilities of mind-mapping software to support co-construction of understanding, which could be revisited and reworked over time both individually and as a group, Bronwyn found herself beginning to set collaborative mind-mapping tasks at the transformational levels of SAMR.

Bronwyn did benefit from 1:1 support in other aspects of technology use. In 2011 she began to work with blogs, although she had initially rejected the idea: ‘When Jamie first mentioned the blog ... I just said, “No, I am not interested in the blog”’ (interview). However, some months later, Bronwyn found herself having to cancel a face-to-face class because of an unexpected disruption. As she contemplated alternative means of delivery, she reconsidered Jamie’s earlier suggestion. After receiving assistance from Jamie in setting up a blog, she was surprised to find that most of the students had logged in before the live session was due to begin:

So, half an hour before the session, students were already on there and we started a conversation – we started the blog then and there. So it ended up going for two and a half hours. I literally put an end to it because I was having problems with my computer. I was doing this from home. Otherwise I am sure it would still be going now ... (interview)

Her approach was to cycle through a series of questions during the blogging session, giving students time to respond before suggesting any answers:

I wanted to see what comments they could come up with and how they could support each other’s learning, and they did They

were incredibly supportive. They were really giving some bright ideas and they gave so much affirmation ... so I am just blown away by this and I let Jamie know how successful it was. I would love to do a similar thing in every unit – if someone could set up the blog. I still need the support in setting it up but I am so sold on using it. (interview)

It is clear that, with appropriate 1:1 support, Bronwyn was able to combine her existing deep PK with her developing TK to create a task which fostered a constructivist online discussion among her students, through which they engaged in deeper reflection than a similar face-to-face discussion might have encouraged. On the SAMR model, this use of technology could be viewed as transformational.

Ursula and Bronwyn were given an opportunity to read through and check the vignettes presented here before the text was finalised. At this point, around three years after the commencement of the TTF initiative, Bronwyn made the following remarks as she looked back over her learning journey:

It was interesting reading over this [vignette], and reflecting on how far I have come since then, especially in relation to SAMR and TPACK. This SAMR model is something we should all have sitting in front of us, challenging our practice. But look at me now – embracing the flipped classroom model, changing my pedagogy, and working out ways to use the flipped model in different units. Perhaps it is that three-year development period required to be comfortable with the technology that is coming through with me. (email)

Discussion and Conclusion

This study aimed to find out how, over a two-year period of TTF-supported PD on integrating new technologies into their pedagogy, lecturers in a Faculty of Education changed their teaching practices. In particular, it focused on how formal and informal professional learning combined to help them use digital tools and techniques to enhance and transform their teaching.

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The nine participating teacher educators in the Faculty indicated that, as they learned more about ICTs through both formal and informal learning opportunities, they reflected deeply on their pedagogy. In some ways this enabled them to fundamentally rethink their approaches to teaching. Although some initially found it difficult to integrate technology without detracting from the nature of their units, all eventually found ways of using ICTs that fitted with their philosophies, content areas and pedagogical preferences. Indeed, as in the cases of Ursula and Bronwyn, assumptions about ‘what works’ were challenged and established strategies were modified.

The factors that influenced the lecturers to explore ICTs included external imperatives such as new course accreditation requirements, as well as the reputation of the Faculty and the expectations both of the Faculty and of pre-service teachers. They included internal imperatives, especially their own intrinsic interest in ICTs, which grew noticeably over time as more and more successes were reported around the Faculty. They included formal PD, which was important, especially in disseminating knowledge of the theoretical TPACK and SAMR frameworks, as well as in demonstrating hardware and software. They included 1:1 mentoring, which was important when lecturers needed ideas on how to match technologies with pedagogies, and to develop their TK so that it could truly complement their CK and PK.

But lecturers also drew on discussions and interactions with colleagues, so that both the enthusiasm for using new tools, and specific ideas on how to do so, spread in a networked way from colleague to colleague – and did so widely, as some colleagues introduced learning gained in external PD sessions, and in some cases shared their learning on social media platforms, thus introducing a more viral element. At the same time, staff became co-learners with the pre-service teachers, allowing for a wider spread of enthusiasm and ideas as different uses of tools were explored and shared back and forth between lecturers and students, again adding a more viral element to the learning. In short, a range of influences coalesced together to create an innovative environment in which formal PD and informal, networked and even viral learning could

helpfully complement each other to further individuals' learning journeys. All in all, this changed lecturers' mindsets about, and increased their knowledge of and skills with, ICTs in education.

This study was limited in a number of ways. First, it was based on a small sample size, though it included nearly all unit co-ordinators in the programme in question, and an in-depth focus group and individual interviews provided detailed data which allowed rich insights into personal learning experiences. Had the formal ICT-related presentations and workshops alerted participants to the possibilities of learning through informal networking, more lecturers might have capitalised on these possibilities from an earlier point in time. Moreover, some obvious learning options did not surface at all in our data collection. As was the case in Peeraer and Van Petegem's (2012) large-scale study of teacher educators' professional learning about ICTs, for example, there were no reports of lecturers inviting each other to observe and provide critical feedback on their ICT-enriched practices, although at the university in question it was a requirement that all academic staff engage in peer observation. This practice could also have been recommended during formal PD sessions as a way to help lecturers deepen their understandings about TPACK, SAMR and ICTs in education.

As Peeraer and Van Petegem (2012) point out, 'it may be best to combine programmed professional development addressing TPACK of teacher educators with incentives for additional engagement with the topic', including prompting 'ICT enthusiasts to exchange with and encourage peers' (p. 1053). Above all, it may be worth highlighting to staff the value of adopting a broad palette of strategies when it comes to ICT-related learning, and stressing the value of combining a range of formal and informal opportunities to engage with new technologies and their accompanying pedagogical possibilities.

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