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Supporting pre-service teachers’ technology enabled learning design thinking through whole of program transformation

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This paper explains a development and evaluation project aimed at transforming two pre-service teacher education programs at Macquarie University to more effectively cultivate students’ technology enabled learning design thinking. The process of transformation was based upon an explicit and sustained focus on developing university academics’ Information and Communication Technology (ICT) capabilities so that they could successfully integrate technology throughout their pre-service teacher education program subjects and model the approaches they were aiming to foster in their students. The initiative involved appointing ICT Pedagogy Officers to work directly with academic staff, funded as part of the Australian Teaching Teachers for the Future Project. Key findings include the sustained effort that is required in order to engender change, and the primary importance of relationship building in successful ICT education development.

Keywords: Pre-service teacher education, technology, TPACK, program development, evaluation, learning technology, design thinking

Introduction

The call to develop the technological capabilities of teachers in Australia mirrors initiatives overseas, with a growing focus on ‘21st Century Skills’ as being essential for both current and future educators (AACTE & P21, 2010; Rotherham & Willingham, 2009). These capabilities, increasingly incorporated in teacher accreditation standards, are aimed at ensuring that our teachers are employing and modelling 21st Century Skills in the classroom so that school students will develop the skills that they require to be successful in the future.
Thus tertiary Teacher Education Programs are challenged to transform their programs so that pre-service teachers develop contemporary technology enabled learning design capabilities they will need to help their students become 21st Century leaders. There have been some documented attempts at this (Hughes, Gonzales-Dholakia, Wen & Yoon, 2012; Jackson, 2012; Jimoyiannis, 2010; Kay, 2006; Madson, Melchert & Whipp, 2004; Norton & Hathaway, 2012; Ottenbriet-Leftwich, 2012). However, many of these focus on specific subjects rather than technology integration throughout an entire Teacher Education Program. Further, program reviews such as those by Jefferson (2009), Louden (2008) and Darling-Hammond (2010) frequently focus on generic teaching skills or present an overview of key issues rather than addressing Teacher Education Program transformation at the level of the actual capabilities that pre-service teachers need to cultivate.

In order to support the development of pre-service teacher Technology-Pedagogy And Content (TPACK) capabilities the Australian Government provided $8.3m funding to be shared across all universities for staff development purposes. At Macquarie University this funding for this “Teaching Teachers for the Future” project was to be used to employ two part-time technology experts (ICT Pedagogy Officers) to work with academic staff, and to provide senior academic time to lead the initiative in each university.

Through a participatory case-study, this paper presents key findings of this project and critically reflects on the one year change process aimed at transforming two pre-service Teacher Education Programs at Macquarie University to develop pre-service teachers’ technology enabled learning design thinking.

**Background Literature**

As outlined, our increasingly technological society it is becoming an imperative that graduating student teachers are adept technology integrators (Duncan, 2010). However, this is
often overlooked in pre-service teacher education programs, which frequently have limited pedagogical use of technology (Lim, Chai, & Churchill, 2010). Further, many programs focus on the “development of technical skills” (Jaipal, & Figg, 2010, p. 420) or subject specific technology use (Jimoyiannis, 2010) rather than the “complex interplay” (Koehler & Mishra, 2005, p. 132) of technology integration.

Mishra and Koehler (2006) developed TPACK as a framework to examine educator’s integration of technology with a focus on integration rather than seeing technology as an add-on to traditional pedagogies. TPACK is presented as the nexus of content knowledge, pedagogical knowledge and technological knowledge, where it is espoused that “strong teaching of the content that utilizes technology” enhances student learning (Mishra, Koehler, Zellner & Kereluik, 2012, p. 2). The TPACK framework explicates “the role of technology in the process of teaching and learning in a truly integrated manner” (Abbitt, 2011 p. 283). While the component concepts of TPACK are accessible to both teachers and researchers the integrated notion can be problematic for some (Jimoyiannis, 2010). As well, there is a scarcity of literature demonstrating approaches that result in measurable gains in teachers’ TPACK capabilities (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Further, Koehler and colleagues suggest that TPACK is essential “but not sufficient for teachers to become creative or innovative in their thinking about using technology for pedagogical purposes” (Koehler et al, 2011, p. 149).

Consideration of learning design and design thinking offers unique possibilities for technology integration, to enable pre-service teachers to move beyond being technological consumers to being creative and effective designers with technology. Learning design can be seen as the “process of designing effective learning experiences” and it “involves a wide set of knowledge, skills and competencies, including learning theory and its applications, course design principles and procedures, use of media, use of different technologies” (MacLean &
Learning design and design based thinking are linked with potential to promote rich pedagogy and authentic learning opportunities (Marshall, 2010). Demonstrating links between design based research and design based learning, Norton and Hathaway (2012) espouse design strategies as a way to enable focus to shift from knowledge of concepts to the process of learning. They propose cyclic evaluation processes where teachers use technology affordances to create an “interplay between what we learn and how we learn it” (Norton & Hathaway, 2012, p.24).

Method

This project adopted a case-study methodology to examine the change processes and evaluate the effectiveness of Information and Communication Technology (ICT) integration into pre-service Teacher Education Programs at Macquarie University. Standard case-study methods were used in order to promote reliability and validity of results, including ongoing documentation of key observations to provide referential adequacy and create a chain of evidence, prolonged engagement with the context to establish credibility and in-depth understanding of cause and effect relationships, and triangulation of results from multiple data sources to promote dependability (Yin, 2003).

The project consisted of three relatively distinct phases:

1. A mapping of how technology was used within the programs in order to develop an understanding of need.

2. A range of interventions aimed at developing integrating ICT throughout the programs and developing teacher capacity, through collaborative curriculum development, workshops, and one-on-one consultation.
3. Evaluation of program efficacy based on multiple data sources including student perceptions of confidence and capability, teacher feedback, and program team self-reflections.

Initially a technology mapping was conducted to determine the ways in which technology was being used in the School of Education and Institute of Early Childhood programs. The mapping sampled over half (39 out of 75) subjects offered within these programs to determine the number and type of ICT related tasks that were being used. The mapping process included examination of the technology applied, the pedagogy used, and the type of thinking engaged (both the knowledge type and cognitive processes), in accordance with Bower, Hedberg & Kuswara’s (2010) TPACK based framework for conceptualising technology enabled learning designs.

For the purposes of the mapping process, technologies such as word processing, database searches, and responding to multiple-choice questions were not included as they related to assumed academic literacies. The approach to categorising pedagogies as either transmissive, dialogic, constructionist or co-constructive focused on the directly observable extent to which the ICT tasks were productive and/or negotiated rather than the teacher philosophy underpinning the task (that latter of which can be more difficult to interpret). Although many pedagogies could be used within one task, classification related to the most productive and/or discursive element of the task to determine whether it was transmissive, dialogic, constructionist, or co-constructive. The ‘content’ element in the Bower, Hedberg & Kuswara (2010) model was categorised according to the cognitive process and type of knowledge being addressed in the activity, in alignment with Anderson & Krathwohl’s (2001) Taxonomy of Learning, Teaching and Assessing. In cases where a task could be conceived as belonging to two cognitive process or type of knowledge levels then it was assigned to the higher level in the Anderson & Krathwohl (2001) taxonomy. For instance, if a task involved a
practice (applying procedural knowledge) phase and then a design (creating conceptual knowledge) phase, then the task would be categorised as creating conceptual knowledge according to the framework.

Throughout the project a range of strategies were used to build academics confidence and capabilities in the use of ICTs for learning. These included holding a series of 18 workshops throughout the year to develop academics’ ability in the use of Interactive Whiteboards, Web 2.0 technologies and subject specific software. A blog (http://blog.ltc.mq.edu.au/mqttf/) as well as a resource website (https://edsnippets.sites.google.com/site/edsnippets/) were constructed to form a repository for project resources and developments. Monthly newsletters were also disseminated to share new ideas and keep the initiative in the forefront of academics’ minds. Central to the transformation strategy was the adoption of a personalized approach to working with academics. This included conducting individual consultations with staff to cater to personal areas of need, one-on-one brainstorming sessions to generate ideas on how technology could be utilized within units of study, and team teaching with academics to implement new technology uses in their pre-service teacher classes.

Two program-wide surveys of pre-service teachers were conducted during the year to provide an indication of how the initiative impacted on the student experience. There were 585 pre-service teachers who completed the May 2011 Semester One survey and 551 pre-service teachers who responded to the November 2011 Semester Two survey (from a student cohort of approximately 1950 students). The two essentially identical surveys incorporated a range of over one hundred indicators relating to pre-service teacher confidence in using ICT and their perceived usefulness of having such capabilities. For instance, questions included “how confident are you that you have the knowledge, skills and abilities to design ICT activities that enable students to become active participants in their own learning”, and “how useful do you
consider it will be for you, as a teacher, to select and use a variety of digital media and formats to communicate information”. Participants responded on a scale from 0 (not confident/useful) to 6 (extremely confident/useful). This survey was also conducted at all 38 other tertiary pre-service teacher education institutions across Australia (10385 pre-service teacher responses in Semester One and 4446 responses in Semester Two). Only the 14 items relating to developing pre-service teachers’ learning design capabilities have been included in this analysis.

To acquire a more in-depth understanding of how the transformation process had impacted upon individuals ten academics and six pre-service teachers from the Macquarie programs were interviewed. This semi-structured process aimed at identifying the most significant changes that emerged as a result of the project, as well as the main issues and benefits surrounding the implementation itself. Students were interviewed in groups by members of the project team (who were not their regular classroom teachers). Academics were interviewed on-on-one, also by project team members. During the interviews the interviewees were encouraged to provide candid feedback, as this was seen as positively contributing to the understanding of factors influencing the success of program level technology change processes. Anecdotal and incidental conversations between project team members and academic staff were also used as sources of authentic evidence.

Project team member reflections were also added to the corpus of evaluative data. The participant-researcher observations were deemed as important due to their close proximity to the project and their in-depth understanding of the key issues at stake. Reliability of these reflections was promoted through the authentic reporting of results and verification (triangulation) with other data sources. The rich descriptive approach to reporting that valued identification of concerns as much as it valued successes provided a level of objectivity, as did the alignment of researcher perceptions with those of other stakeholders. The quality of the
evaluation is based upon presenting how similar future projects could build and improve upon the strategies adopted in this initiative.

Results

Mapping

This analysis of the 39 subjects revealed 147 tasks that utilized or focused upon ICT, with 49 of these as assessable tasks for the pre-service teachers. The most popular use of technology was digital content such as learning objects (28 instances), with desktop software such as Excel and Geobra being the next most common use of technology (16 instances). A full list of technologies used is provided in Table 1.

Table 1. Types of Technologies Used or Focused Upon in Tasks

<table>
<thead>
<tr>
<th>Category of Technology used in Tasks</th>
<th>Total No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital content such as learning objects</td>
<td>28</td>
</tr>
<tr>
<td>Desktop software such as Excel and Geobra</td>
<td>16</td>
</tr>
<tr>
<td>IWB</td>
<td>10</td>
</tr>
<tr>
<td>Forums within LMS</td>
<td>8</td>
</tr>
<tr>
<td>Websites (static, content-based)</td>
<td>8</td>
</tr>
<tr>
<td>Wikis</td>
<td>8</td>
</tr>
<tr>
<td>Other Web 2.0 (PollDaddy, mindmapping, etc)</td>
<td>7</td>
</tr>
<tr>
<td>Blogs</td>
<td>6</td>
</tr>
<tr>
<td>Audio content</td>
<td>6</td>
</tr>
<tr>
<td>Presentation software such as PPT and Prezi</td>
<td>5</td>
</tr>
<tr>
<td>LAMs / create online learning activity</td>
<td>5</td>
</tr>
</tbody>
</table>
Apart from the technologies shown in Table 1, there were an additional 8 tasks that involved a wide variety of technologies in the one activity, as well as 13 tasks that did involve students using a particular technology (for instance if they were discussing ICT issues based on professional experience observations). Table 1 illustrates that while a range of contemporary technologies were being used (Wikis, Blogs, Social Bookmarking, and other Web 2.0), there was still some focus on legacy tools such as PowerPoint, and arguably an overemphasis on Learning Objects into the classroom.

Using these technologies a range of pedagogies was applied, with 21 transmissive uses of technology, 66 constructive uses, and 15 co-constructive uses (see Table 2). There were also 45 dialogic activities were technology was used as a tool for discussion or the focus of the task was about discussing technologies.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diigo / Social bookmarking</td>
<td>5</td>
</tr>
<tr>
<td>Audio / video creation</td>
<td>5</td>
</tr>
<tr>
<td>Video content such as YouTube</td>
<td>3</td>
</tr>
<tr>
<td>Hardware e.g. graphics calculator</td>
<td>2</td>
</tr>
<tr>
<td>Image such as iPhoto</td>
<td>2</td>
</tr>
<tr>
<td>Virtual Worlds</td>
<td>1</td>
</tr>
<tr>
<td>Webquests</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Types of Pedagogies Used in Tasks

<table>
<thead>
<tr>
<th></th>
<th>Not Negotiated</th>
<th>Negotiated</th>
</tr>
</thead>
<tbody>
<tr>
<td>No product</td>
<td>Transmissive</td>
<td>Dialogic</td>
</tr>
<tr>
<td></td>
<td>(21)</td>
<td>(45)</td>
</tr>
</tbody>
</table>
Table 2 makes no absolute judgement on the types of pedagogies that are used, rather acknowledging that different pedagogies may be appropriate for different stages of the learning cycle. The data in Table 2 does, however, indicate that a reasonable spread of pedagogies was being used throughout the program, though with a greater emphasis on dialogic and constructive pedagogies than transmissive and co-constructive pedagogies.

Mapping the content of tasks to Anderson & Krathwohl’s (2001) Knowledge Type and Cognitive Process dimensions of their Taxonomy of Learning and Teaching and Assessing is shown in Table 3 below. This mapping exposed a proportionately greater emphasis on remembering factual knowledge and applying conceptual knowledge as opposed to developing higher order thinking skills and metacognitive knowledge.

<table>
<thead>
<tr>
<th></th>
<th>Remember</th>
<th>Understand</th>
<th>Apply</th>
<th>Analyse</th>
<th>Evaluate</th>
<th>Create</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factual</strong></td>
<td>24</td>
<td>3</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Conceptual</strong></td>
<td>1</td>
<td>8</td>
<td>28</td>
<td>16</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td><strong>Procedural</strong></td>
<td>1</td>
<td>0</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Metacognitive</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

As a result of the mapping process, it was evident that a reasonable range of technologies, pedagogies and content types were included in the ICT components of the programs, but that it would be appropriate for the project to focus on shifting teachers towards the use of more contemporary technologies, encourage greater emphasis on higher order
thinking skills (including creative design tasks) and potentially more socio-constructivist (co-constructive) pedagogical approaches.

**Responding to Need**

Interviews of academics and project team member reflections emphasised that in order for academics to be receptive to project team members’ advice and support first required trusting relationships to be generated. There was a degree of wariness amongst many of the academic teaching staff within the programs, which meant that they were initially reluctant to open up their pedagogic approaches and subject materials to scrutiny. Academic interviews and project team member reflections concurred that critical to developing trust between project team members and staff was a reassurance of confidentiality, and reassurance that the objective of the initiative was not to judge their work but rather explore whether there were ways that it could be enhanced. However, once constructive relationships had been established, several academic staff in the Education program indicated that they were more comfortable working with the ICT Pedagogy Officers than with their other colleagues because they felt unembarrassed to ask simple questions.

Project team members all observed that developing academics’ confidence in the effective integration of ICT tasks and pedagogies required sustained effort over time. This confidence appeared to be underpinned by first understanding the range of technologies at their disposal, then familiarising themselves with their use, combined with guidance about how they could be used to develop pre-service teacher learning design capabilities. In order to develop the underlying technological familiarity along with general understanding of pedagogical possibilities, the ICT Pedagogy Officers facilitated a series of workshops relating to Interactive Whiteboards, blogs, wikis, tablet devices, and a range of other specialised technologies. Informal drop-in sessions were also offered so that academics could provide support in areas
that they designated as being of greatest need. In order to engage people with new technologies and approaches the monthly newsletters included information about new innovative tools and research, the blog was kept current with project initiatives and progress, and all information and resources on how effectively ICT integration were placed on the repository website.

One-on-one consultation sessions provided academics and project team members with the opportunity to collaboratively reflect on the curriculum design for academics’ particular subjects and how technology could be best tailored to help pre-service teachers to achieve the pre-defined learning outcomes. The opportunity enabled the ICT Pedagogy Officers to partner in thinking through how technology could be integrated into the subjects provided academics, and offer their context-specific understanding of technology enabled learning design thinking related to the academics’ disciplines, in a way that the general workshops could not. Working in tandem to develop this Technology-Pedagogy-And-Content Knowledge not only meant that the curriculum was redesigned to integrate tasks that focused on cultivating pre-service teachers’ TPACK understanding, but also that academics then had the skills to model this understanding and use it future curriculum design tasks.

As a result, a range of ICT innovations were injected into the curriculum. This included utilisation of a range of Web 2.0 tools for instance using wikis such as PBworks to facilitate collaborative project work for students and social bookmarking systems such as Diigo to enable co-constructive development of knowledge bases. Social Networking tools such as Edmodo we adopted to foster student interaction, community building and groupwork processes. Desktop recording technologies such as Jing were utilised to model technology thinking processes. SMARTboard and Notebook Interactive Whiteboards were integrated throughout tutorials with a focus on how to promote student interaction and engagement. Uses of technology for information organisation and assessment management was also addressed,
for instance, file sharing systems such as DropBox. The initiative not only impacted on classroom practice but also resulted in the transformation of assessment criteria to incorporate the use of ICT for major assignments. The subject-specific technology outcomes and innovations were consistently aligned to the University’s graduate capabilities and the new Australian Institute for Teaching and School Leadership (AITSL) standards.

**Student Surveys**

Results of the Semester One survey indicated that students perceived usefulness of the ICT capabilities represented in each item was significantly greater than their confidence in using ICTs for each of those items, demonstrating the need for enhancing the pre-service teacher curriculum to better prepare students for using ICT in the classroom (see Figure 1 and Figure 2 below). Results of the Semester Two survey revealed a discernable increase in average pre-service teacher confidence in using ICTs across the 14 indicators, with a significant improvement being observed across several of the indicators (again see Figure 1 and 2 below). The Semester Two perceived usefulness of ICT capabilities for each item was still significantly greater than students’ confidence across all indicators, indicating that developing pre-service teachers’ ICT capabilities is both a long term and worthwhile endeavour.
Figure 1. Pre-service teacher perceptions of confidence with ICT and the usefulness of skills for them

* represents significant improvement in confidence at a 5% level

** represents a significance improvement in confidence at a 0.1% level

Figure 2. Pre-service teacher perceptions of confidence to use ICT in classes and the usefulness of skills for their students

* represents significant improvement in confidence at a 5% level

** represents a significance improvement in confidence at a 0.1% level
Qualitative impact of the project

Academics and pre-service teachers interviews provided a more in-depth understanding of how the transformation process had impacted upon individuals. Students indicated that they were more motivated, engaged and enthusiastic about technology, indicating that the infusion of technology throughout their subjects contributed to their increased sense of confidence. One pre-service teacher observed a tangible sense of improved confidence amongst her peers, commenting “I could see it in their faces and body language.” In some cases, pre-service teacher perceptions shifted from feeling technology was a tool that they ought to use, to enthusiastically and purposefully designing with technology in ways that could enhance their students’ learning outcomes. As well, students were better able to critically reflect upon effective versus inappropriate uses of technologies. Students related this increase in confidence and capabilities to the sustained transformation of academics’ “language, knowledge and understanding” with respect to effective pedagogical use of technology, so that they could model its use and develop pre-service teachers’ thinking skills relating to ICT usage.

The academics that were interviewed indicated that these changes could be directly attributed to the presence and work of the ICT Pedagogy Officers. Working one-on-one with the technology officers in some cases engendered a more positive, inquiry mindset amongst academics. For instance, once academic commented “my thinking went from ICT being an adjunct to being integral and I stopped asking what don’t I know and began asking ‘Is there an ICT application for me in this area?’” The one-on-one pedagogical ICT support was critical to building confidence and capability. One academic observed “you’re coming from a position of insecurity and so that lack of familiarity is enormously supported by having someone to ask”. Academics felt that the individualised mentorship enabled them to develop their technical and pedagogical skills as it related to their content area (i.e., TPACK understanding). For instance, one academic commented “My session with [technology officer] was fantastic… to
be able to explain my objectives, talk through possible solutions, decide on the wiki and then have a one-to-one hands-on session in my office to not only teach me the wiki skills but also to actually go through the steps in setting it up in readiness for the assignment. The opportunity to try it as we went through the session provided troubleshooting and problem-solving opportunities, with [technology officer] there to lend her expertise.” One academic extended this to suggest that her students’ quality of work would improve because of the ICT Pedagogy Officer’s input.

Academics also provided a range of constructive feedback about how to effectively continue integrating ICT into the pre-service teacher education programs. All felt that it was highly desirable for the departments to have an ICT pedagogy person permanently available (rather than just for the duration of one year) in order to help them further enhance the development of their capabilities and maintain the momentum accumulated during the project. The academics wished to continue learning about the new technologies available to them and their students, but because of limited access to technology and lingering fear that the technology in the classroom would not always work, academic thinking tended towards merging the technical support roles and the pedagogical support roles - “I just like having someone I can call on”. The staff also liked the team teaching approach to further extend their pedagogical capabilities but that development was gradual, thus recommending its continuation over time. Arising from a comment about continuing the discussion in colloquia was the notion of eventually creating specific professional learning communities where academics could learn from each other and not just the ICT Pedagogy Officers. However, timetabling pressures and perceptions of academic expertise were seen as hindrances to this.

The project leaders attributed much of the success of the project to the quality of the ICT Pedagogy Officers that they had seconded. The ability of the ICT Pedagogy Officers to establish trusting and productive relationships with academic staff members was largely a
result of their high levels of interpersonal skills. This was seen as equally as important as their expertise in integrating technology into learning and teaching. From the project leaders’ perspective the challenge of the project was how to enact change in such a short amount of time and how to create lasting change. For this reason it was seen as critical that the ICT Pedagogy Officers maintained a focus on developing academic’s capacity to operate autonomously so that in the future they could be leaders in the use of technology in learning.

Discussion and Conclusion

This project resulted in multiple layers of learning, spanning from the sorts of ways technology can be effectively integrated in learning and teaching, through to factors underpinning successful TPACK capacity building initiatives.

Mapping and unpacking the way in which the Teacher Education Programs were integrating technology into the classroom revealed needs within the program. As a result of the mapping it became evident that there was potential for more design based learning within the curriculum through creative design tasks and tasks that integrated cyclic design processes (Norton & Hathaway, 2012). Similarly, there were opportunities for more co-constructive approaches to learning, focusing on more contemporary technologies. This enabled the project team to more accurately target the curriculum and pedagogy needs of the programs and the academics who taught them. Both the mapping process and results are intended to offer a valuable reference for other universities attempting to transform their Education programs.

In line with the work of Jackson (2012) these data demonstrate that working effectively with people was pivotal to the success of the project. The ability of the ICT Pedagogy Officers and projects leaders to gain peoples’ trust was a prerequisite for supporting redesign of their subjects and helping them to developing their confidence and understanding relating to
effective use of technology in learning and teaching. Without these people skills, only menial progress would have been made.

Redesign of programs and development of TPACK understanding is an extensive undertaking. Although there were measurable improvements in pre-service teacher confidence, they only improved marginally towards their perceived usefulness of these skills. Similarly, after a year of concerted effort by the project team, not all subjects had integrated ICT education activities into their curriculum, and although academics’ technology integration capabilities had noticeably improved, they were still developing.

Cultivating the technology enabled learning design thinking of pre-service teachers is primarily dependent on the understanding and abilities of the academics who teach them. The academics are the key drivers of curriculum change and the source of cognitive apprenticeship regarding TPACK practise in the classroom. It is hoped that this case study provides insight into frameworks and strategies for supporting the development of academics’ learning design capabilities, so that other institutions may more effectively support their Education students to become innovative and successful 21st Century teachers of the future.

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References


