

# Chapter 12

## Innovative Approaches Used to Prepare Pre-service Teachers to Activate Learning with Digital Technologies



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**Abstract** This chapter explores the innovative approaches employed within core subjects of two initial teacher education degrees, where the emphasis has been on the connection of pedagogy, digital technologies, collaborative learning, team teaching and learning spaces to activate pre-service teacher learning. Whilst the specific focus of the subjects is to prepare pre-service teachers to be educators who embrace digital technologies as a tool to support learners and enhance learning, it is the informal reflexivity espoused within new team teaching approaches that cater to novel ways of engaging with the challenges associated with digital pedagogies. The chapter will draw upon several years of research, and the experiences of teacher educators in the field of digital pedagogies, whilst highlighting how an approach that embodies creative inquiry has enabled pre-service teachers to connect with their prior learning experiences to form new understandings of the role of digital technology in their future classrooms. It is the agentic actions of the authors that drive the innovative approaches in learning design and pedagogical practices associated with these subjects.

**Keywords** Digital technologies · Teacher education · Creative inquiry · Team teaching · Innovative pedagogies · Digital pedagogies

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## 12.1 Introduction and Background

Digital technologies can be considered the ‘backbone’ of the current information society (Aslan & Zhu, 2015); their use has grown exponentially and has become subsumed into almost all aspects of everyday routines. Digital technologies have become so ‘deeply ingrained in our lives’ (McDonald & Smith-Rowsey, 2018, p. 6) that it is imperative that each and every individual has the ability to engage with them at varying levels of competence, to actively participate in and contribute to today’s society (Australian Curriculum and Assessment Authority [ACARA], 2013). However, arguments about the positives and the negatives arise around every innovation, and it is important to note that ‘every technology is both a burden and a blessing; not either-or, but this-and-that’ (Postman, 1992, pp. 4–5).

Educators can no longer ignore the importance of digital technologies and must embrace them as an essential pedagogical tool. In Australia, educators are required to use digital technologies in learning (ACARA, 2013) and they are an essential component of initial teacher education (ITE) degrees (Australian Institute for Teaching and School Leadership [AITSL], 2020; Moran et al., 2013). Similarly, a growing number of other countries are implementing policies and embarking on large digital technology projects with the aim to digitally transform education (Darling-Hammond et al., 2005; König et al., 2020; Ministry of Education Singapore, 2015; Steinar et al., 2018; Tamim et al., 2015; Tezci, 2011; U.S. Department of Education, 2016). It is in this sense that the need for digital transformation has seen governments and education departments invest heavily in infrastructure and other initiatives (Gill et al., 2015; König et al., 2020). However, whilst the need to prepare future teachers to adopt approaches to using digital pedagogies in their future classrooms is an expectation of teacher training institutions (Sweeney & Drummond, 2013; Voogt et al., 2014), there are varying views on how this should be undertaken (Starkey, 2019). Consequently, multiple strategies have been employed by teacher training institutions to prepare future teachers to ‘develop pre-service teachers’ competencies to use technology and harness its potential to enhance teaching and learning’ (Tondeur et al., 2018, p. 32). However, graduate teachers often find themselves teaching in educational institutions that have not yet embraced the important role that digital pedagogies can play in educating today’s students.

Whilst many would argue that there is a need for digital transformation within our educational systems, and that it is clearly being pursued globally, the ideology behind this investment is fraught with many challenges and concerns. In the schooling system there is a concern that whilst there have been pockets of innovation, evidence of the impact of digital technologies on teaching and learning is limited and widespread adoption seems to be lacking (Bate et al., 2013; König et al., 2020; Tamim et al., 2015). In parts of Europe, there is further evidence that many schools and systems lag behind with regard to digital transformation, and progress in this area has been slow to date (Bildungsberichterstattung, 2020; Fraillon et al., 2019). Despite continuing investments in digital technologies, the high hope of digital transformation has not yet been realised in many parts of education.

There is no doubt that the role of an educator is both complex and challenging and with the continually evolving nature of digital technologies there is a concern that current knowledge and skills associated with rapidly changing and outdated technologies will not serve educators as they look towards new pedagogical approaches for connecting and engaging with students (Koehler et al., 2013). Finding effective approaches to developing pre-service teachers' (PSTs') generic and teaching specific digital competencies remains an ongoing research priority in ITE (Starkey, 2019). Even though many of the recent teacher education graduates have grown up with digital technologies and have been immersed in a culture that relies on them for many functions, many recent graduate teachers do not feel confident in using them in the classroom (König et al., 2020; Tondeur et al., 2013). Preparing teachers to use digital technologies effectively in the classroom, where they have the capabilities to adapt them to new ways of teaching and learning is a challenge (Aslan & Zhu, 2015; OECD, 2015) for ITE programmes. Many educational institutions spend a large proportion of their budget on digital technologies and infrastructure, however, 'simply providing access to digital technologies does not mean they will be used with good effect in teaching and learning' (Nykvist et al., 2019, p. 401).

Given the importance in preparing PSTs to agentically leverage the dynamic and protean nature of digital technologies, this chapter will focus on two initial teacher education subjects where the emphasis has been on the connection of pedagogy, digital technologies, collaborative learning, team teaching and flexible learning spaces to activate PST learning. In particular, the authors draw upon research data collected over a period of eight years, and their collective experiences, to adopt and create new pedagogical approaches that can respond to the changing needs of today's students, where digital technologies will play a critical role (Fullan, 2013). The authors utilise an innovative learning design which is focussed on digital learning and digital pedagogy (see Sect. 12.2.1). The learning design is referred to as creative inquiry (CI) and it is the interconnected play between pedagogy (creative inquiry and team teaching), learning spaces (virtual and physical) and PSTs' prior experiences in the form of digital identity that has been a unique, yet innovative approach to the development of knowledge and skills associated with digital technologies. The subjects have been taught with a mix of blended, online and at times, hybrid modes of teaching and learning, and this has prepared students well for recent changes in teaching and learning where they have had to rapidly respond to new ways of teaching and learning.

The term digital technologies are used in this chapter to 'collectively describe hardware and software, including current and emerging technologies, for example: information and communication technologies, digital media tools, robotics, coding, virtual and augmented reality technologies, and wearable technologies' (Nykvist et al., 2019, p. 400). It is the role of the teacher educator to ensure that pre-service teachers can competently and effectively use digital technologies within and beyond the classroom. 'Digital technologies can be used across all learning areas to activate, enable, support and enhance learning, promote engagement, connect with the real world, and provide feedback in new, previously inconceivable ways' (Nykvist et al., 2019, pp. 400–401).

A number of other terms associated with the field of initial teacher education and digital technologies are used in this chapter. For the sake of clarity and understanding, these terms are defined here for the reader. The term ‘students’ refers to learners in both school and early childhood settings and the term ‘teachers’ refers to educators in school and early childhood settings. The term ‘teacher educator’ refers to a person who teaches pre-service teachers in initial teacher education courses, such as higher education academics, lecturers and tutors. The term ‘educators’ is used in this chapter as a collective term for both teachers and teacher educators.

## 12.2 Changing Times, Changing Approaches

The changing nature of digital technologies and how they are used in society will continually present challenges for educators. However, if educators are equipped with new ways of thinking about digital technologies and can connect with their prior learning experiences and identity to form new understandings of the role of digital technology in their future classrooms, they can better respond to change. The 2020 pandemic and its associated disruptions is an example of a disruption that prompted a rapid change in approaches to teaching and learning, not only in schools but also in higher education. Educators all over the world needed to respond to this changing nature of education and, in many cases, embrace online digital pedagogies that would best meet the needs of their students. This was met with mixed results, and multiple studies into how educators responded to this change have been published outlining the experiences from both an educator and student experience (Hjelsvold et al., 2020; König et al., 2020; Lorås et al., 2020). The transition from a face-to-face mode of teaching and learning to an online only mode was a new experience for many. Where previously, both students and educators could draw on their prior experiences to guide them through traditional approaches to teaching and learning, this was no longer the case.

This is an example of the transformative potential of digital technologies and how educators (and students) needed to embrace new educational approaches. Educators needed to learn how to approach teaching with digital technologies in new ways, and students needed to learn how to learn in new ways. For teachers to feel confident about teaching in new ways, it is imperative that teacher educators equip PSTs with the knowledge and skills to be able to respond to the changing needs of students. Whilst the modes of face-to-face, blended and online teaching and learning have been available for many years, and in many cases, the infrastructure has been in place (Hjelsvold et al., 2020), it took a worldwide pandemic for many educators to embrace new ways and discover the benefits that new pedagogical approaches can offer as more agile and flexible learning environments were encouraged. According to Binet and Carter (2018) ‘the real digital revolution will occur only when we stop treating “online” and “offline” as two discretely different worlds. Then we’ll be able to measure its true potential’ (p. 297).

In teacher education, pre-service teachers are part of an education system which is still undergoing digital transformation. It is within this system that PSTs will need to develop three types of digital competence: generic digital competence—how to personally use digital technologies; digital teaching competence—how to integrate technology in learning and teaching; and professional digital competence—how to enact professional responsibilities in technology-rich environments (Starkey, 2019). Generally, PSTs are exposed to a series of lectures and tutorials and / or workshops which are very different to the environments in which they will be teaching. Although exposure to occurrences of digital technologies in learning and teaching is beneficial and improves PSTs' perceived competence, more overt approaches are needed (Tondeur et al., 2017). One solution to this is to model teaching with technology within the PST education courses ensuring that the students have first-hand experience. However, whilst modelling good practice is preferred amongst PSTs (Laronde & MacLeod, 2012), it needs to go beyond this because the skills that are modelled may quickly become redundant and the associated mindsets may be professionally counter-productive when the respective technologies are superseded. It is therefore essential that PSTs are able to conceptualise the role of digital technologies in learning and teaching such that they have a language and understanding that will allow them to contribute meaningfully to the profession.

### ***12.2.1 Impetus of a New Pedagogical Design***

The two ITE subjects that underpin this chapter are focussed on early childhood, primary and secondary pre-service teacher education. They are currently titled 'Supporting Innovative Pedagogy with Digital Technologies' (SIPDT) and the number of PSTs in each yearly cohort ranges from approximately 500 to 900 PSTs. A unique approach to these ITE subjects is focussed on, firstly, purposefully considering the role of digital technologies in teaching and learning (Nykivist et al., 2019), and subsequently, collaboratively and creatively identifying, then exploring the learning affordances of any digital technology using a specific pedagogy and/or andragogy called creative inquiry (Lee et al., 2016).

SIPDT are core subjects offered to PSTs in their first semester of university. In the current offerings of SIPDT there are no lectures, but rather, students participate in a series of three-hour creative inquiry (CI) sessions which are also supplemented with two, two-hour learning forums where practicing teachers and associated experts discuss the current and potential use of digital technologies in schools. The learning forums are driven by the PSTs, and they lead the forums with questions to the practicing teachers. This authentic learning experience allows the PSTs to connect with the profession in their first semester of ITE. It also allows the PSTs to connect the underpinning theory and practices with what is happening in the real world. In turn, the assessment tasks incorporate reflective practices that draw on PSTs' prior experiences and connect with the underpinning theory associated with digital

pedagogies and the CI sessions. This allows the PSTs to establish a vision and intent for use of digital technologies in their future classroom.

The pedagogical approach espoused in the teaching of these subjects is focussed on creative inquiry (CI). This term encompasses both the notion of *inquiry* and *creativity* as it foregrounds the creative aspects of inquiry and knowledge building. According to the 2016 NMC Horizon Report for Higher Education (Johnson et al., 2016) there is a real need for students to engage in creative inquiry. The report also highlights the integral role of digital technology in the development of this capability and further predicts that learning space redesign to support changes in pedagogy will be a major trend in the next three to five years, and in the immediate future, that state-of-the-art blended learning classrooms would 'foster greater collaboration in healthier environments' (p. 13). The proliferation of wireless, mobile technologies and the increase in the number of personal devices brought into the classroom is one of the drivers impacting pedagogy and learning space design and use, and as such, is encouraged within the pedagogical approaches adopted in the teaching of these subjects (Lee et al., 2016).

Initial teacher education is a complex, ever-changing field where it is important for PSTs to be reflective in their practice as they develop their own professional identity through the 'deconstruction, construction and reconstruction' (Stîngu, 2012, p. 618), of values and assumptions about the use of digital technologies and their ability to enhance education. It is in this context that 'we start to see the teacher as a reflective practitioner which, through a process that involves interpretation and reinterpretation of experiences, gains knowledge about the teaching profession and develops his/hers professional identity as a teacher' (Stîngu, 2012, p. 618). Consequently, teacher educators play an important role in the nature of this reflexive practice by ensuring that the learning environment is conducive to the nature of reflexivity and that they, themselves, model reflective practices. The CI approach espoused by the authors encourages this through its design and the role of team teaching. Team teaching allows the teacher educators to work with each other and target the teachable moments that are most important in the classroom.

It is the connection of each of these aforementioned attributes that makes the pedagogical approach to these subjects unique. The subjects are designed and continually modified to meet the needs of PSTs and prepare them for a continually changing world where they will need knowledge and skills that enable them to adapt and modify learning to new situations. The subjects not only meet the requirements of initial teacher education programmes in Australia, as specified by the relevant accrediting authorities and professional bodies, but they also encourage the development of attributes that are necessary for teachers to prepare their future students, specifically, for life and work in an uncertain digital world in which creativity, critical thinking and other so-called soft skills will be increasingly valued (Caputo et al., 2019).

### 12.3 An Informed Response

The deliberate development and refinement of CI, through team teaching, explores the agentic actions undertaken by the core teaching team (which includes the authors), and the positive impact that this has had on pre-service teachers' use and understanding of digital technologies for teaching and learning. According to Priestley et al. (2015) 'people's potential for agency changes in both positive and negative ways as they accumulate experience and as their material and social conditions evolve' (p. 197). It is this agentic response that has influenced the design of the SIPDT subjects and 'it is only when a person has been able to dovetail their concerns with their ongoing experiences that traction within a particular context can be gained' (Willis et al., 2017, p. 805). This agentic action has seen the authors elucidate the many challenges associated with helping PSTs to conceptualise and use digital technologies in learning and teaching whilst adapting and modifying the current learning design to meet the needs of PSTs.

The agentic actions undertaken by the core teaching team are underpinned by multiple research initiatives with an aim to improve ITE approaches to using digital pedagogies to enhance learning opportunities for all students. The integration of digital technologies in teaching and learning is positioned in literature to facilitate the enactment of student-centric pedagogies (Ertmer et al., 2012) and is considered an essential tool for deep learning (Fullan et al., 2018). It is through informed research and practice that the ITE subjects are continually evolving to meet the needs of students and pave the way for new approaches to ITE in the area of digital pedagogies.

The core teaching team's agentic actions were supported by an exploratory multiple case study mixed methods research design and are informed by grounded theory methods (Thornberg, 2012). The studies were designed to understand the digital technology background of PSTs entering initial teacher education programmes and their experiences with using digital technology. The research generated both qualitative and quantitative data gathered over eight years. A case study methodology based on Yin's (2018) model for exploratory case study, using multiple sources of evidence was applied in this study. Data sources included classroom observations, online student surveys, student focus groups, and educator interviews and reflections. Students were asked to voluntarily complete an online survey at the beginning of the semester. Data were gathered through multiple case studies between 2012 and 2019 (eight years) as the authors continually modified and reflected upon the results to deliver a subject that met the needs of students. During this study, the pre-service teacher cohort ( $n = 2821$ ) consisted of a mixture of early childhood, primary and secondary pre-service teachers. Analysis of the data included descriptive and inferential statistical methods for the quantitative data, and informed grounded theory methods for the qualitative data.

The PSTs completed an anonymous survey at the beginning of the semester. It asked PSTs to self-report about their experience level with a range of technology skills. The categories were taken from the literature which outlines activities using digital technologies that are deemed as essential to their future teaching and learning.

The questions were initially piloted in a separate study in 2011 and then refined in 2012 and over the subsequent years. New questions were added as new technologies and pedagogical approaches became more ubiquitous in classrooms. Although the students were self-reporting their skills, the educators were able to report on the level of skills observed in the classes to compare this with the survey data. The surveys also asked students to comment on a series of questions related to learning spaces and the influence of previous digital technologies in their personal lives and their schooling experiences. The latter was important for students to understand the impact of their prior experiences and how this contributed to defining their digital identities as PSTs.

In addition to the initial survey, students also voluntarily completed anonymous end of subject evaluations that included three Likert scale questions focussed on learning opportunities and satisfaction ('This unit provided me with good learning opportunities.' 'I took advantage of the opportunities to learn in this unit.' 'Overall, I am satisfied with this unit.'). In 2016, PSTs also participated in small group semi-structured interviews after the end of semester subject evaluations. These semi-structured interviews focussed on PST prior experience and competency with digital technologies, pedagogical approaches and learning spaces.

One of the informing factors for the pedagogical design of the SIPDT subjects was PST confidence and digital competency. In the 2019 study 85.45% of PSTs (N = 618) saw a digital device such as a laptop as beneficial to their studies. The study also indicated that 85.75% of PSTs found it necessary to bring a smartphone to class though the most common use of the device was for email or social media. The case study further revealed that 46.59% of PSTs felt that using social media gave them a sense of belonging but again this was focussed on personal use as opposed to using social media in their future classrooms.

During the 8 years that these subjects have been taught and continually refined by the core teaching team, a number of research outputs have informed the ongoing development of these subjects. These research outputs include a recent article (submitted) that explores the student tensions relating to the pedagogical approach of CI (Blundell et al., 2022); a report on creative inquiry learning spaces (see Lee et al., 2016) that examines new generation learning spaces and associated pedagogical approaches in ITE; an article that explores PST identity within a digital world (Nykvist & Mukherjee, 2016); an article that explores the notion of enabling a positive first year experience at university through the use of social media and mobile technologies (Nykvist et al., 2014); and articles that explore the PST use of digital technologies and their confidence in using these technologies (Nykvist, 2012; Nykvist et al., 2015). The results from these research outputs are referred to in the following discussion and reinforces the reflexive decisions that have been made in designing the subjects and the associated pedagogical approaches.



## 12.4 Agents for Change

The research findings discussed in this chapter are organised around key themes that have emerged as the core teaching team agentially responded to the changing nature of education and in particular digital pedagogies and digital technologies in ITE. The core themes are the pedagogical approach of creative inquiry, collaborative learning and team teaching (including prior experiences), the role of digital technologies, and learning spaces. These themes are discussed in more detail in Sects. 12.4.1–12.4.4.

### 12.4.1 Creative Inquiry

Creative inquiry is the driving pedagogical approach used in the ‘Supporting Innovative Pedagogy with Digital Technologies’ (SIPDT) subjects. In the creative inquiry classroom, the teacher educators provided a safe and supportive environment through team teaching, mentoring, and coaching, whilst also empowering the PSTs to be reflective. In creative inquiry:

a key objective is for students to learn how to learn, thus there is little or no instruction on how to use unfamiliar technology. PST are encouraged to work collaboratively to discover the operation of new technologies, and then reflect on their strategies for learning. This approach models how teachers learn when technology is changing and formal instruction in its use is rare: working with colleagues, using online content, or experimenting (trial and error) to develop new skills. CI intentionally foregrounds constructivist and student-centric learning (Blundell et al., 2022).

*Creative inquiry* involves an approach to learning where the creative processes are foregrounded in the process of inquiry. ‘Creativity is highly valued in the *imagining* of the inquiry, finding the problem, defining the scope of inquiry, generating and playing with multiple ideas and solutions’ (Nykqvist et al., 2021). Creativity is defined here as ‘the development of novel and appropriate solutions to problems’ (Williams & Askland, 2012, p. 9) and it is within the context of education that there is a need for educators and students to develop the capability and capacity to investigate and solve complex problems in new ways. There is an expectation that something is produced when undertaking creative inquiry. PSTs are encouraged ‘to *create*, to *make*, and to *generate*’—this could be an ‘artefact, an idea, a communication or an expression’ (Nykqvist et al., 2021). This process allows them to ‘explore new ways of expressing themselves, communicating and reframing ideas through individual and group interaction, and building on the work of others, driven by a process of inquiry’ (Nykqvist et al., 2021).

Once PSTs have pursued a line of inquiry it is expected that they critically reflect upon their inquiry, and it is in this sense, that the role of the teacher educator is as a coach and/or mentor to students as they navigate the process of solving ill-structured problems and engage in critical reflection. Creative Inquiry needs to be set against a safe and supportive environment that is dynamic and continually evolving to meet

the needs of students as they formulate solutions to problems and take risks. Lee et al. (2016) argue that teachers who excel with the practice of creative inquiry:

- View students as creators and curious learners;
- Foreground creative approaches in the process of active and challenging inquiry;
- Value ‘the process of discovery as much as the discovery itself’ (Bellefeuille et al., 2014, p. 2);
- Encourage the development of creativity, exploration, design-thinking and problem-solving skills that are strongly grounded in discipline knowledge;
- Encourage critical thinking, self-reflection, and student responsibility for learning;
- Allow for individual and collaborative meaning making;
- Recognise the need to develop students’ agency and self-confidence in support of the inquiry processes.

The data from the PST surveys indicate that at first some students may feel uncomfortable with CI, whilst other students embrace the approach without hesitation. The teaching team have continually adapted the approach to CI by identifying the positive and negative experiences that PSTs have indicated in their surveys. This response has seen not only an overall PST satisfaction with the subjects over the years but has also seen a change in the way that PSTs view the role of digital pedagogies and digital technologies in their future role as teachers. As one student so succinctly wrote:

The way that my tutors communicated with me, making me feel a sense of competence, like I was able to achieve anything. This feeling was also accompanied by autonomy, through the inquiry-based learning style adopted by my tutors. (Student 2, 2016)

### ***12.4.2 Collaborative Learning and Team Teaching***

Whilst the specific focus of the subjects is to prepare PSTs to be teachers who embrace digital technologies as a tool to support learners and enhance learning, it is the informal reflexivity espoused within team teaching approaches that cater to new ways of engaging with the challenges associated with digital pedagogies. To achieve this end, the cohort is allocated to groups of approximately 60–70 students where two teacher educators work together in a team teaching scenario. The team teaching aspect of this design is important to the overall positive success of these subjects and in many ways acts as a mentoring scenario for both teacher educators (no matter their level of experience).

The subjects are generally taught in a blended teaching and learning environment but are adaptable to a fully online mode of teaching and learning. The aim is to engage students with authentic tasks. According to Coates (2007), engagement is the ‘active and collaborative learning, participation in challenging academic activities, formative communication with academic staff, involvement in enriching educational experiences, and feeling legitimated and supported by university learning communities’ (p. 122). The PSTs work collaboratively, in small groups, on authentic problems that challenge them to be critical and creative thinkers. It also challenges them to

use digital technologies in new or different ways. The following quote from a PST reinforces the positive experience they had in this environment.

‘I wish you could teach my other lecturers how to teach like this’ (Student 3, 2016).

Whilst this quote illustrates a positive experience, not all PSTs’ experiences were equal. There are a number of tensions (Blundell et al., 2022) between what works for students and what did not. Some of the negative and positive feedback is largely informed by PSTs’ prior experiences, being immersed in a new approach to learning and teaching (creative inquiry), and needing to ‘unlearn’ and ‘relearn’ in new ways. In 2018, when PSTs ( $n = 108$ ) were asked if the approach to teaching and learning was working for them, 83.5% indicated that it met their needs. Whilst this is only a small sample of students, it highlights the need to understand why this mode of learning is not working for some of the PSTs. When students are placed into uncomfortable situations, they must draw on their prior experiences to make sense of this new approach. It is in this sense that having two or more educators in the classroom offers an opportunity to better support students at both ends of the spectrum.

The approach to learning and teaching enacted in these subjects, challenges students to reflect on their prior experiences of digital technologies, to better understand how these experiences may or may not shape their digital identity as educators. Exposure to prior experiences with digital technologies can both positively and negatively impact how PSTs use digital technologies in their future classrooms. The prior experiences will be a frame of reference for their attitudes and beliefs about digital technologies in learning and teaching, and against which they will evaluate the content and learning experiences (Egan et al., 2018; Poyo, 2016; Seifert, 2015). Relevant to this argument is the fact that the ‘intensity of ICT use however has no impact on pre-service teachers’ ICT competencies’ (Tondeur et al., 2018, p. 38).

The approach to teaching and learning in these core ITE subjects also utilised a form of team teaching. The notion of team teaching in higher education is relatively rare and there is a paucity of research in this area, though there is some research on the benefits of PSTs team teaching with practicing teachers (Baeten et al., 2018; Rickard & Walsh, 2019; Tsybulsky & Muchnik-Rozanov, 2019). The experience of the authors generally indicates that the lack of team teaching in higher education is due to a lack of resources at multiple levels. The authors adopted this approach based on multiple reasons. These reasons included:

- Early childhood and primary PSTs are likely to be working in a team teaching scenario during practicum or in their future classrooms;
- Provides opportunities for mentoring and coaching (especially with new teacher educators);
- Combines the knowledge and experience of two or more teacher educators;
- Creates many spontaneous teachable moments;
- Draws on the strengths of each teacher educator’s prior teaching experience and background;
- Allows for more student support and diversification;
- Similar learning experiences across all groups of PSTs.

When collaborative learning and team teaching come together with creative inquiry, they form a powerful alliance which enhances the student learning experience. It is within this context that educators feel supported by each other, and the collective knowledge of multiple educators can enhance the learning experience for the students. A teacher in this subject indicated that they felt more comfortable teaching the subject as a relatively new staff member, and it gave them the opportunity to learn from someone else. They also indicated how important it was for them to have a voice to share their teaching experiences in a supportive environment.

The addition of team teaching as a pedagogical approach was a response to both PST surveys and teacher educator surveys that indicated the need for PSTs and teacher educators to have more confidence and experience with digital pedagogies and digital technologies. This is a changing field where technologies quickly become redundant and where there are large amounts of experimentation with regard to which tool is best suited for the task at hand. Team teaching allows each of the teacher educators to support each other and to bounce ideas off each other.

### ***12.4.3 Role of Digital Technologies***

A model of teacher education that supports identity, agency and community is seen to be beneficial to teacher development (Moate & Ruohotie-Lyhty, 2014). It is within this context that the pedagogical approaches used in the digital technologies subjects actively try to address the notion of identity, agency and community. The pedagogical approaches draw upon the expertise and experiences of practicing educators in the learning forums to explore how digital technologies can be used to enhance the student learning experience. The PSTs find this to be a valuable and authentic experience where they can connect the theoretical underpinnings of the subjects with what is happening in schools. The PSTs are empowered to be critical and creative thinkers through the provocative creative inquiry tasks that they undertake. Whilst these tasks are deliberately provocative in nature they are also designed as authentic tasks that are relevant to the PSTs future area of teaching. Due to the nature of ITE this can be quite varied across early childhood, primary and secondary education and therefore the teacher educators need to draw on multiple provocations to meet the needs of all PSTs.

PSTs are given the opportunity to explore digital technologies and to choose digital technologies that are best suited to solving the task or responding to the provocation that they are given, as opposed to being taught how to use a particular tool, and then trying to find a use for it in the classroom. In the surveys, a small number of students did indicate that they would prefer to be taught how to use a specific tool and wanted step-by-step instructions for doing so. For example, some PSTs indicated that they wish they knew how to use a tool such as Microsoft Excel or Apple Keynote in their teaching. This indicates that these PSTs are very much focussed on the tool as opposed to the pedagogy. A number of PSTs also indicated that they struggled with the new learning approach, but then, through reflective tasks, the learning forums and

the provocations, developed a deeper understanding and appreciation of the role of digital pedagogies and digital technologies. The following PST response highlights the positive aspect of this approach:

I believe that the activities demonstrated within the creative inquiry sessions were able to address an area of expertise which I was not aware that I was lacking in (in the past) and would have been beneficial to learn ... (Student 3, 2016)

#### ***12.4.4 Learning Spaces***

The approach to creative inquiry is situated within new generation learning spaces that are purposefully built to be agile and flexible (Lee et al., 2016). The learning spaces are open and spacious; there is no front of the room, the furniture is flexible and configurable and personal digital devices work seamlessly with the digital solutions in the learning space. For example, PSTs can mirror a mix of personal devices to projectors and screens throughout the space for the purpose of collaboration and sharing. PSTs responded positively to the learning space design:

That's my favourite classroom. It's like: 'I got the good classroom today!' (STFG [student focus group])

And,

It's just like a nice environment. Other classrooms are a bit sterile and a bit the same, whereas that's just something a bit different. Makes you want to come in there. (STFG)

These quotes are from PSTs involved in small focus groups. In the 2019 survey of students (n = 618), 96.75% of PSTs indicated that the learning space was relevant to extremely relevant in their studies. As part of the approach to using creative inquiry as a pedagogical approach, the core teaching team ensured that the learning environment met the needs of PSTs. The overall response from both PSTs and teacher educators was extremely positive, though there were still a number of PSTs and teacher educators who indicated they preferred a more traditional approach.

The design of the learning spaces afforded greater movement of both PSTs and teacher educators. Social relations were constantly being 'made and remade' (McGregor, 2003, p. 353). 'Movement was observed and perceived to be more impromptu and "allowable"' (Nykivist et al., 2021) thus also giving PSTs agency, as opposed to other rooms, where there was less space, and the furniture was less easily reconfigurable.

I like it that you can walk around. You don't have to be stuck in a seat. If you want to go to a different group you can move around, it's really open and you're allowed to do that. (STFG)

Learning can occur whether students are standing or sitting, and responses from the PST survey in 2016 (STsurvey) suggest that 'greater movement around the room may have created increased opportunities for the formation of unexpected relationships and serendipitous insights' (Nykivist et al., 2021).

It's much easier to make friends and have good conversation in groups where you can rearrange the furniture. I found this subject to be the one where I made the best friends. Normal classrooms have straight tables and you can only speak to the two/three people around you without having your back to them (STsurvey, 2016).

And.

It's a very open space that invites you to talk to people as well. It's not like you just have your friends and you stay there, like in a classroom. Different groups sit around different sides. I can see what this group is doing and I can go over and say, 'Hey, what are guys up to?' (STFG).

Such comments suggest that some PSTs felt a greater sense of agency in the room. Agency can contribute to a sense of belonging, which leads to deepened student engagement (Nykvist & Mukherjee, 2016; Solomonides et al., 2012), and subsequently improved student retention (Nelson et al., 2012). Whilst the learning space has always been seen as an important component of an effective learning experience by the authors, they also had the opportunity to prototype a new learning space in 2016. This was continually refined to meet the needs of the PSTs and the teacher educators, and subsequently informed the development of new learning spaces in the university. It is the reflexive nature of the core teaching team that has prompted the need for similar teaching spaces across the university.

## 12.5 Conclusion

Preparing pre-service teachers to be able to effectively use digital pedagogies and digital technologies in their future classrooms is what some teacher educators may refer to as a 'truly wicked problem.' Teacher education is challenging and there is no 'one way' that will ensure that all pre-service teachers will have the required knowledge and skills to adapt and change to new ways of teaching and learning when needed. The approach elaborated upon within this chapter is an example of an agentic response by teacher educators needing to ensure that PSTs are prepared to positively meet the challenges they may encounter as teachers in an ever-changing world where digital technologies become more pervasive. The learning design, in particular participation in creative inquiry, prepares PSTs to embrace change whilst exploring their prior learning experiences in a reflective forward-looking manner. PSTs need to understand the role of digital technologies and the impact of the learning environment, whilst also working together to collaboratively solve problems. As future teachers, they will need to be flexible and adaptable as they agentially respond to the changing nature of education and the uncertainty that occurs in education. Emerging evidence from the research work of the authors demonstrates that an approach such as creative inquiry can enable these teacher capabilities.

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