A professional learning model supporting teachers to integrate digital technologies

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Contemporary teachers have an obligation to support and scaffold students' learning in digital technologies and to do this in authentic contexts. In order for teachers to be successful in this, their own competency in digital technologies needs to be high, and their own 21st century learning skills of communication, collaboration, creativity and problem solving need to be well honed. Teachers are challenged to understand not only the associated digital pedagogical practices and content knowledge, but also to be familiar with how the technology components can be best used to support learning (Ertmer & Ottenbreit-Leftwich, 2013). This paper reports on a 2016 pilot project that incorporated the key components of highly effective teacher professional learning to leverage transformational change: on-site, over-time, through a community of practice and building the confidence and competence of teachers to implement the digital technologies curriculum (Jimoyiannis, 2010; Rodrigues, 2005; Wenger, White & Smith, 2009). This project supported 28 primary and secondary school teachers from regional Western Australia to collaborate through a distributed digital learning network or a guided Professional Learning Network that was called a "cluster" to develop and reflect upon their digital capabilities.

Introduction

In 2018, the new *Australian Curriculum: Technologies* (ACARA, 2016) will be implemented across all Australian schools from Foundation year to Year 10. There are two strands as a progression from Foundation year to Year 10; the *Design and Technologies knowledge and understanding* that examines the use, development and impact of technologies and design ideas across a range of technologies contexts, and the *Design and Technologies processes and production skills* that focus on the skills needed to create designed solutions (ACARA, 2016). The rationale is to enable students to develop knowledge about the technologies and then design solutions within the context of society considering a range of frames including local, regional and global communities, the economy and also the natural world.

Teachers will be expected to unpack the content descriptions, create authentic learning activities, and assess and moderate students' work. Students will need to develop and demonstrate high-level competency in their day-to-day use of digital technologies to be able to navigate an increasingly complex and information-rich life (International Society for Technology in Education (ISTE), 2016; Ministerial Council on Education Employment Training and Youth Affairs, 2008). In primary schools, where educators generally teach across all learning areas, this has been identified as a challenging task and teachers have indicated that they need quality professional learning and significant support to effectively address this challenge. In large educational jurisdictions such as Western Australia (land area of 2,529,875 km^2) in which schools are not only located in metropolitan areas but also widespread in rural and remote communities, the challenge of transformative teacher professional learning almost becomes insurmountable. This is due to high costs (travel and accommodation, and teacher release) and the availability of qualified providers. The pilot reported in this paper sought to overcome these challenges by establishing and supporting professional learning networks that subtly shift the locus of control to Lead Teachers in their local communities.

Background

The impact of the recently released 2016 International Society for Technology in Education standards (ISTE, 2016) has not yet been felt in Australia – however this is only a matter of time. These standards move beyond simply knowing about the latest open-source technological gadgets; consideration and focus is on how students are able to solve problems, curate knowledge, demonstrate their creativity and collaborate with their peers. In addition to these skills is the concept of "Information literacy", an essential set of understandings, skills and dispositions, in today's information-rich learning and working environments (ISTE, 2016). The quality and relevance of information so effortlessly retrievable will need to be scrutinised and evaluated by those accessing it. Students and teachers must be able to engage with diverse learning technologies efficiently and effectively in the search for the right information at the right time for the right purpose.

Teacher change

It has become clear over the last several decades that professional development innovations are important in fostering teachers' continued development as life-long learners (Guskey & Huberman, 1995; Jimoyiannis, 2010; Rodrigues, 2005; Smylie, 1995). Effective change innovation has been thoroughly researched, and consequently attributes of effective professional learning programs have been identified (Jimoyiannis, 2010; Penuel, Fishman, Yamaguchi & Gallagher, 2007). These attributes include: the ability of teachers to work collaboratively and collegially; an understanding of teachers' prior knowledge; promotion of experimentation and risk-taking; provision of time for teachers to reflect on their learning experiences, and to seek further clarification where necessary; the involvement of teachers in all aspects of the professional learning; a supply of appropriate rewards to encourage teacher participation; the provision of links to the Department of Education WA, the school, the wider organisation; and the provision of other professional learning opportunities (Guskey & Huberman, 1995; Loucks-Horsley, Hewson, Love & Stiles, 1998; Penuel, Fishman, Yamaguchi & Gallagher, 2007).

Darling-Hammond, Wei, Andree, Richardson and Orphanos (2009) affirmed that the review by Loucks-Horsley et al. (1998) resulting in an articulated vision of effective teacher professional learning was still pertinent. The framework for effective professional learning is based on the following seven principles:

1. have a clear, well-defined purpose of what it is aspiring to achieve;
2. allow teachers opportunities to build on their knowledge and skills;

3. model with examples the strategies to be taken to the classroom and used by the teachers;
4. be part of the continuous development of the learning community;
5. provide opportunities for teachers to lead reform efforts;
6. help provide links to other parts of the education system; and
7. consistently review its success in meeting its objectives and ensuring a positive impact on teachers' effectiveness and students' learning and attitude.

Decades of research into the characteristics of effective teacher professional learning (for example, Fernandez, Cannon & Choski, 2003; Jacques, Behrstock-Sherratt, Parker & Bassett, 2017; Garet, Porter, Desimone, Birman & Yoon, 2001; Penuel, Fishman, Yamaguchi & Gallagher, 2007) have confirmed that transformative learning occurs when instruction and support is: over time, onsite, reflective, and has clearly identifiable links to the curriculum. These are the characteristics that underpin the model used in this pilot.

The affordances provided by the technologies throughout the pilot enabled teacher participants to remain connected and continue to participate in reflective and transformative professional learning regardless of their geographical location and that of the professional learning facilitator. In previous professional learning events and programs, all of the participant support was provided by a cumbersome form of group email or by meeting with the teachers onsite – an expensive and time-consuming approach. Having a digital community enables the facilitator to support the participating teachers, and also enables the teachers to communicate and share ideas with each other (Ertmer & Ottenbreit-Leftwich, 2013). Whilst some teachers may be reluctant to adopt these collaborative technologies, other teachers embrace being part of a digital community and the support provided for their learning (Buzzard, Crittenden, Crittenden & McCarty, 2011).

Professional learning networks

In recent years, teachers have been able to take control of their own learning using networks to connect and curate new knowledge and, in so doing, participate in and demonstrate lifelong learning (Garet, Porter, Desimone, Birman & Yoon, 2001; Jacques, Behrstock-Sherratt, Parker & Bassett, 2017; Macià & García, 2016). Learners are empowered to be in control of when, how and what they learn through the connectedness of professional learning networks. These networks are "uniquely personalised, complex-systems of interactions consisting of people, resources, and digital tools that support ongoing learning and professional growth" (Trust, Krutka & Carpenter, 2016, p. 35). As Trust et al. (2016) proposed, this has led to an increase in the number of these communities supported through social media (such as *Twitter* and *Facebook*) whereby teachers can work together on a shared idea or themes such as science, technology, engineering and mathematics (STEM) education, or for pre-service teachers, it can be related to a unit of work or a course of study. Professional *Facebook* groups have become more popular and widely used in the last decade; however there is still a lack of evidence to support a correlation between professional learning networks and gains in teachers' professional learning (Macià & García, 2016).

Educators and researchers have been trying to negotiate the complex system that constitutes professional learning networks, to determine how they can be harnessed for use to support focused, generative learning (Macià, & García, 2016). Attempts to guide professional learning networks may work against the organic nature of an individual's professional learning network, which is a reflection of the needs of the individual and of the community it supports. Each teacher has a unique professional learning network that they create based on their interests, their colleagues and connections, and their ability to connect with relevant communities. There is power in the connectedness of communities that has been recognised since the work of Wenger from the early 1980s and then subsequently in a digital frame (Wenger, 1998; Wenger, White & Smith, 2009). This research has recognised the power of teachers' communities of practice and the significant role they play in professional learning networks, and this supports the strong component of connectedness in the professional learning model used in this pilot.

Teacher professional learning models

Supporting teachers' practice and helping them enact change in their classroom practice is a complex process and incorporates a number of key elements. Goodrum, Hackling and Rennie's (2001) *Collaborative Secondary Science Program* (CASSP) model brought together three distinct elements, including face to face support, resources and reflective opportunities, and interwove them to produce a comprehensive approach to teacher professional learning designed to bring about prolonged and sustained teacher change. These key components were considered to be significant, however this model was not sufficient to incorporate other key factors suggested by Darling-Hammond et al. (2009). Sheffield and Blackley's (2016) *Reflective Identity Formation Model* supported pre-service teachers who initially participated in a learning task in a hands-on workshop and then reflected on their learning and considered how these skills were impacting their professional identity through increased competency. They used their pedagogical knowledge to determine how they could best implement the skills into their classroom to support their students' learning, and then how they could determine the success of the implementation. For the experienced teachers in this pilot, the model (Figure 1) helped them move from a digital technology "novice" to "expert" and provided them with resources and tools to use with the students in their classroom.

The model includes a *Learning by doing* component, a technical, hands-on workshop where teachers came together, with face-to-face support from the facilitator, to explore a range of digital technology tools. This enabled teachers to become familiar with the technology tools and the digital technologies curriculum, as well as demonstrating their collaborative and problem solving skills. In the next stage, *Personal reflection* teachers critically reflected on their personal learning, and then created a learning experience or sequence of learning experiences, to implement in their classroom, integrating the tools, the curriculum and also their own understanding of effective pedagogy targeted to their students' needs.

Figure 1: Reflective Identity Formation Model (Sheffield & Blackley, 2016)

In the third phase, *Implementation*, the teachers implemented their created learning experiences in their classroom with their students, and *Professional reflection* followed this, where data were gathered on students' confidence and understanding and also the teachers' reflections. During the professional reflection the teachers met in their cluster (either online or face to face) to discuss the implementation of the learning experiences in their classrooms. They used their reflections to refine these learning experiences or artefacts, and create modified learning experiences. The strength of these clusters was the building of teacher capacity and the sharing of ideas, resulting in a bank of learning experiences on which to draw (Trust, 2012; Wenger, White & Smith, 2009). This model is underpinned by a systematic distributed learning network that supports the transition from *novice* to *expert* in digital technologies based on aspects of the communities of practice and also draws on the work around professional learning networks and how teachers create networks, particularly through social media (Trust, 2012; Wenger, White, & Smith, 2009).

The 2016 pilot project

The pilot study data is the focus of this paper and is significant in the development and implementation of a wider scale project (*Deeply Reflective Engagement and Mastery* – "DREAM") that commenced in 2017. Table 1 outlines the phases of the whole professional learning program undertaken by the research team in collaboration with an experienced Western Australian facilitator from the Datacom Group Ltd.

Table 1: Professional learning program

Year	Scope	Who	What
2016	Pilot	Invited: 2 x Department of Education school clusters; 10 schools in each cluster; 2 x teachers per school – Potential total of 40 teachers – 28 participated	Professional reflection on the implementation. Teachers use the technologies and gain experience and formulate pedagogy. Measure achievement. Ensure capacity building.
2017	State-wide implementation	13 x Department of Education clusters; 2 x teachers per school; 10 schools in each cluster. Total of 130 schools. Each cluster nominates a Digital Edge Teacher to lead the cluster	Refinement of digital pedagogy and exposure to various digital technologies in a familiar environment. Professional reflection on the implementation. Teachers refine the use of the technologies and gain experience. Measure achievement. Ensure capacity-building.
2018	Platform and web repository	Department of Education and cross- sectorial involvement; 2 x teachers per school as indicated by expressions of interest.	Creation of a web platform to support all participants in the program with resources. Learning materials to be created and uploaded by the teachers.

In Term 3, 2016, two clusters in regional Western Australia were formed with 20 teachers from 10 schools to pilot the process, and they were supported over 10 weeks by an experienced digital technologies professional learning facilitator. The data collected and analysed from the pilot were used to validate the modified professional learning model and determine its effectiveness in supporting teachers' professional learning. The pilot and the subsequent DREAM project focused on primary educators; however regional communities, where traditionally teachers in lower secondary may teach in multiple content areas and where there are often less opportunities for professional learning, saw the uptake of the program in some secondary or middle schools.

Research questions

The research component of the 2016 pilot sought to answer the following questions:

1. To what extent did the modified *Reflective Identity Formation Model,* as a professional learning model, support teachers' learning?
2. What impact did the pilot have on the confidence and ability of the teachers to design, create and evaluate effective learning experiences based on a range of technology tools and the digital technologies curriculum?

2016 pilot program implementation

Table 2 outlines the program that was developed and implemented, indicating the specific focus at each stage. The pilot consisted of a 10-week immersive program where the cluster teachers were supported through a series of face-to-face professional learning sessions in Week 1, Week 5 and Week 10, and online support in the intervening weeks run by the facilitator. Figures 1-4 are snapshots of the participants' involvement in Week 1. Teachers unpacked the WA: Digital Technologies Curriculum and used a variety of digital tools and apps to expand their skills in coding and programming. In Weeks 2 and 3, teachers were connected through SeeSaw and posted their experiences and Connect to post their proposed lesson plans. *SeeSaw* and *Connect* were two communication and collaboration platforms that were introduced to support and connect the teachers during the trial, enabling them to share experiences and artefacts that were created.

Table 2: Professional learning program for the clusters.

Week	Focus	Mode
1 Initiation	• Unpack WA: Digital Technologies Curriculum (Design and Technologies and Digital Technologies) as the preferred version of the Australian Curriculum: Technologies. • Familiarisation with a range of technology devices and software, such as *Spheros, Edison robots* and *Scratch Junior*. • Development of a lesson or series of lessons using one of the devices or software program.	Face to face Full day - off-site
2 Implementation	• Participants implemented their lesson/s in their classrooms and reflected on the experience.	Onsite
3 Learning check	• Cluster teachers debriefed with the research team using conference calls.	Online
4 Extension	• Teachers planned and implemented a follow-up learning experience based on the same technology.	Onsite
5 Networking	• Teachers collaborated to produce a second learning experience for each class and mapped this to the curriculum. This was supported by the facilitator.	Face to face Half day - off-site
6 Implementation	• Participants implemented their lesson/s in their classrooms and reflected on the experience.	Onsite
7 Learning check	• Teachers emailed to debrief with the facilitator.	Online
8 Extension	• Teachers planned a follow-up learning experience based on the same technology.	Onsite
9 Implementation	• Participants implemented their lesson/s in their classrooms and reflected on the experience.	Onsite
10 Celebration and future planning	• Participants shared their stories, and discussed how to move the implementation of the new curriculum forward in their school communities.	Face to face Half day off-site

Figure 1

Figure 2

Figure 3

Figure 4

Figures 1-4: Participants engaging with the technologies in the first face to face session in Week 1

In Week 5 the teachers again met face to face to discuss their progress in producing a learning artefact that they then mapped to the curriculum. Teachers returned to their classrooms to develop, implement, review and refine their learning artefact in Weeks 6 to 8. In the final, Week 10, teachers met and celebrated their learning and the artefact that they had created and implemented and they also planned future learning experiences using the digital tools and the digital technologies curriculum.

Methodology

The methodology for this pilot project was an interpretive case study with qualitative data collection and analyses. The teacher participants were asked to undertake two online, anonymous surveys: pre-program (Appendix A) and post-program (Appendix B).

Data instruments

The pre-program survey contained questions designed to establish current states of confidence in planning for and teaching digital technologies, current teacher practices, and reflection upon their professional learning needs in the field. Items were distilled from the work of Carney, Brendefur, Thiede, Hughes and Sutton (2016). The post-program survey was designed to determine whether changes in confidence and practice had occurred, and to draw out self-identified areas for further development. This survey also served to critique the affordances of the Department of Education's tool *Connect* and the use of *SeeSaw* to support the learning community. *SeeSaw* is a curation and blogging platform that is private and where participants are invited to join. It is free and open-source, yet can be kept private; videos, documents and audio files can be uploaded and shared.

During the ten-week professional learning program several platforms were created to help teachers to communicate and collaborate their reflections and learning experiences were uploaded onto *SeeSaw* and initially to the Western Australian Department of Education *Connect* site. This method was chosen to provide a rich and detailed dataset to determine how the program was enacted in regional areas, and how it could be improved to best support the professional learning of the participating teachers. The select-option survey items were analysed using frequency expressed in percentages, and free-text elaborations which were coded categories identified and subsequent themes distilled.

In addition to the two online surveys, *Post-it* notes ('sticky' notes) were used in the initial face to face, one-day introductory workshop to determine what the teachers wanted to achieve as a result of the program and what their initial concerns were in implementing the technologies curriculum. One researcher analysed the notes by coding like text into themes; this was then ratified by the second researcher, resulting in a 90% match. Finally, there were structured interviews at the midpoint of the project where the researcher and facilitator sought to collect personal and, at times, anecdotal reflections from the participating teachers that could not otherwise be obtained from the surveys.

Ethics

Ethics approvals were granted by the Department of Education for the collection of anonymous survey data only and not for the collection of artefacts which were deemed to intellectually belong to the Department. The researchers and project facilitator did not have access to *Connect* as this was a Department of Education owned platform and requested analytics about the statistical use of the platform were not forthcoming.

Participants

The District Office in a regional centre participating in this trial had a pre-existing relationship with the corporate partner of this project and they contributed the necessary funds to pay for the professional learning pilot. The cluster schools were asked to nominate to participate in the project; however, there was encouragement from the District Office for schools that had previously indicated that they needed support to participate. The district where the two clusters were situated was over 500 km from Perth and so the facilitator and one researcher flew to visit the clusters. Teachers were drawn from the region around the District Office with some from the nearby local school, whilst others had up to a two and a half hour drive both ways from their school to the District Office to attend.

Ten schools in two geographic clusters were invited to nominate two teachers per school. Not all schools provided two teachers; as a consequence 28 teachers consented to participate in the research component of the program. Eight of these teachers indicated that they taught across several year levels (e.g. K-6), four were in administration/ leadership positions, two taught in Years 7 and 8, three taught in upper primary (Years 5-6), four in middle primary (Years 3-4), and seven taught in the early years (K-Year 2). There was a considerable range in their self reported digital technology competence and confidence amongst the participants.

Results

The pre-program survey examined the teachers' confidence and competence in skills and knowledge of the digital technologies curriculum. Teachers in the study were very diverse in their skill and competence levels (see Table 3), and consequently were at very different stages in the enactment of or engagement with the curriculum. When asked what aspects, if any, the teachers had incorporated into their classroom practice (Item 3), it was clear that some teachers had not accessed the curriculum documents at all, whereas others felt that they were very competent and reported that they were coding and using *makey makey* (an electronic invention tool and toy that allows users to connect everyday objects to computer programs using closed loop electrical signals) in their classrooms, and across the participant group the spread was even.

Item 4 asked teachers to indicate how much time per week their students engaged in a technologies-based activity. Of the teachers who responded to this item (43% of the participant group), 42% indicated that their students engaged for 40 minutes per week, 33% 30-40 minutes, 8% 20-30 minutes, and 17% indicated that there was no engagement. Teachers were also asked to rate their level of confidence in five key areas (Item 6, as shown in Table 4) and the majority of teachers in this pilot rated their confidence as "low or basic" in many areas. For example, in programming and coding, 78% of teachers reported "basic" or "no understanding", and, in computer systems, 70% of teachers reported "basic" or "no understanding". Teachers reported a higher level of confidence in "design" and "project-based learning", with only 50% of teachers reporting a basic understanding in this area.

Item 7 asked the teachers to indicate related areas of teaching and learning they would like to explore further. The highest rated area at 40% of first choice was "Building learning journeys for STEM to become a focus to the way my students learn". This was followed by 20% "Building solution apps and websites with digital tools", and 16% for both "Involving students in food production enhanced by technological systems" and

"Programming, coding and game-based learning to improve cognitive concepts in the digital space". Only 8% rated "Engineering concepts and building machines and structures" as their top preference.

Table 3: Teachers' understanding and/or involvement with implementing the digital technologies curriculum at the start of the professional learning program (N = 28)

Self-reported extent	% of teachers	Examples of the digital technology currently implemented in their classrooms
Have little or no understanding of this area of teaching and learning.	25	1. Design, creation and review. 2. Planning, designing, making and evaluating an object to solve a problem/meet a need. 3. Technology process, ICTs.
I have read and understand the documentation but have as yet have not tried to program a learning journey around this curriculum.	25	1. Use of Internet for videos, use of whiteboard for modelling, use of *Excel* for graphing, making and creating tables. 2. Working on apps on the *iPads*.
Only dabbling in parts of the curriculum, mostly in the design technologies area when modelling, engineering and crafting.	25	1. Commenced this week, still figuring out school resources/planning, Specific STEM tasks once or twice a week. Hands-on construction, craft mainly, 2. Robotics. 3. Explicit teaching of new apps, projects, tech discovery rotations, and peer tech teaching.
Currently testing out parts of both the design and digital technologies curriculum.	25	1. Use of *iPads* to complete specific tasks. 2. Creating a simple movie. Adding comments and labels to photos using *Skitch* (1). 3. Chaos - no not really but it is active and noisy. 4. Students participate in term-based projects that involve designing and planning, experimenting with different materials, collecting and analysing data from experiments before building their final creation. 5. Coding. 6. Computer Lab - coding using *Scratch* (2), working towards designing and building our own computer games using *Scratch*. 7. Sometimes we just do other activities to work on team skills, bridge building, design challenges, etc.

1. *Skitch* is a free screenshot editing and sharing utility for *OS X, iOS, Windows*, and *Android*. The app permits the user to add shapes and text to an image, and then share it online. Images can also be exported to various image formats.
2. *Scratch* is a project of the Lifelong Kindergarten Group at the MIT Media Lab. It is available free of charge.

The teachers were also asked to gauge the level (0 = not at all to 5 = extensively) to which their students demonstrate selected 21st century learning skills as described in the 2016 ISTE Standards, as shown in Table 5.

Table 4: Teachers' confidence in digital technologies in the pre-survey at the start of the professional learning program. (n = 28)

Teachers' rating of their confidence	Teachers' confidence (% of participants) in the areas of:				
	Design thinking and methodology	Project based learning and why we do it	Identifying, collecting and using data for a purpose	What makes a computer system and peripheral devices work	Programming languages, coding and robotics
No idea	8	0	4	22	41
Basic understanding	42	50	41	48	37
Use elements of T&L	38	23	22	15	15
Covered in each term plan	4	4	7	7	0
Build it into my yearly plan	8	19	23	7	7

Table 5: Student engagement levels (mean) with 21st century learning skills

Skill	Level
Investigate, create, communicate and manage ICT.	2.2
Inquire, explore, analyse, generate, reflect and evaluate whilst thinking through tasks.	2.3
Regularly consider and manage the way they act and act with others whilst completing tasks.	2.8
Purposefully enhance their capacity in literacy skills through applied project work.	2.5
Purposefully enhance their capacity in numeracy skills through applied project work.	2.4

When asked what specific support teachers felt they needed at the beginning of the pilot, many did not respond; however, those who did highlighted general issues around technology, for example: "need reliable Wi-Fi connection for successful implementation" and "support to ensure the technologies that we currently have in our school work on a regular basis". Responses were also elicited at the beginning of the first face to face training session using sticky notes on the wall (for example, Figure 5). Teachers were asked what they would like to achieve as a result of their participation in the pilot. Some teachers demonstrated a limited understanding of the project and the new curriculum. These participants articulated that they needed support but could not or did not specify what the support entailed; whereas other teachers, particularly those in leadership roles, wanted advice on how to support their colleagues and peers. These comments were analysed into broad themes as shown in Table 6.

Post-survey results

When asked to respond to the final survey, only 15 teachers from the two clusters participated. The researchers speculated it was due to the constraints on the teachers around end of the year activities, although during the program several teachers reported

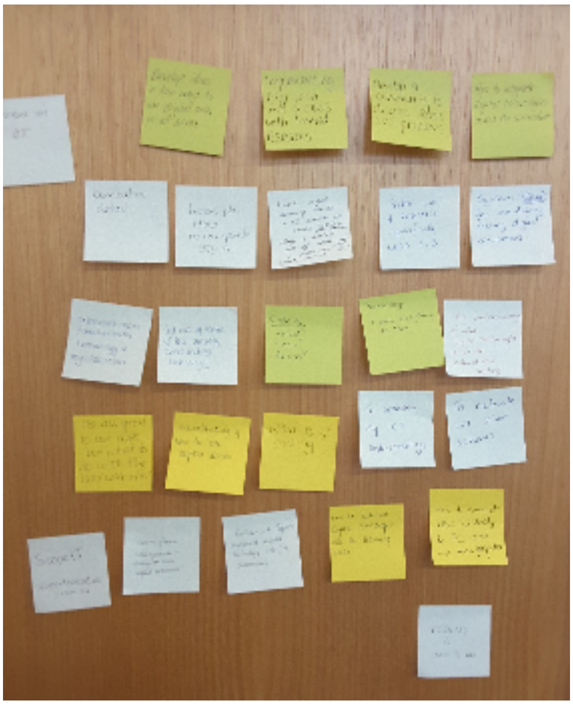

Figure 5: Data collection by sticky notes

feeling overwhelmed and had pulled out. It would have been useful to follow up with teachers who did not participate in the final part of the program why they had not continued, although this was not done in the pilot. When this cohort was asked if their students were now spending more time engaged in digital technologies-based activities (not ICT general capabilities/ using computers) than they did before, 33% (5 teachers) said "no they had not spent more time in class" yet 66% (10 teachers) reported that they had spent between 30 and 120 minutes per week more than they had previously.

When asked again to rate their confidence at the conclusion of the pilot, the responses showed a positive shift indicating that the teachers were developing a greater understanding and use of the key aspects of the technologies curriculum. In the post-program survey (Table 7), none of the teachers reported that they had "no idea" in regards to the implementation of the "Design thinking and methodology" (process and production strand) of the digital technologies curriculum, and, in the "Programming languages and coding", 40% of the teachers reported that they had now incorporated these aspects into their yearly class program. Coding was particularly successful with 77% of the original team having "little" or a "basic understanding" dropping to 20% after involvement in the program.

Table 6: Sticky note analysis at the start of the professional learning program (n = 28)

Comment categories	%	Comments about support needed or wanted
General	14	Better understanding of what we are doing. Hopefully to gain a deeper understanding of how I can use this journey effectively. Understand what is required of me what skills to teach/expect.
Understanding of digital technologies (DTs)	11	Various technologies available and how to use in the classroom. Deeper knowledge of DTs and DTs curriculum planning, assessing and teaching. The language of DTs and how to code.
Access issues	3	Best way to teach with small sets of *iPads* for the whole class.
Confidence	11	Develop confidence in teaching technologies curriculum to make teaching computer skills easy for me and interesting to students. Confidence to teach coding and programming.
Lesson planning	3	To design a lesson plan that all staff may be able to implement as a start.
Assessment	7	How do I assess tech skills taught? Implementing into a curriculum easily with the assessment ideas.
Integration	7	Some ideas for how to develop units of work integrating subject areas. How to implement robotics and coding into the classroom in a meaningful way - links to the curriculum.
Scope and sequence	11	Developing a scope and sequence plan for the school.
Collaboration	14	How to best train early childhood education students. How to develop skills/knowledge to argue the case for design and technologies in my school. Understand digital technologies better to be able to guide my staff implementation. How do we develop/discover teacher competencies.
Miscellaneous	11	Engineering project, project based learning, STEM.

When teachers were asked about their confidence to teach and support colleagues in digital technologies, 80% felt that they were confident in teaching the digital technologies curriculum and 80% "agreed" or "strongly agreed" that they felt confident to support the teachers in their school to plan and deliver the digital technologies curriculum (refer Table 8). *Seesaw* was not a popular tool with the cluster teachers and they felt that the *Connect* community, which was already available to them, was a more effective tool. In total, 87% of the teachers who completed the final survey reported "agreed" or "strongly agreed" that the 10-week program was an effective way to communicate collegially and develop professionally. Whilst this was a positive result, it needs to be pointed out that only 50% of the original cluster teachers completed the final survey.

Finally, teachers were asked to examine their self-efficacy to teach technology after participating in the 10-week program by rating their preparedness to "Plan and implement learning experiences to address the curriculum in digital technologies in the classroom" and "Participate in conversations at your school around the implementation of digital technologies in your school" (refer Table 9). For both statements, 93% of teachers rated themselves "well prepared" or "very well prepared" to plan and implement learning experiences and to participate in conversations around the implementation of the digital technologies curriculum at their school.

Table 7: Teachers' level of confidence in digital technologies areas after the professional learning program (n = 15). Shaded cells are from pre-program survey for comparison.

Teachers' rating of their confidence	Teachers' confidence (% of participants) in the areas of: Design thinking and methodology (process and production strand)		Project based learning and why we do it		Identifying, collecting and using data for a purpose		What makes a computer system and peripheral devices work		Programming languages, coding and robotics	
No idea	0	8	0	0	0	4	0	22	0	41
Basic understanding	13	42	13	50	6	41	40	48	20	37
Use elements of T&L	20	38	33	23	27	22	13	15	20	15
Covered in each term plan	27	4	27	4	33	7	13	7	20	0
Build it into my Year plan	40	8	27	19	33	23	33	7	40	7

Table 8: Confidence levels in teachers subsequent to participating in the professional learning program (N = 15)

Statement	Strongly agree %	Agree %	Neutral %	Disagree %	Strongly disagree %
I am confident in teaching the curriculum in digital technologies in my classroom.	33	47	13	7	0
I feel confident to support teachers in my school in exploring how to plan and deliver digital technologies learning.	40	40	7	13	0
The use of *Connect* was an effective way for me to communicate and develop professionally.	20	47	33	0	0
The use of *SeeSaw* was an effective way for me to communicate and develop professionally.	0	33	40	13	13
The 10-week professional learning program was an effective way for me to communicate and develop professionally.	47	40	7	7	0

Table 9: Teachers' level of preparedness after the pilot professional learning program (% of cohort) (N = 15)

Statement	1: Limited preparation	2: Well prepared	3: Very well prepared
Plan and implement learning experiences to address the curriculum in digital technologies in the classroom.	7	46	47
Participate in conversations at your school around the implementation of digital technologies in your school.	7	33	60

Program review

Differentiation

The tailoring of a ten-week program to meet the needs of all the teachers was very challenging and relied on the facilitator being flexible enough to change aspects of the program as deemed necessary. Teachers reported that their experiences with digital technologies were varied, as seen in Table 3, and this made designing a differentiated program difficult. Some teachers were highly engaged and keen to upskill; they attended all of the workshops and posted onto *SeeSaw* when they experienced issues with connectivity, for example, as challenges to overcome. Anecdotally, at the initial workshop there were other teachers who seemed much less engaged; one left at lunchtime and did not return, and another left at the time when school would have finished (3:15 pm) despite the fact that the workshop had not been completed. It was a challenge to follow up on these teachers without drawing negative attention to them. Why these teachers and others were not engaged and did not finish the project is not known. It may be speculated that they had low levels of concerns about the use of digital technologies and/or implementing the new curriculum as they had yet to consider the implications of the mandatory implementation and reporting of the AC: Technologies in 2018 on their teaching lives. From the sticky note review, it was apparent that teachers were interested in a range of support and therefore trying to meet all of their needs - some requesting support around assessment (7%), others specifically with the scope and sequence, (11%) and others just needing more confidence (14%) – required creative solutions.

Connectedness

Teachers did not report being highly engaged through digital platforms such as *Connect* or *SeeSaw*. Only 33% of the 15 teachers finishing the program thought that *SeeSaw* was an effective tool to enable open and ongoing collaboration and communication, whilst *Connect* was more popular with 67% strongly agreeing or agreeing that it was effective tool to develop professionally and communicate. It was noted that *Connect* is a Department of Education monitored and administered platform and therefore we speculate that teachers in the project who were struggling may have been less comfortable in reaching out to their peers. Unfortunately this was not followed up as part of this pilot.

The teachers in the clusters in regional Western Australia who participated in the pilot reported high levels of technical difficulties: lack of or patchy connectivity, the lack of digital tools (for example, only having four *iPads* for their class to access) and the lack of general onsite technical support. Whilst this impacted on their ability to participate fully in the project and be part of the distributed learning networks, these teachers developed some creative alternatives. For example, "*programming unplugged"* where a teacher used the children in a physical space to teach the basic concepts of programming using simple yet precise directions to move a peer through a particular space. Students were then able to transfer the experience from the physical space to the digital realm.

Findings and conclusions

Firstly, the pilot needs to be acknowledged as a verification of instruments and processes, and as such, caution needs to be taken in drawing generalisations from the limited data set. However, the feedback received through the pre- and post-program surveys enabled the project team to reflect on the process, including the materials and support for teachers. The data sets were anonymous to promote honest teacher reflections, so identifying and mapping teachers' pre- and post-program survey responses was not possible. However, the data show that a long term, embedded professional learning program can be successful in improving the confidence and preparedness of teachers in implementing a mandated curriculum change. Teachers reported being more confident in every aspect that was surveyed pre- and post-program (Table 7) and 93% of the teachers reported feeling "*well prepared* or "*very well prepared* to integrate the digital technologies curriculum into their classroom. Teachers in the pilot also reported feeling more prepared and confident with 80% (see Table 8) agreeing or highly agreeing to the statement about their improved confidence as a result of this project and 80% felt more prepared (Table 9) to support their colleagues at their school to engage with the new digital materials and curriculum.

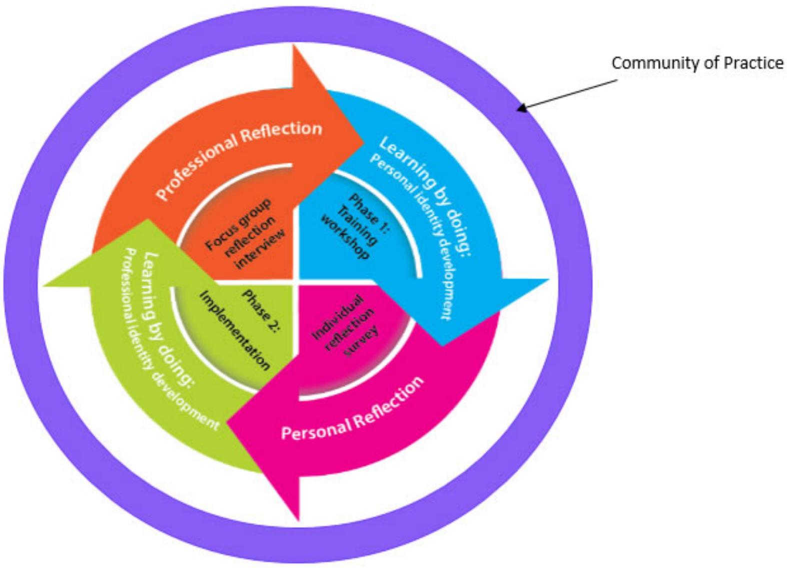

Figure 6: Modified Reflective Identity Formation Model

Model effectiveness

The modified *Reflective Identity Formation Model* (Figure 6) focused on teachers' personal reflections in the first instance and then, through a *learning by doing* approach, teachers would develop new skills and understanding, and then focus through a professional reflection lens on how to teach these new skills and consequently how to assess in the classroom. It was important that teachers were able to undertake the activities as part of the *learning by doing* approach as this was how they gained competence in aspects of programming such as using *Scratch* and *Scratch Junior*. The *learning by doing* approach, however, takes time and therefore this extends the time taken for the program to be implemented. The approach also supported a focus on the digital pedagogies that the teachers could in their classrooms.

Connectedness and collaboration were missing from the original *Reflective Identity Formation Model* (Sheffield & Blackley, 2016) and so were added as an overarching dimension for the up-scaled 2017 project (Figure 6). The connectedness of the community, and the ability to support each other, share ideas and resources, have been identified as vital to the success of the program (ISTE, 2017). It was determined that the digital communication platform chosen was not successful and was not inclusive of all members of the clusters. For the 2017 up-scaled project, it was decided that clusters could either use the Department of Education *Connect* community where each cluster has its own community, or use another form of social media such as *Facebook* that is more accessible to members of the community, supporting individuals' personal digital identity on phones or tablets.

As previously mentioned, a *learning by doing* approach takes time and so it was recognised that the professional learning program would need to be more than a one-day workshop (Sheffield, 2004). Even a 10-week program, however, was not sufficient for some teachers to make sustained or even significant changes to their practice in the use of digital technologies. There has to be a compromise between the time available to teachers and the time necessary to make sustained or transformative changes to teachers' practice. This program sought to balance the available time with the necessary time, and ensured that teachers felt connected and supported even in those weeks between the face to face experiences.

Pilot to full-scale implementation

As this project was a trial for a wider scale program in 130 schools in 2017, the researchers and the professional learning facilitator identified some key issues that would need to be addressed to ensure success on a larger scale. These included:

- *Internet connectivity*. In moving to a larger implementation of the project, there was nothing that the project team could do to improve the Internet connectivity of some schools. It has been bought to the attention of the Department of Education and a new multimillion dollar contract has been awarded to the Datacom Group Ltd to improve the technology infrastructure in regional areas. The team was aware of the Internet challenges and ensured that there were a range of unplugged activities to help support the teachers and encouraged principals to support teachers from isolated schools to meet face to face to spend time with their cluster colleagues.

- *Connecting the clusters*. This could be refined and improved through online connectedness using the Department of Education's *Connect communities,* rather than introducing teachers, some of whom already felt a lack of confidence with technology, to new technology as was the case was *SeeSaw*. It was recognised that some teachers were less eager than anticipated to engage with new technology and therefore reticent to use this method of communicating. It was suggested that as this aspect was so important, other social media platforms should be explored. In the full-scale implementation there was a range of tools used including *Connect* to share artefacts, and *Facebook* and *Trello* to support professional communication.

- *Model development.* As discussed in the section above, the model was refined based on the feedback from the pilot and the notion of a community of practice was established.

- *Data collection.* In the 2017 project teachers participated in two anonymous surveys that were modified based on the results of the pilot. Data was collected on the teachers' experiences and on other aspects of their professional learning. Some teachers were interviewed, and the use of a social media platform approved by the Department of Education enabled richer data to be collected and analysed, thereby providing greater clarity to the picture of the professional learning.

- *Digital technologies curriculum*. Teachers sought to increase their understanding of the digital technologies curriculum; however, they felt that time, a crowded curriculum and work demands made a deep immersion difficult. This was exacerbated by the time of year, at the end of Terms 3 and 4, which is recognised as being an extremely busy time. This may explain why a limited number of teachers were engaged throughout the 10 weeks and completed the final survey.

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Appendix A: Online survey – Pre-program

1. What year level/s do you currently teach?

2. For how many years have you been teaching?

3. Although this curriculum area is not due to be implemented till 2018, which of the following would best describe your understanding of the Technologies Curriculum area?
   - Have little or no understanding of this area of teaching and learning.
   - I have read and understand the documentation but have as yet not tried to program a learning journey around the this curriculum.
   - Only dabbling in parts of the curriculum, mostly in the Design Technologies area when modelling, engineering and crafting.
   - Currently testing out parts of both the Design and Digital Technologies curriculum.

4. Indicate the approximate time (per week) that students in your classroom would engage in a Technologies based activity (not ICT General Capabilities/using computers).

5. Please elaborate on what Technologies time would look like in your classroom.

6. How would you rate your confidence in the areas of: (no idea, basic understanding, use elements of T&L, covered in each term plan, build it into my year plan)
   - Design thinking and methodology (Process and Production Strand)
   - Project based learning and why we do it
   - Identifying, collecting and using data for a purpose
   - What makes a computer systems and peripheral devices work
   - Programming languages, coding and robotics

7. Which of the following areas of teaching and learning would you like to explore more? (rating 1 - 6 in order of preference)
   - Engineering concepts and building machines and structures.
   - Building learning journeys for STEM to become a focus to the way my students learn.
   - *Makerspace* methods with a focus on sustainability and resource management.
   - Involving students in food production enhanced by technological systems.
   - Programming, coding, and game based learning to improve cognitive concepts in the digital space.
   - Building solutions apps and websites with digital tools.

8. To what level do your students: (0 = not at all to 5 = extensively)
   - Investigate, create, communicate and manage ICT.
   - Inquire, explore, analyse, generate, reflect and evaluate whilst thinking through tasks.
   - Regularly consider and manage the way they act and act with others whilst completing tasks.
   - Purposefully enhance their capacity in literacy skills through applied project work.
   - Purposefully enhance their capacity in numeracy skills through applied project work.

9. In reference to Teaching & Learning, rank the following in order of your interest and importance (1 being the highest):
   - Student collaboration
   - Knowledge building (researching skills)
   - Creativity and communication
   - Differentiation - learning styles
   - Differentiation - ability
   - Learner feedback (formative assessment)
   - Promoting Design thinking in all classroom activities so that students become creative innovators for the future.

10. What additional support do you require to confidently share your learning programs with others in the cluster group. Please don't hesitate to ask?

Appendix B: Online survey – Post-program

Q. 1 and 2 – matching demographics.

3. Re your students spending more time engaged in Digital Technologies-based activities (not ICT General Capabilities/using computers) now that they did before?
   - Yes, if so how many minutes per week?
   - No

4. How would you rate your confidence in the areas of: (no idea, basic understanding, use elements of T&L, covered in each term plan, build it into my year plan)
   - Design thinking and methodology (Process & Production Strand)
   - Project based learning and why we do it
   - Identifying, collecting and using data for a purpose
   - What makes a computer systems and peripheral devices work
   - Programming languages, coding and robotics

5. Which of the following areas of teaching and learning would you like to explore more? (rating 1 – 6 in order of preference)
   - Engineering concepts and building machines and structures.
   - Building learning journeys for STEM to become a focus to the way my students learn.
   - Makerspace methods with a focus on sustainability and resource management.
   - Involving students in food production enhanced by technological systems.
   - Programming, coding, and game based learning to improve cognitive concepts in the digital space.
   - Building solutions apps and websites with digital tools.

6. Please indicate your level of agreement with each of the following statements after the 10-week Professional Learning Program. (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree).
   - I am confident in teaching the curriculum in Digital Technologies in my classroom.
   - I feel confident to support teachers in my school in exploring how to plan and deliver Digital Technologies learning.
   - The use of *Connect* was an effective way for me to communicate and develop professionally.
   - The use of *SeeSaw* was an effective way for me to communicate and develop professionally.
   - The 10-week Professional Learning Program was an effective way for me to communicate and develop professionally.

7. How would you rate your level of preparedness related to each statement after your participation in the 10-week Professional Learning Program? (1 = very limited, 2 = well, 3 = very well).
   - Plan and implement learning experiences to address the curriculum in Digital Technologies in the classroom.
   - Participate in conversations at your school around the implementation of Digital Technologies in your school.

8. Rank these topics in order of your professional growth interests for this focussed program. Ranking 1 (top choice) – 5 (last choice).
    - What is a computer system and how do I explain the concepts to students?
    - The terms and information used in the Digital Technologies area, including computational thinking.
    - How to develop an appropriate scope and sequence for Digital Technologies.
    - Knowing how to incorporate the use of robots and control devices in a meaningful and educative way.
    - Building my understanding of coding and programming so that I can improve my students' ability in this growth area.

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