



Information Communication Technology in schools: Students Exercise ‘Digital Agency’ to Engage with Learning

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Abstract

In contemporary society nationally and internationally, the use of Information Communication Technologies (ICTs) has become a vitally important component in the workforce, recreationally, and in schools. In Australia, as in many countries, there is a nation-wide priority within education systems that endeavours to ensure that in an increasingly digital world, students possess the ICT skills to participate fully in their schooling and, later in contemporary society. While progress has been made towards achieving these goals, research demonstrates that there is a general loss of engagement and confidence in ICT tasks as student progress through school systems.

In order to explore what students currently in secondary schools think and feel about their use and engagement levels regarding ICTs, this paper draws on a pilot project conducted in Australian schools. This pilot study found that agency and design-based pedagogy concerning the use of ICTs were key factors in engaging students and promoting learning. To further explore the findings of the project, the authors have formulated a model of Digital Agency. This term, ‘Digital Agency’ is defined as *the students’ experience of autonomous technology learning in the classroom*.

Keywords Information Communication Technology (ICT) · ‘Digital Agency’ · Pedagogy · Curriculum

1 Introduction

Globally the use of Information Communication Technologies (ICTs) has become a vitally important component in the workforce, recreationally, and in schools (Goldin, 2014). ICTs are defined in this paper as hardware and software commonly used in Australian

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classrooms to store, create, manage and distribute information. They include Word, PowerPoint, Web pages, 3D Printers, Apps, iPads, tablets, and digital cameras. In Australia, there is a nation-wide priority within education systems that endeavours to ensure that in an increasingly digital world, students possess the ICT skills to participate fully in their schooling and, later in contemporary society (MYCEETYA, 2008). The ability to use ICTs and other technologies competently is featured as one of the general capabilities in the Australian Curriculum (ACARA, 2011). While progress has been made towards achieving these goals, data derived from annual Australian standardized testing, in particular, the National Assessment Program–ICT Literacy and other research, demonstrates that there is a general loss of engagement and confidence in ICT tasks after students transition from primary to high school and as they move through the secondary school year levels (Thomson, 2015).

To gain the technological knowledge and skills necessary to complete their schoolwork and, in the future, lead fulfilling lives in technology-rich post-compulsory schooling environments, pupils need to understand themselves and how they learn (Wylie, 2012). In order to equip students with these kinds of technological skills and knowledge, educators turn to a variety of theories and teaching approaches (Bulfin et al., 2015; Selwyn et al., 2018; Twining, 2017). There are a range of factors implied in the promotion of learning about and with ICTs such as the need for competence, relatedness, and autonomy which affect students' levels of motivation and engagement (Jayalath & Esichaikul, 2020; Ryan & Deci, 2000). In their Self-Determination Theory (SDT), Ryan and Deci (2000) argue that to engage people, they need to feel—even if this is an illusion—that they have choice and are able to act with free will, thus, tying motivation to emotional states. While the ability to motivate oneself is affected by personal factors including emotions, Ryan and Deci (2000) state that external environmental conditions can also impact students' motivation and engagement with learning. For instance, the amount of teacher control evident in learning activities and classroom environments can affect the extent of students' intrinsic and/or extrinsic motivation and engagement. While the research reported in this paper touches on notions of motivation, competence, relatedness and autonomy, a deep examination of these issues is outside the scope of this article. The focus of this paper is 'Digital Agency' (DA) which the authors suggest is a subset of student agency.

The concept of student agency is often discussed in education literature (Amplify, 2019; Perkins, 2014; Richardson, 2019). In this paper 'student agency' is defined as a student's experience of autonomous self-directed learning in the classroom. As the paper also focuses on the strategic use of ICTs to promote student learning in general, and specifically regarding digital technologies, the authors have identified a form of agency that they argue is an important sub-set of student agency. In identifying this type of agency, the authors are expanding on the term 'digital agency' used by Passey et al. (2018, p. 426) where the notion is defined as a combination of 'digital competence, digital confidence and digital accountability'. 'Digital agency'(DA) is defined as the level of autonomy that a student experiences when digital technology is used in the classroom or the learning activities that are employed to scaffold the development of skills and knowledge relevant to the capable use of ICTs and other digital technologies.

School leadership and teachers are usually the agents who make decisions about how ICTs are used in class learning activities (Rehmat & Bailey, 2014). Unlike their current students, however, not all teachers have grown up with a plethora of technological devices. As a result, there is a wide range of levels of knowledge, skills and feelings of comfort among contemporary teachers concerning their use of ICTs in the classroom, as well as their adoption of digital pedagogies (Grigg, 2016; Spiteri & Rundgren, 2020).

To investigate students' digital agency, the researchers gathered student and teacher data and applied critical reflections of their own experiences using Mishra's and Koehler's (2006) Technological, Pedagogical, and Content Knowledge (TPACK) framework as well as the researchers' original contribution of the model of 'Digital Agency'. The researchers used TPACK as it mobilizes the ability to categorize the level teachers are operating at within the classroom, in terms of their pedagogical content, technology knowledge, skills, and confidence in using technology. The notion of DA has been employed to critically evaluate which approaches encourage high levels of agentic behaviour and understanding from the students. This combined framework is used in this paper to present a nuanced account of the ways in which teachers and students interact and learn with technologies in the classroom.

2 Literature Review

Throughout the world, the use of technology in general, and in particular information and communication technologies (ICTs) is an essential element of any student's education. This foregrounding of technological use and competency within schools is predicated on two main factors: the need to keep up to date with advances in technology and the requirement to prepare students for a productive and informed life in a rapidly changing technology-reliant world after school (Eady & Lockyer, 2013; Ojo & Adu, 2018). The formal literature on this topic supports the premise that there are many benefits for students with the widespread use of ICTs in classrooms. These benefits for teachers and students include greater access to information and other education resources, refined administration, and management practices, and enhanced presentation of work (Basargekar & Singhavi, 2017). ICT use also aids the fostering of inclusive teaching (Tikam, 2013). In addition, research found that purposeful use of ICTs in the classroom enhanced students' engagement and participation in learning activities which led to higher success rates in achieving learning outcomes (Basargekar & Singhavi, 2017; Naji, 2017).

While research documents the benefits of ICT use in the classroom, there are also grey areas in this domain where some 'benefits' have actually displayed limited advantages. For example, greater efficiency and clarity concerning administration and presentation of teaching and student work are cited as advantages of using ICTs (Basargekar & Singhavi, 2017; Hoffmann & Ramirez, 2018). However, these are quite routine matters when researchers are examining tools and factors that might enhance teaching approaches and student learning. Similarly, research regarding the use of ICTs in classrooms has focused on social rather than cognitive elements of learning and teaching processes. This means that the ways in which ICT use might promote student participation and motivation (Gordin & Katz, 2018; Steff-Mabry et al., 2010) tends to be the focus of much research that does not explore whether ICT use fosters cognitive gains for students. In addition to these somewhat limited advantages, negative issues with student ICT use have been identified as plagiarism, as well as technologies becoming distractions from set learning tasks (Sohrabi et al. 2011). Alongside these issues, contemporary students often have access to technology that is newer and less limited than the ICTs used in their classrooms which means that they have greater access to information and other technological resources outside their school environment (Steff-Mabry et al., 2010). This situation would leave room for future research into students' technology use outside rather than inside classrooms.

The formal literature on the topic of ICTs in education debates the benefits and challenges involved in the use of ICTs in classrooms and acknowledges that teachers play a complex and pivotal role in working critically and creatively with educational ICTs (Hennessy et al., 2010). The literature is also clear that a range of factors impact on student uptake of ICTs –for example, teacher competence, creativity and confidence (Hoffmann & Ramirez, 2018; Levin & Wadmany, 2006; Mustafina, 2016). In order to explore these issues further, the authors turn first to an investigation of TPACK, as it examines intersections of technology, pedagogy and content knowledge. In combination with this investigation, the authors employ their own original contribution to this field of literature, a model of DA so that the level of student agency regarding the use of ICTs and digital technologies in classrooms can be explored.

2.1 TPACK

There is a general agreement among researchers in the area of educational ICTs that teachers need to have current skills and knowledge of contemporary technologies to effectively embed technologies in their teaching (Simsek & Sarsar, 2019; Voogt & Roblin, 2010). The competencies framework, TPACK, developed by Koehler and Mishra (2005) enables teachers to interrogate their current approaches to teaching with and about technology as well as assisting with goal-setting, to assist teachers in successfully embedding technologies in their pedagogies and practices (Baran et al., 2011; Kaplon-Schilis & Lyublinskaya, 2020). The TPACK framework identifies three basic forms of knowledge of which teachers using and teaching technology need to be aware: Technological Knowledge, (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). These three types of knowledge intersect, and in the intersections stronger levels of understanding are possible.

The centre of figure one is where the three different types of knowledge come together to form what is called TPACK. In this space, all three elements are working together in an optimal capacity so that students experience appropriately challenging and engaging learning activities. It is the coming together of these three types of knowledge that is important, as having knowledge of these three individual areas separately is not the same as understanding how to combine these elements purposefully together to enhance learning opportunities.

While TPACK is useful for encouraging teachers to think critically about the ways in which they might incorporate ICTs into learning activities (Drummond & Sweeney, 2017), there is some debate concerning the further development of this framework (Archambault & Barnett, 2010; Graham, 2011). What TPACK does not address in any depth is student learning and interaction with ICTs and how they might exercise and demonstrate their agency in this field so that they are able to complete school tasks and build critical thinking and problem-solving skills confidently. To unpack these ideas, the authors first examine the notion of student agency and then turn towards the concept of DA.

2.2 Student Agency

The term ‘agency’ refers to a person’s ability to act independently of social structures and contextual constraints. The theoretical perspectives of Giddens and Bandura are useful in examining the notion of student agency. Giddens has constructed one of the most inclusive contemporary theories of agency that defines the term “as the stream of actual or contemplated causal interventions of corporeal beings in the ongoing process

of events-in-the-world” (Giddens, 1976, p. 75). Bandura (2009) defines agency as “the human capability to exert influence over one’s functioning and the course of events by one’s actions” (p. 8). Bandura (2006) argues that humans negotiate their way through their circumstances, being active participants rather than being completely influenced by their context. This theoretical perspective has had significant implications for further study regarding student agency as it could be used to argue that pupils are not passive recipients of knowledge, and instead flourish when their sense of agency is further developed.

Much has been written about student agency and engagement being crucially important elements of teaching approaches that foster deep learning (Klemencic, 2017; Martin, 2016). In this paper, student (or learner) agency is broadly defined as the level of autonomy and power that a student experiences as part of their education. It is the student’s self-conceptualization of the extent and degree of power they possess regarding their own learning experiences. Student agency is perceived as desirable in classrooms as it is seen to increase motivation, commitment, engagement, and it directly improves learning outcomes (Holdsworth, 2018).

The level of autonomy and power that students experience in a classroom setting can be limited by a range of factors, including the need to prepare students for high stakes testing through scripted curriculum and the types of pedagogy that the teacher employs (Goodman & Eren, 2013). When working with technology, student agency might be influenced by a variety of factors including their own disposition (Bennett & Foley, 2018) and their level of digital literacy (Price-Dennis et al., 2019). In addition, contextual factors like classroom environment and delivery mode also impact on the level of DA a student can experience at any particular time.

Many benefits for students being engaged in learning experiences that cater for a range of individuals have been extolled in the formal literature. Hargreaves (2005) argues that when students become part of the decision-making process concerning their learning, their motivation to learn is increased. The diversity of contemporary classes and the individualised nature of each student’s learning pathways leads to the idea that personalised learning is an important teaching approach that is built on the development of student agency—often in the form of student voice and choice (Deed, 2014). In addition, to develop the skills and knowledge that will equip them to lead fulfilling lives in an increasingly complicated and digital world, students need to know themselves and understand their own learning processes (Wylie, 2012). Thus, student agency is widely perceived to be an extremely desirable element of an education program that seeks to promote autonomous learners in preparation for a diverse, technological, and sometimes uncertain future.

However, the concept of ‘student agency’ is complex and the research in this field can be complicated with contradictions or partial analyses (Arnold & Clark, 2014). For instance, the research can focus on choice, student voice, autonomy and/or motivation as a determinant for student agency (Goulart & Roth, 2010; Sharma, 2007; Ryan & Deci, 2000). In order to move beyond these complications, the authors define ‘student agency’ in this paper as the degree of autonomy and power experienced by a student in a learning environment that leads to learning that is self-directed and self-regulated. The authors argue that an important subset of student agency is ‘digital agency’ (DA) which is the appropriate concept to investigate regarding learner autonomy, choice, and motivation in digital educational settings.

2.3 Digital Agency

While the concept of student agency has been widely discussed and researched, the notion of ‘Digital Agency’ is becoming of concern to theorists and practitioners in response to increasingly digitalised social and education systems (Lindgren & McDaniel, 2012; Passey, et al., 2018; Voogt & Knezek, 2018). Passey et al. (2018) defines DA as understandings and practices that derive from notions of agency where individuals are empowered to adopt and adapt digital technologies safely and wisely. The concept of DA encompasses choice and activity leading to change so that individuals are empowered to use technology responsibly and safely as opposed to feeling disenfranchised by new technologies. Passey et al. (2018) state that DA is “the individual’s ability to control and adapt to a digital world ... through the exercise of digital competence, digital confidence, and digital accountability” (p. 426). According to Passey et al. (2018), people are empowered to exercise DA in their lives when they develop digital skills, digital literacy, and digital responsibility within the broad areas of competence, confidence, and accountability in the digital domain. In this paper, the authors employ Passey et al.’s (2018) concept of DA specifically in the context of classroom use of ICTs with a research focus on secondary school students.

3 Teaching Approaches that Demonstrate Student (Learner) Agency

3.1 Design-Based Pedagogy.

Design thinking is a process where students must identify a problem and determine what effect the issue has in the ‘real world’. Potential solutions are proposed, discussed, and developed to the prototype stage. Prototypes are then tested to determine their relative merits (Smith & Mader, 2017).

Teachers often use design pedagogy to challenge their students in different topic areas in STEM (Science, Technology, Engineering & Mathematics) subjects. Dakenbring et al., (2014) explained the design process that they used with their students which required students to explore the concept of energy transfer in ecosystems. Smith and Mader (2017) describe how a design process can be used in conjunction with a 3D printer to create bridges with the goal of creating a bridge to carry the largest load. These examples highlight how design pedagogy can be used in the classroom, allowing students to build their design skills which can be used in future employment and to develop their ability to exercise agency (Fig. 1).

4 Digital Agency in Educational Settings

This paper expands on Passey et al.’s (2018) notion of digital agency in the construction of a non-linear model (Fig. 2) to identify five categories of DA in school and post-school learning environments. As previously mentioned, our specific definition of DA is *the students’ experience of autonomous technology learning in the classroom*. The authors suggest that DA is essential to scaffold students in their development of digital literacy as well as prepare them for future employment as most careers already use digital technology

Fig. 1 Technological Pedagogical Content Knowledge (TPACK). Reproduced by permission of the publisher, © 2012 by tpack.org (Koehler, 2011)

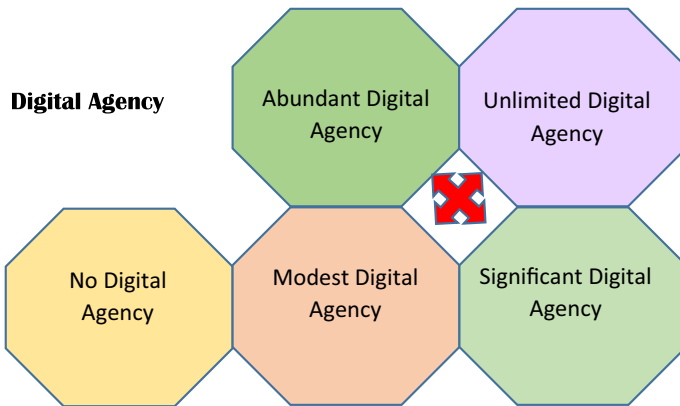
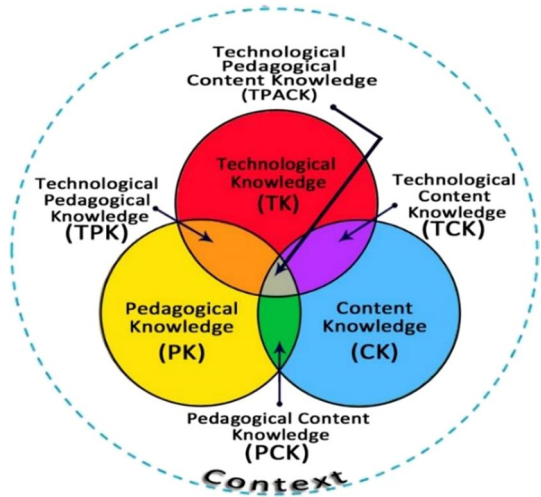


Fig. 2 A depiction of Digital Agency (DA) categories and how they apply to educational settings

in some aspects of their work and this is highly likely to expand over the coming years. While most Australian teachers are using digital technology in their classrooms, the level of autonomy that their students experience can vary considerably.

The authors propose a non-linear and non-hierarchical model (shown in Fig. 2) in which the degree of DA relates to the level of students' autonomy regarding their technological learning in the classroom.

It should be noted that the concept of unlimited Digital Agency might not be appropriate for certain situations. Constraints on the uses of technology might be necessary for the learning goals of a lesson to be met or school rules which limit the use of certain types of technology might need to be considered. For example, unrestricted Internet searches might be more appropriate for adult learners rather than school students under 18 years of age due to the abundance of material in this domain that is inappropriate for minors to access.

By using our model of DA, teachers could enhance their understanding of which activities and approaches encourage the growth of students' knowledge, skills, understanding

of digital technologies, and develop their use of digital pedagogy. This kind of pedagogy is not necessarily based on the use of digital technologies. Rather, digital pedagogies are teaching approaches in which teachers critically evaluate the use of technology in their planning and seek to harness the capabilities of digital technologies to enhance student-centred learning activities and outcomes. It is vitally important that digital pedagogies are not 'tech centric' and that they are chosen with learning goals and the technological means of achieving these objectives in mind.

5 Methodology

This research collected qualitative data to answer the following research question:

How is learning promoted using Information and Communication Technology (ICT) in the classroom?

This research question was then broken down into the following sub-questions.

Which teaching pedagogies are being used in ICT classes and/or classes using ICTs or other digital technologies?

What support do teachers perceive that they need to successfully use ICTs and/or other digital technologies in the classroom?

5.1 Participants

The participants in this study were secondary teachers ($n=13$) and students ($n=23$) from two co-educational secondary schools in regional Victoria, Australia. One of the schools is a private, fee paying school of 430 students in a disadvantaged region of Victoria. The school supports students to gain an education by maintaining a low fee policy and supports 25% of school families with financial assistance in the form of bursaries. In contrast, the other school is a government funded state school with 1509 students also located in an area of socioeconomic disadvantage.

The teachers were recruited by a general request for participants in the project emailed by the researchers. Participant teachers' qualifications consisted of a mix of four year undergraduate degrees and two year Master of Teaching degrees in Education. The participants taught across a broad range of subject areas including English literature and language, Humanities, Mathematics, Physical Education, Design, Science, Woodwork, and Media Studies. One teacher had industry experience in Media and Design. As this group of teachers taught in a wide range of subject areas, the researchers were able to draw upon a broad representation of approaches and strategies in different discipline areas concerning teaching with and about ICTs.

The students at both schools were in their first (Year 7) and third years (Year 9) of secondary schooling. These year levels were targeted so that the researchers could investigate student engagement, self-efficacy and Digital Agency in early to mid-secondary school as current research states that learners tend to become disengaged from ICTs as they enter and progress through high school. Students reflected on and discussed their use of ICTs in all subject areas.

The researchers asked questions to identify which learning activities employing ICTs students enjoyed, disliked, found challenging and what kind of ICT-based activities they might prefer. Questions were also asked about student confidence in their ICT use. Teachers were asked questions about how they use ICTs in their teaching approaches, their

ICT-use confidence levels, and how the use of ICTs might encourage further participation in STEM.

While researchers attempted to attain a gender balance in focus groups, there were more female than male participants which reflected the composition of those classes. Pseudonyms have been used for students and teachers in this paper Table 1.

5.2 Ethics

Ethics approval was gained through the university human research ethics committee (approval number A18-102) as well as the Victorian Department of Education and Training (approved project ID number 2018–003,834) and the private school's board. Teacher participants signed a consent form, while student participants were only allowed to participate if their parents signed a consent form and they agreed on the day of the interview to participate. Participants were able to withdraw from the interview at any time if they did not feel comfortable with the questions asked.

5.3 Procedure

Teachers were interviewed individually using a set of questions designed to elicit information about the research questions. The interviews were held in a private location and were run in a conversational style. Students were interviewed as part of a focus group with an ordered sharing process used for the first few questions to encourage participation from all members of the group. All responses in interviews and focus groups were audiotaped so that the researchers could listen to the interviews more than once. All interviews and focus groups were also transcribed.

5.4 Analysis

The audiotaped interviews were transcribed, and the researchers listened to these recordings, then coded responses by theme. Initially, thematic analysis was explored for the teacher interviews and the student focus groups separately, with commonalities examined after completion of the first round of thematic analysis. Common themes were then explored between teacher and student responses with the reporting of results linked to the themes discovered. Direct quotes from both teachers and students were used to support reported findings on the use of ICTs in the classroom.

6 Findings/Discussion

All teachers interviewed reported that they used Word, Excel and PowerPoint for preparation and administration purposes and in their classes to teach students how to use these ICTs to develop digital literacy skills. The teachers all stated that they felt a significant degree of confidence using these ICTs for class preparation as well as making use of these technologies in various classroom activities and assessment tasks. The majority of teachers commented that the use of ICTs had improved the presentation of their work and decreased preparation time. For example, Tim stated that "It's so much better ... printing things up and using PowerPoint. The kids sometimes struggle to read my handwriting". Another

Table 1 Digital agency – categories and examples

Digital agency category	Description	Example of teaching activity
No digital agency	Students have no autonomy in how technology is used	Teacher delivers a pre-prepared PowerPoint presentation
Modest digital agency	Students have a limited choice in technology available. Students might still have scope to extend their technological skills	Students are required to create graphs in Excel. Students can explore types of graphs that could be used and the presentation of these graphs, therefore having the scope to extend technological skills in a software program
Significant digital agency	Students are given some choices in the technology available and how this technology is used	Students are asked to create a website on a set topic and have a choice of 4 different platforms that they can use
Abundant digital agency	Students have a high degree of choice in how technology is used	Students are required to create a multimedia presentation using at least 3 different types of media and have a choice of 5 different platforms that they can use
Unlimited digital agency	Students have unlimited autonomy in how technology is used	Students are asked to deliver a presentation in any digital format that they wish to use. This would allow students to extend their technological skills

teacher, Denise, talked about using images in her PowerPoints to engage students: “If you can just pop in a little picture or image you can grab their attention”.

Examination of the data demonstrated that ICTs including Word, Excel and PowerPoint were used by teachers and students confidently. However, while teachers considered their use of these ICTs to be beneficial to their preparation and presentation, the majority of students did not see the use of these technologies in the same light. PowerPoint and Word were described as “boring” by students who also stated their disenchantment with using Word – “so boring just typing” and “everything is always typing”. In the activities that Word and PowerPoint were chiefly used – written reports, essays, and exercises as well as presentations – the TPACK rating would be low and the level of digital agency could be classified as ‘Modest’. So, this might mean that even though the use of ICTs like Word, Excel and PowerPoint make a difference to teachers in their preparation and presentation, as they have an understanding of how these technologies have facilitated positive change for them; their students do not have the same historical understanding and prefer more interactive technology use with potentially higher levels of TPACK and DA.

The previously identified findings concerning a difference in the ways teachers and students perceived the use of ICTs also suggest that learning activities promoting the development of technological literacy with a modest level of digital agency can be valuable but need to be used judiciously by teachers. Technological literacy must be developed in culturally appropriate ways, so that not only are learners’ needs met within the classroom but they are also equipped with an understanding of technology that can be used more broadly in their lives (Clausen & Greenhaigh, 2017). In order to promote technological literacy, the authors argue that student learning could be enhanced by the promotion of DA (see Fig. 2). It is vitally important that students experience a sense of agency within their learning so that they can develop their thinking at critical, creative and problem-solving levels, as well as derive deep content knowledge and understanding.

Examples of Significant and Abundant DA were found in classrooms where ICTs were used to stimulate reflective and critical thinking, collaborative learning as well as forming part of the design learning process. For instance, in the English classroom where students used the software Popplet before, during and after a sequence of lessons to create mind maps focusing on their learning, the data revealed a level of Significant DA. This activity relied on one particular ICT but it was used in a visual way so that students were able to employ Significant DA in the display of their critical reflections concerning their learning of the material covered by the unit of work. Research data demonstrated that when students participated in a Design Learning project where they used their mobile phones in a Humanities classroom to record interviews and comments in order to create podcasts, Abundant DA was shown. Drawing on Design Learning principles, the project required students to identify an issue perceived to be a school concern including providing healthy and affordable canteen food and how water waste might be prevented. Students then formulated questions on their chosen topic and interviewed other students and staff. These recorded interviews were edited and formed the basis of the podcasts which were shared with the whole school and the leadership team.

A significant or abundant DA rating and a higher TPACK level were also apparent in situations where students decided to perform their own trouble shooting when problems arose whenever they were using ICTs and in activities including using the 3D Printer as well as designing and developing films in Media classes. The ability to feel confident using a ‘trial and error’ approach to trouble shoot problems with computer applications in a classroom is explained as “let’s say we try shutting it down or closing the program and then reopening it ...I just tap things until it yeah. Then if that doesn’t work, I usually have a look in settings

and stuff, see if something has been knocked automatically” (Todd, student). It appears that some of the young people interviewed have become self-reliant and they discuss how they might “have a play” with the computer to see if they can fix problems before they ask their peers, or before they resort to asking the IT support person. However, another student had the opposite experience and described his reaction to problems on the computer as “I get really sweaty hands when something goes wrong on the laptop. I think I’ve done something wrong, because I’m not too confident in using it” (Fergal, student). These two examples imply that gender alone is not necessarily a strong indicator of general confidence with computers. However, when the group was asked about gender and whether it related to ability with computers, the idea that males tended to play more computer-based games was raised. While the students were all very aware of the limitations of gendered technology-use stereotypes, they, nevertheless, seemed to adhere to these dominant cultural ideas.

Generally there was an expressed hope among the teachers that mandating participation and encouraging engagement in technology-based subjects for all students in Years 7 and 8 would offer a means of producing deep cultural change so that girls and boys would move beyond the gendered stereotypes that tended to offer girls limited scripts for participation in technology-rich subjects. Most of the teachers were explicit in their concern to cater for all students and to offer opportunities for authentic learning activities that engaged students and assisted in the development of DA.

Two further examples of teachers using design principles to develop purposeful and engaging learning activities at the level(s) of significant and abundant DA occurred in the work of Jeff, a design teacher, who focused on the use of the 3D printer and Louise, who taught media studies and design. According to Jeff, the implementation of new software BCarve Pro and Fusion 360 has enabled students to use their own designs to create linoleum prints or other types of artwork or to print their designs on t-shirts or other objects. Jeff stated that students “love it and they understand – because we’re teaching it now in Year 7 ... we’re scaffolding that as they go ... So, when they get to Year 12, they should be confident and can then customise and tailor their own designs”. In this example, the design and implementation of the task encourages a significant level of DA as students use the software to construct their creative artefacts.

In a similar vein, Louise focuses on creating interactive experiences for students where they can use digital media to create films and audio files as well as exploring digital photography and developing websites. Louise states that “there’s lots of technology I use in my resources ... that would be film-making, audio files, smart board interactivity, digital photography, animation and special effects”. One of the assessment tasks in her design course, making a film, could be classified as falling within the significant and abundant categories of DA as they promote students’ agentic behaviours and skills using digital technologies. In this activity, Louise states that the students drive the project of making the film:

someone will be a leader, someone will be a camera operator, they work that out themselves and then they have to set schedules, they have to do storyboarding, shot lists, and all those sorts of things in pre-production. Then they have to go and produce – make the film. Then they have to edit it. That’s a massive thing and it’s a hard thing for a group to work on. ... and basically that’s pretty much working effectively in the screen and media industry (Louise, teacher).

In this instance, significant DA is shown within the particular roles that students individually assumed. Then, abundant DA is shown in the agentic behaviours that students demonstrated in their selection and autonomous use of a range of technologies to edit, produce and arrange a viewing of the film. Finally, students demonstrated an awareness of their own

DA when they wrote reflections on their experiences in order to identify potential strengths and challenges.

Student responses to focus group questions concerning the kinds of activities involving the use of ICTs they found interesting and they felt assisted their development in this area, reflected teacher responses for the most part. These responses indicated an overwhelming preference for technology-rich tasks that were authentic and genuinely catered for student interest.

Being mindful of the research data, the authors argue that the construction of the DA model provides a tool that could be used to increase learner ICT engagement and enhance curriculum development. The project findings indicate that the secondary school student participants are more engaged in learning opportunities with ICTs in activities where they experience autonomy regarding the use of technology. This is an important issue to note as research clearly indicates the steady decrease of student ICT engagement and confidence throughout secondary school in Australia (Thomsen, 2015). Thus, the research project reported in this paper investigates a particular point of need regarding students' use of ICTs in the contemporary Australian schooling system. The authors argue that the use of our innovative model of DA throughout secondary schools, would contribute to the provision of the kind of learning opportunities that would increase students' ICT engagement, confidence, and capability. If our model of DA could be consistently applied across disciplines in secondary schools, it could indicate to teachers the level of student autonomy involved in learning experiences, and therefore, which activities might increase or decrease student ICT engagement, confidence and skill building. In doing so, the DA model could be a useful framework to assist with teachers' planning, curriculum design, and development of pedagogical approaches.

7 Conclusion

Despite the use of ICTs and other digital technology being a priority in schools, the trend towards decreasing student interest and engagement with these technologies continues. In an attempt to gain more understanding of this issue, the pilot project examined in this paper investigated what secondary school students and teachers thought and felt about the use of ICTs in the classroom. It was encouraging to find that all the teacher participants were enthusiastic about ICT use and that they believed that employing technology had greatly improved their presentation and preparation of teaching materials. This indicates an overall confident use of ICTs at the modest level with reference to the model of Digital Agency formulated by the authors and utilized in this paper. While this represents a positive use of, and attitude towards ICTs, further investigation of the findings showed that the classroom activities that promoted the highest levels of student participation and engagement in learning were also those that attained high levels of DA, when rated using our model of DA.

It is important to note that the types of pedagogies and activities that appeared to offer students significant opportunities for the expression of digital agency were in the domains of project-based and inquiry-based learning as well as design pedagogy. Design briefs involving the 3D printer and the making a movie activity opened up opportunities for students to develop their critical, creative and problem-solving thinking further, as well as encouraging the exercising of DA. Within our model of DA, these tasks would be rated as significant and/or abundant. It is of note that our findings concerning the use of these types of activities and pedagogies to foster a student's capacity to think critically and problem

solve, as well as autonomy, is in line with research in this field. This project has expanded upon previous research regarding student agency, critical thinking, and problem-solving skills by the mobilization of the term ‘digital agency’ (DA) and the use of our model of DA.

While the authors recognise that the research this paper is based upon was a small pilot project, the key findings suggest that there is a need for further study in two main areas. First, the concept of Digital Agency may be a useful pedagogical tool for teachers, especially with contemporary moves towards more inquiry- and competency-based learning models in schools. In these models, there is an emphasis on teachers designing authentic learning experiences and assessments that foster student agency, learning, engagement, and allow scope for students’ demonstration of mastery in multiple modalities. Second, the findings suggest that more professional development opportunities could assist teachers to empower their students to use and explore a range of ICTs and other digital technologies in new and creative ways within the classroom, and also later in their post-school adult life.

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