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Teacher educators' and pre-service teachers' preparedness to use ICT: a Western Australian perspective

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Teacher educators' and pre-service teachers' preparedness to use ICT: a Western Australian perspective

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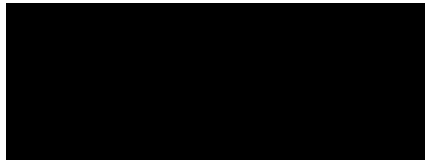
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ABSTRACT

With the ongoing development of the Information and Communication Technology (ICT), a wide variety of devices, software and apps are available that could be used in education. As a result, universities and schools are adopting different policies and strategies for integrating these new technologies. As teachers are a key element in the implementation of educational innovation, teacher educators and pre-service teachers need to be confident in using ICT effectively in teaching and learning.

This study proposed to investigate how teacher educators' and pre-service teachers' integration of ICT in their teaching and learning. A mixed methods design, that included both quantitative and qualitative methods, was employed in this research. Through conducting surveys and semi-structured interviews, the study examined teacher educators' and pre-service teachers' ICT ownership and self-perceived ICT skills along with perceptions of ICT use within the classroom. Document analysis was used to examine the current institutional ICT policies and infrastructure support for teacher educators and pre-service teachers at two of the largest teacher education providers in Western Australia and one Australia's online university.

It is anticipated that this research will have benefits for both teacher educators and pre-service teachers. It is hoped that the research outcomes will have both practical implications for current in-service teachers and students as well as having policy implications for university and future teacher education.

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LIST OF ABBREVIATIONS

ACARA	Australian Curriculum Assessment and Reporting Authority
ACMA	Australia Communication and Media Authority
AITSL	Australian Institute for Teaching and School Leadership
APST	Australian Professional Standards for Teachers
BECTA	British Educational Communications and Technology Agency
BYODD	Bring Your Own Digital Device
CITS	Curtin IT Service
CK	Content Knowledge
CLT	Centre for Learning and Teaching
CSaLT	Centre for Schooling and Learning Technologies
DEEWR	Department of Education, Employment and Workplace Relations
ECU	Edith Cowan University
HE	Higher Education
ICT	Information and Communication Technology
ITE	Initial Teacher Education
LMS	Learning Management System
NMC	News Medium Consortium
OECD	Organisation for Economic Co-operation and Development
OUA	Open Universities Australia
PK	Pedagogical Knowledge
PCK	Pedagogical Content Knowledge
PST	Pre-service teacher
SPSS	Statistical Package for the Social Sciences
TCK	Technological Content Knowledge
TE	Teacher educator
TEMAG	Teacher Education Ministerial Advisory Group

TK	Technological Knowledge
TPACK	Technological Pedagogical Content Knowledge
TPCK	Synthesised Knowledge of Technology, Pedagogy and Content
TPK	Technological Pedagogical Knowledge
TTF	Teaching Teachers for the Future
WA	Western Australia

DEFINITION OF TERMS

Graduate teacher	Beginning teacher teaching school students
Lecturer	Any university academic staff
Pre-service teacher	Student in Education Faculty at university
School student	Primary, secondary and high school student.
School teacher	Teacher teaching school students
Student	Any university student
Teacher educator	Lecturer teaching pre-service teachers

Chapter One: Introduction

Overview

This study investigated how teacher educators perceive and use Information and Communication Technology (ICT) in teacher education and the perceptions of pre-service teachers towards integrating ICT in their future teaching practices and their use of it for their current studies.

According to Mlitwa (2005), in the educational context, ICT refers to educational technology related to computers, communications and the internet. ICT has had significant impact on both teaching and learning processes. Vajargah, Jahani, and Azadmanesh (2010) stated that ICT is used to improve efficiency in teaching and learning processes, increase motivation and deepen understanding. Furthermore, learning environments that utilise technologies display many advantages. Tondeur, Cooper, and Newhouse (2010) described the advantages that ICT can bring to learning environments including "investigation of reality, knowledge building, active learning, authentic assessment, engagement, student productivity, higher level thinking, learning independence, collaboration and cooperation, learning styles, and physical disabilities" (p. 300).

Education systems around the world are adopting different policies and strategies for integrating ICT into education. However, the potential of ICT in education has not been completely realised (Moonen, 2008). In order to effectively integrate ICT into teaching and learning, a number of factors need to be taken into consideration. According to Venkatesh, Thong, and Xu (2012), characteristics such as age, teaching experience and gender have been found to influence teachers' application of ICT. A lack of ICT pedagogical knowledge is also one of the main barriers to ICT integration in teaching (Chai, Koh, & Tsai, 2013). As teachers have always been the key factor in the practice of any educational innovation, it is necessary to explore the current situation in teacher education with regard to ICT use.

Schools of Education in universities upgrade their education programmes and renovate classroom facilities in order to benefit from ICT and enhance the quality of teacher education (Dixit & Kaur, 2015). With the development of new technology, a variety of devices and applications (apps) can be used in education. Thus, teacher educators and pre-service teachers need to be confident in using ICT effectively in their teaching and learning.

Although institutions frequently upgrade their computer hardware and software, improve the network and introduce new digital devices to integrate ICT in the education system, the problem is whether the teacher educators and pre-service teachers are fully prepared for this integration. Since teacher educators are the trainers of future teachers, their use of ICT in training will influence pre-service teachers' perception of their future use of ICT in the classroom. Therefore, it is of primary importance to investigate teacher educators' and pre-service teachers' perceptions of the technology and its use in education by examining their ICT ownership, self-perceived skills and the skills they need to further develop. This information should provide implications for future teacher education.

This study was an extension and enhancement of an ongoing project started in 2008, carried out at Edith Cowan University (ECU) examining ECU pre-service teachers' ownership, ICT skills and use of ICT. Therefore, some findings and modified instruments from this project have been used to guide this study.

Background of the study

Teacher education in Australia

In relation to initial teacher education (ITE) programmes in Australia, the Australian Institute for Teaching and School Leadership (Australian Institute for Teaching and School Leadership, 2011) (AITSL) highlighted the dual improvement and accountability agendas, stating that national accreditation of initial teacher education programmes has two key objectives:

> • *improving teacher quality through continuous improvement of initial teacher education, and*
>
> • *accountability of providers for their delivery of quality teacher education programs based on transparent and rigorous standards and accreditation processes.*
>
> *By contributing to teacher quality, national accreditation of initial teacher education programs will help to achieve the national goals for schooling expressed in the Melbourne Declaration on Educational Goals for Young Australians endorsed by Ministers in December 2008. (Australian Institute for Teaching and School Leadership, 2011, p. 3)*

ITE programmes are offered in 48 institutions in Australia, and mainly in public universities. There are a number of ways to becoming a school teacher in Australia. Most pre-service teachers undertake four-year programmes, which lead them to a Bachelor of Education. Others can choose graduate programmes if they are eligible, which might be a Graduate Diploma of Education or a Master of Teaching programme. These programmes vary from 12 to 24 months full-time study, offered in a teacher education institution, or in an intensive programme with employer support, such as Teach for Australia (2014).

The accreditation of ITE programmes in Australia is governed by AITSL. The two core frameworks, which are the Australian Professional Standards for Teachers (Australian Institute for Teaching and School Leadership, 2011) and the Accreditation of ITE Programmes in Australia: Standards and Procedures (Australian Institute for Teaching and School Leadership, 2012) are important in this process. These standards ''make explicit the knowledge, skills and attributes of graduates of nationally accredited programs'' (Australian Institute for Teaching and School Leadership, 2011, p. 3). Focusing on the graduate level, the Technological Pedagogical Content Knowledge (TPACK) framework guided the Teaching Teachers for the Future (TTF) Project which sought to enhance graduate TPACK confidence and capabilities in Australian ITE programmes (Jamieson-Proctor, Albion, Finger, Cavanagh, Fitzgerald, Bond, & Grimbeek, 2013).

Since 2012, all modes of initial teacher preparation have been subject to national accreditation. The Australian Government believes that teacher quality is essential to the future generation and school education. Consequently, there is increased

accountability of ITE programmes to develop pre-service teachers who are better prepared. To illustrate, a Teacher Education Ministerial Advisory Group (TEMAG) was established in 2014 to provide advice to the Australian Government on ''how teacher education programmes could be improved to better prepare new teachers with the practical skills needed for the classroom'' (Teacher Education Ministerial Advisory Group, 2014, p. 2).

The importance of developing graduate TPACK capabilities through quality ITE programmes is evident in the Teacher Education Ministerial Advisory Group Issues Paper (Teacher Education Ministerial Advisory Group, 2014) which stated that, ''In 2012, there were around 76,000 domestic pre-service teachers enrolled in these programmes—62,000 in undergraduate programmes and 14,000 in postgraduate programmes'' (p. 5). Thus, it is critically important that ITE programmes develop pre-service teachers who have the TPACK capabilities to use technologies to support teaching and student learning.

Teacher Education institutions in Western Australia

At present, there are five institutions and one online education provider offering teacher training in Western Australia (WA). The five institutions are Edith Cowan University (ECU), Curtin University, University of Western Australia (UWA), Murdoch University and The University of Notre Dame Australia. Open Universities Australia (OUA) is an online higher education organisation providing online courses including teacher education. These universities offer four-year Bachelor of Education (B.Ed.) courses for early childhood, primary and secondary teacher education, and one-year Graduate Diploma of Education programmes.

This thesis looks at teacher education from a Western Australian perspective with the three biggest providers in WA being two physical institutions and one virtual institution (OUA). ECU and Curtin University are the two largest teacher education institutions in Western Australia, with a large number of education students, professional teacher trainers and advanced technological support.

Edith Cowan University (ECU) is a large university, with more than 27,000 students (Edith Cowan University, 2016). Its School of Education is the largest in Western Australia, with approximately 3000 students. It is also the oldest, with more than 100 years of experience in teacher training and education since 1902 when the Claremont Teachers College was established, which was the first education institution of higher education in Western Australia. Five other teacher training colleges, including Graylands Teachers College (GTC), the Western Australian Secondary Teachers College (WASTC), Nedlands College of Advanced Education (NCAE), Mount Lawley Teachers College (MLTC) and Churchlands Teachers College, were formed into the Western Australian College of Advanced Education (WACAE) in 1982. In 1991, Edith Cowan University was formally established from WACAE. ECU offers courses in Early Childhood, Primary and Secondary Teacher Education. Graduates from ECU have won the annual WA Education Awards. Its education programme has been named in the world's top 250 for four years in a row. Moreover, ECU has established partnerships with other international education universities to conduct courses and programmes (Edith Cowan University, 2019b).

Curtin University was granted the university status from the Western Australian Institute of Technology (WAIT) in 1986. As one of the leading universities in Western Australia and a member of Australian Technology Network (ATN), Curtin is famous for its academic and practical research, especially combining technology with the academic fields. Since 1975, the School of Education has offered courses that encourage students to learn teaching theory and practice in an innovative way by using technologies (Curtin University, 2019b). Curtin also offers online learning platforms such as Massive Open Online Courses (MOOCs) and is a part of Open Universities Australia (OUA). OUA allows students to complete education courses online in a short time with online support and services including access to its online learning system at anytime and through different devices and apps, and learning resources provided by experienced teacher educators (Open Universities Australia, 2019).

OUA is a consortium of 16 Australian universities providing various online courses globally. OUA teacher education courses are provided though Curtin university. However, for the purposes of this thesis OUA will be treated as a separate case to that of Curtin university as its students are drawn from across Australia (not just WA) and its staffing and policies vary from its host institution. Thus OUA while providing similar teacher education courses to Curtin is in fact a separate entity which in fact competes with its host institution, and has different entry requirements etc.

The focus of this study is to find out the extent of ICT application in two Western Australian universities and an online education platform providing teacher education in WA. Firstly, ICT policies and technological infrastructure support and ICT service for teacher educators and pre-service teachers have been investigated by analysing paper documentation such as ICT policies and regulations from the university homepage websites. The second aim of this study was to assess the teacher educators' and pre-service teachers' ICT ownership, self-perceived skills and ICT use. In particular, it aims to estimate the hardware ownership and software skills of both teacher educators and pre-service teachers. Lastly, this study focuses on how ICT is applied in the teaching and learning processes of the universities. Based on an analysis of this data the study reveals the way teacher educators' apply ICT in teacher training and pre-service teachers' perceptions of using ICT in their learning and future classroom teaching.

Significance

This study investigated and analysed current ICT support for teacher educators and pre-service teachers, their ICT ownership, skills, and application in teaching and learning. It is anticipated that this research will have benefits for both teacher educators and pre-service teachers. Furthermore, it is hoped that the findings will have an academic impact on teacher training and an effect to school education. It is anticipated that this research, through a better understanding of the use of technology by both teacher educators and pre-service teachers, will provide guidance for improving teacher education in universities, which will be mutually beneficial for teacher educators and

pre-service teachers. Should this research result in teacher educators and pre-service teachers using technology more effectively in their classroom teaching, then the quality of school education will be enhanced. Finally, this study provides information not only for educators, Higher Education leaders, policy makers and technologists, but also may be useful for guiding institutions in their research and development structure regarding ICT literacy and capacity building in education and training. It is hoped that the research outcomes will have both practical implications for current pre-service and in-service teachers as well as having policy implications for universities and future teacher education.

To date, little focus has been given in the literature to teacher education programmes regarding their use of ICT. A considerable number of studies can be found that focus on pre-service teachers' perspectives and classroom practice with ICT in Australia, but relatively few studies focus on the teacher educators' perspectives of using ICT in teacher education programmes. Understanding teacher educators' perspectives of ICT in education is important because educators will then know the extent to which ICT is being integrated in teacher education in Australia. Additionally, few studies investigated both teacher educators' and pre-service teachers' perceptions of using ICT in teaching processes. This study explored that gap and examined teacher educators' and pre-service teachers' ICT ownership, self-perceived skills, and observed how ICT has been applied in teacher education programmes in Western Australia.

Thus it is hoped that the research will inform policy and direction of schools of education in WA as they move towards a Bring Your Own Digital Device model of ICT integration. It will deliver a perspective on student use of, and preferences regarding, ICT in teacher education courses. This insight will enable us to better understand the ICT capabilities and preferences of students that study Education, in addition to this it is expected that the outcomes from this research will have significance for those who recruit and teach in teacher education, including insights into the ICT based pedagogies that are most likely to be effective when working with these students.

Research questions

This study investigated ICT application in teacher education and identified whether there was an incongruity between teacher educators and pre-service teachers in ICT ownership, skills, and application in teaching and learning. The over-arching research question for this study is:

How do teacher educators and pre-service teachers use ICT in teaching and learning within the context of the support provided by the institutions?

The subsidiary questions that follow from the over-arching question are:

1. What are teacher educators' ICT ownership, self-perceived ICT skills, and use of ICT in their teaching?

2. What are pre-service teachers' ICT ownership, self-perceived ICT skills, and use of ICT in their learning?

3. What are the universities' ICT policies and support for teacher educators and pre-service teachers?

4. Are there any synergies and differences in terms of ICT ownership, self-perceived ICT skills and use between teacher educators and pre-service teachers?

Structure of the thesis

The whole thesis consists of eight chapters, which are Introduction, Literature Review, Methodology, Edith Cowan University Case Study, Curtin University Case Study, Open Universities Australia Case Study, Cross-case Analysis, and Conclusions.

Chapter 1 provides the background information and indicates the significance and rationale of the study. The Initial Teacher Education programmes and the context of the three education institutions in Western Australia have been put forward following up with the significance of the study and the introduction of research questions.

Chapter 2 begins with a brief overview of research that demonstrates the advantages of integrating ICT into education, and reveals the barriers to this integration. Because teachers have played an important role in the successful uptake of ICT in

education, articles that show how teachers utilise ICT have been reviewed and summarised. The TPACK framework has been found and indicated that TPACK was a critical framework to guide teachers' implementing ICT in education. When specified in ICT application in teacher education programme, teacher educators' and pre-service teachers' integration of ICT in their teaching and learning have been reviewed. Only several articles related to teacher educators' application of ICT, which was the gap and part of the research been doing in this study. That was the reason why this research focused on how teacher educators and pre-service teachers apply ICT in teaching and learning in the context of the institutional policy and support.

Chapter 3 discusses the methodology used in this study, how this research has been designed and how the data have been collected and analysed. It also presents the validity and reliability of the research and the ethical considerations.

Chapters 4, 5 and 6 present the findings of each case study. These chapters focus on in details regarding the teacher educators' and pre-service teachers' hardware ownership, self-perceived software skills, and use of digital devices and software in their teaching and learning. Each university-specific section, summarises how ICT been integrated in the relevant university.

Chapter 7 combines the results of teacher educators and pre-service teachers from the three universities to present the commonalities and differences between the three universities. It indicates how teacher educators and pre-service teachers in Western Australia use ICT in teaching and learning within the context of the support provided by the institutions. It also summarises the key findings at the end of the chapter.

The final chapter (Chapter 8), the researcher answers and discusses the research questions, points out their limitations and makes suggestions for further research.

Chapter Two: Literature review

Introduction

This chapter focuses on previous research related to the application of Information and Communications Technology (ICT) in education and teacher education. Firstly, the broad meaning of ICT is considered, followed by the advantages of using ICT in education and the barriers that impede teachers' application of ICT. Following this is a discussion of how ICT is applied in school education and teacher education, which provides the reason for investigating teacher educators' and pre-service teachers' ICT ownership, skills and use. Additionally, Australian ICT policy and technical support are examined. Finally, the conceptual framework for the current study is presented.

ICT: Terms and definitions

ICT is a term that includes any communication device or application, that is used for accessing, gathering, manipulating, communicating, creating, disseminating, storing, and managing information. With the advent of the internet, the World Wide Web, and the improvement of social media, the term "Information Technology" (IT) was merged with telecommunications into the more modern terminology, "Information and Communications Technology" (ICT) (Alexander, 2008). Another area for consideration when discussing ICT is digital technology. This includes the following: design; technologies which enhance students' design thinking; and technologies for generating and producing designed solutions for current, authentic, and future needs and opportunities. Computational and design thinking, as well as technical skills enhance the creation of solutions and information (Australian Curriculum and Assessment Reporting Authority, 2014). Scholars sometimes refer to ICT and digital technology as just technology, particularly in the United States of America.

On a broader basis, technology refers to all the technologies and the related devices involved in the management and processing of information systems. For example, some of the technological devices most important in education are computers, mobile phones, digital cameras and interactive whiteboards (Finger, Jamieson-Proctor, Cavanagh, et al., 2013). Other technological devices and software used in education are iPads, and web-based resources, such as the World Wide Web, blogs, podcasts, and wikis.

In this research, the term ICT refers to hardware devices (desktops, laptops, smart phones, tablets, printers and scanners etc.) and some widely used software, such as Microsoft Office, applied by teacher educators and pre-service teachers in their classroom teaching and learning.

Teachers should be educated appropriately to integrate these devices for adapting the curriculum for the future teaching and learning. Also policies and frameworks are being developed to promote sustainable changes in pedagogical practices as well as to evaluate ICT application and integration in educational institutions (Cerratto-Pargman,

Järvelä, & Milrad, 2012; Mishra & Koehler, 2009; Rodríguez, Nussbaum, & Dombrovskaia, 2012).

In practice, ICT integration into teaching and learning is the pedagogical employment of ICT to facilitate learning in finding and applying information, solving problems, communicating ideas effectively and providing a greater degree of independent learning (Mumtaz, 2000). The integration involves the use of ICT not only to enhance teaching but also to facilitate and improve active learning (Jung, 2005). The next section will discuss how ICT has been applied in education, more specifically, what are the advantages and barriers of integrating ICT into education.

ICT application in education

General introduction

Over the decades the use of ICT in education has not only developed rapidly but has also become an important part of the modern education system with its impact on teaching (Kihoza, Suhonen, Vesisenaho, & Tukiaianen, 2014). Several advantages of ICT enhanced learning have been mentioned in the literature and the importance of the effective use of technology for education has been discussed (Bottino, 2004; Cartwright & Hammond, 2007; Kellner, 2006).

Technology is widely used in education (Kopcha, 2012). Therefore, understanding how to improve the utilisation of technology in the classroom is a topic frequently studied in research (Kim, Kim, Lee, Spector, & DeMeester, 2013; Miranda & Russell, 2012; Wang, Hsu, Campbell, Coster, & Longhurst, 2014). There have been many studies that have argued that ICT should be integrated into education because it can enhance the teaching and learning processes (Bottino, 2004; Smeets, 2005; Volman & van Eck, 2001; Smeets, 2005; Butcher, 2010; Siemens & Tittenberger, 2009; Mintz, Branch, March, & Lerman, 2012; Park, 2011; Sharples, Taylor, & Vavoula, 2010; Zweekhorst & Maas, 2015; Mai, 2015).

The importance of ICT in education is supported by different researchers. They argue that ICT can help to create a more transformative learning environment for

students through active, self-directed and constructive learning (Bottino, 2004; Smeets, 2005; Volman & van Eck, 2001). For example, Bottino (2004) argues that ICT as a tool a communication media, can help to improve teaching and learning processes. It has been pointed out that ICT provides interactive learning environments by using multimedia software and simulations "…that combine text, image, sound, animation, and video" (Volman & van Eck, 2001, p. 78) to present real-life situations from which learners can work actively (Smeets, 2005). Additionally, Smeets points out that ICT can allow learners to visualise and manipulate abstract or complex concepts of the curriculum.

Over the recent years, technological innovations have become more prominent. The web 2.0, mobile smart phones and tablets, social networking services, and portable digital ICT devices have given individual users greater control over information creation and sharing (Butcher, 2010; Siemens & Tittenberger, 2009). The later innovations of web development (3.0-5.0) have not yet to be adopted by most higher education institutions in Australia. At the time of this study are still using an LMS as a delivery platform. In developed countries, the use of mobile devices with wireless internet has enabled teachers and students to seamlessly access and use online content and applications without time and space limitations (Mintz, Branch, March, & Lerman, 2012; Park, 2011; Sharples, Taylor, & Vavoula, 2010).

Research undertaken by Bakar and Mohamed (2008) showed that ICT could provide new opportunities for students to interact with knowledge, accessing information, improving critical thinking and problem solving skills, and transforming classrooms into more student-centered teaching and learning environments. The use of ICT in instruction can also enhance academic performance of students. Zweekhorst and Maas (2015) conducted an experiment, which demonstrated that ICT use resulted in more participation in the classroom and a deeper understanding of the content knowledge. Mai (2015) stressed that ICT could be used to engage students in an active learning environment and motivate them to study.

Although some countries are still at the initial stage of applying ICT in education, its potential in education cannot be ignored. Thus, governments and universities in developed countries such as Australia have invested heavily in computers and technological infrastructure for integrating ICT into education systems. However, the issue is no longer only about fixed ICT infrastructure with the all-pervasive nature of technology and the sheer variety of devices that students are bringing to school and campus.

Barriers of integrating ICT into education

Research reveals that ICT tends to have a positive impact but may have a neutral or negative impact on teaching and learning if not appropriately used (Cartwright & Hammond, 2007; Cox & Marshall, 2007; Moonen, 2008; Warschauer, Knobel, & Stone, 2004). Similarly, it has been observed that ICT does not "automatically add quality to teaching and learning or lead to a better education system. It is possible to use them for trivial purposes, to waste students' time" (Boakye & Banini, 2008, p. 1).

While many countries have been using technology in education for a long time, ICT has not always been as effectively applied as expected (Gosper, Malfroy, & McKenzie, 2013). Research findings have shown that although many teachers acknowledge the advantages of using ICT, they cannot optimise these benefits and integrate them into their teaching (Cox, Preston, & Cox, 1999; Pedretti & Mayer-Smith, 1999; Zhao & Cziko, 2001). An American national survey (Gray, Thomas, & Lewis, 2010) indicated that ICT had been used in administration in schools more than in actual teaching practice. Even in teaching practice, the ICT usage level was found to be relatively low and limited to a narrow range of applications, such as word processing (Mai, 2015; Waite, 2004).

Much research has been done to determine the barriers to completely integrating ICT into education. Razak (2003) associated factors with access to internet, ICT training and technological support. Wong (2002) suggested that gender, age and experience were additional factors in determining ICT use. However, Lin and Williams

(2015) indicated that gender did not influence teachers' implementation of technology but their value and attitudes towards technology and abilities in solving problems are the key points. According to Nikolopoulou and Gialamas (2013), factors such as lack of support, training, facilities and resources were the main reasons why technology had not been effectively integrated into education.

Liu and Pange (2015) summarised barriers into two types. First-order barriers were lack of hardware, teaching content and material, and pedagogical models, while the second-order barriers included teachers' lack of enthusiasm and support. Pelgrum (2001) identified similar factors, but further emphasised ICT knowledge and skills and pedagogical skills. Johnson et al. (2016) also indicated that digital literacy was one of the barriers that was widespread in higher education. However, this report also suggested that this challenge could be solved, and institutions were planning to integrate digital literacy in their curriculum objectives and teacher training programmes. Tondeur, van Keer, van Braak, and Valcke (2008), found barriers that could have a significant effect on the use of ICT. These barriers were ICT planning, support and training, and ICT policies that were usually underdeveloped.

Teachers are central to ICT integration and are considered as a key point to the effective implementation of ICT in the education system. However, teachers are not yet ready for this integration technically and pedagogically. The study done by Al-Awidi and Aldhafeeri (2017) involved 532 public school teachers and found that barriers related to technical support and time limit lead to lack of teacher preparedness. Other researchers have investigated barriers teachers face when applying technology. Mumtaz (2000) pointed out barriers that could prevent teachers from using ICT effectively, which were the teachers' ICT experience, ICT support for teachers, guidance of using ICT for students, lack of ICT expert teachers and the time required to integrate technology into the curriculum and financial support.

Rogers (2000) divided barriers into external and internal to teachers. Meanwhile, Alshemmari (2015) also found that the use of ICT was influenced by external and internal barriers which may prevent teachers from integrating ICT in their teaching

practice. Ertmer and Ottenbreit-Leftwich (2012) similarly separated barriers that prevent technology integration into two categories: first-order and second-order barriers. These categories were similar to Rogers' external and internal barriers. First-order barriers referred to barriers external to teachers, such as resources and training. Second-order barriers described barriers related to teacher beliefs and attitudes about educational technology as well as technological knowledge and skills. In other words, first order barriers are those beyond the teachers' control, while second order barriers are barriers created by teachers themselves, such as attitudes, confidence, and competence (Akcaoglu, 2008; Al-Sulaimani, 2010). For the purposes of this review, these factors are further explained under the following headings: first order (external) barriers and second order (internal) barriers.

First order (external) barriers

Snoeyink and Ertmer (2001) indicated that first order (external) barriers include lack of technology infrastructure (hardware and software), lack of technical support, access to computers and the internet respectively, insufficient time, ineffective training, and limited resources. Semenov (2005) further pointed out that the technological equipment cost can be considered as first order barrier.

According to Rogers (2000), external barriers were categorised into three groups: availability and accessibility, technical and institutional support, and stakeholder development. Barriers related to availability and accessibility included access to useful, relevant, and appropriate hardware and software, and the need for quality software and hardware. Technical and institutional support barriers included ICT services and specialists, technical support, low levels of administration support and lack of funding. Finally, stakeholder development barriers were lack of time for individual and institutional development.

Ertmer and Ottenbreit-Leftwich (2012) pointed out that even more efforts put on first order barriers, it did not lead to more effective technology integration in the classroom. They indicated that some teachers were able to achieve high levels of integration even with few resources (high first-order barriers). However, "teachers with

many resources but strong traditional beliefs have been observed to limit their students' technology uses" (Ertmer & Ottenbreit-Leftwich, 2012, p. 177). They further explained, "This is not to suggest that a lack of technology resources cannot act as a gatekeeper, but that teachers with strong beliefs in the pedagogical value of technology have been observed to overcome these barriers" (p. 177).

Second order (internal) barriers

By contrast, second order (internal) barriers are focused on teachers' preparedness and willingness to change (Khan, Hasan, & Clement, 2012). As Al-Mofarreh (2016, p. 57) pointed out, "second order barriers to ICT integration in classroom are more directly related to human stakeholders in the integration process". P. Rogers (2000) considered teacher attitudes and perceptions as the source of internal barriers. She observed that the difference between early technology adopters and other teachers was the perceived potential and benefits of technology. Selwyn (1997) pointed out that teacher unwilling to change was because of technology anxiety. Their ICT skill level, beliefs and attitudes toward the technology play an important role in their acceptance of it. Other research on barriers to educational technology use follow a similar emphasis on teacher beliefs and attitudes about educational technology (Hokanson & Hooper, 2004; Karmeshu, Raman, & Nedungadi, 2012; Norum, Grabinger, & Duffield, 1999; Norum & Lowry, 1995; Oncu, Delialioglu, & Brown, 2008) and contextual barriers (Cuban, Kirkpatrick, & Peck, 2001; Fisher, 2006; Karmeshu et al., 2012; Norum et al., 1999).

The factors described above demonstrated that, although external factors are relevant and important, the central driving force to integration is the individual teacher. As Zhao and Frank (2003) illustrated:

> *To summarize, although there are many possible influences at multiple levels of the educational hierarchy, two factors ultimately determine the degree and types of computer use by teachers: (a) the nature of the uses, and (b) the result of the teacher's analysis of the uses. All other factors contribute to these two. In other words, most factors do not directly influence technology uses in a linear fashion; rather, their influence is mediated or filtered by teachers' perceptions.* (p. 817)

Norum et al. (1999) similarly described:

Leverage comes from the individual . . . The individual teacher must be willing to make changes in teaching strategies, scheduling, and allocation of time. The individual teacher must be willing to take risks, be a model and mentor to peers, [and] educate others on issues related to the integration of technology in the classroom. (p. 202)

Furthermore, Taylor (2003) argued that positive teachers' attitudes towards the use of ICTs were essential to the effective ICT integration into teaching and learning. He pointed out that attitudes towards the use of ICT include ICT usefulness, ICT confidence, ICT anxiety, and ICT liking. Teo (2009) found significant relations between ICT attitudes, ICT experience and ICT confidence. He observed that teachers with more ICT experience showed more positive attitudes, and the availability and accessibility to ICT could attribute to higher levels of ICT confidence and positive ICT attitudes. Furthermore, research also showed that teachers' ICT experience relates positively to their perceived usefulness of ICT use for teaching and learning (Hammond, Reynolds, & Ingram, 2011; Kreijns, Van Acker, Vermeulen, & Van Buuren, 2013; Smeets, 2005; So, Choi, Lim, & Xiong, 2012). It is evident that the more the experience a teacher has in using particular ICT, the more likely that they are to show positive attitudes towards ICT innovations (Kreijns et al., 2013). Therefore, previous use of related ICT resources improves the teachers' perceived knowledge and skills to use any other ICT innovation hence their positive attitudes. Consequently, appropriate interventions to promote a positive attitude towards pedagogical ICT integration should consider teachers' professional development in the pedagogical use of ICT resources.

As Buabeng-Andoh (2012) pointed out, successful implementation of educational ICT interventions in schools largely depends on the teachers' support and attitudes. Several other studies (British Educational Communications and Technology Agency, 2004; Drent & Meelissen, 2008; Guo, Dobson, & Petrina, 2008; Mumtaz, 2000) also indicated the factors that influence successful integration of ICT into teaching, such as teachers' perceptions and attitudes towards ICT (Buabeng-Andoh, 2012; Cox, Cox, & Preston, 2000; Keengwe, Kidd, & Kyei-Blankson, 2009; Mumtaz, 2000; Somekh & Davis, 1997). If teachers perceive particular ICT resources as neither fulfilling their needs nor their students' needs, they are unlikely to integrate them into their teaching

and learning (Buabeng-Andoh, 2012). Cox et al. (2000) analysed and identified a range of factors that contribute to teachers' motivation to use ICT. They suggested that more attention should be given to factors that motivate the teacher to use ICT more in their teaching.

However, the studies further revealed that the teachers' individual personalities have a significant influence on their perceptions and attitudes towards their use of ICT in teaching and learning (Rogers, 2004). Correspondingly, Cheon, Lee, Crooks, and Song (2012), Teo (2012) and Moss, Hamilton, White, and Hansen (2014) suggest that if a teacher's personality is extroverted and conscientious, she or he is more likely to integrate ICT in teaching than a personality that is nervous and cautious about change.

Similarly, Peralta and Costata (2007) observed that teachers' practical ICT competence and pedagogical and personal factors contributed to their confidence in ICT use. Furthermore, Romeo, Lloyd, and Downes (2012) noted that opportunities to work and practice ICT, get support from experienced teachers and professional development were the key positive conditions for improving teachers' confidence in ICT usage. The next part will present more detailed discussion on how ICT has been used by teachers and students in school environment.

ICT application in school education

ICT has been utilised in our society for decades and the new generation of students were born and grew up with technology. However, students may still need schools to teach them to use technology for the future. Teachers may have limited confidence in using technology that improves specific skills and teaches students abstract and complex concepts (Kafyulilo & Keengwe, 2014). It is important that both teachers and students update their ICT knowledge and skills (Stefl-Mabry, Radlick, & Doane, 2010).

Students and teachers have different levels of competencies in the use of ICT. Sleezer, Russ-Eft, and Gupta (2014) defined competency as "knowledge, skill, attitude, or behaviour that enables a person to perform effectively the activities of a given occupation or to function to the standards expected in employment" (p. 146). van Braak,

Tondeur, and Valcke (2004) defined ICT competence as the ability to handle a wide range of varying ICT applications for various purposes. Basically ICT competency means being able to use the technology effectively. In this study, ICT competence refers to the level of understanding, and skill that a teacher educator or a pre-service teacher has in the use of certain ICT applications.

The Horizon Report identified several significant challenges that schools might be confronted with (Johnson et al., 2013). The most essential challenge was digital literacy. However, the report found that schools did not assist students to develop and make use of the digital literacy skills across the curriculum. Wang et al. (2014) found that teachers were likely to use technology to solve their own academic/curriculum problems rather than allow students to use technology to solve academic problems. As indicated in the Horizon Report, formal training for teachers was not sufficient, and basic training in digital-supported teaching techniques was inadequate.

School students' ICT application

Eynon (2009) discovered evidence that home was the primary source of ICT engagement. Recent Australian statistics (Australian Bureau of Statistics, 2012) also demonstrated that 82% of households had computers and 79% had internet access. The research demonstrates clearly that most students have access to technology at home. Morgan (2012) found that students possessed a high skill level in the use of Web 2.0 tools for learning. Pullen also pointed out that "students who used ICT at home more frequently tended to use the same technologies at school and were more confident users" (2012, p. iv). However, Abbott, Blakeley, Beauchamp, Cox, and Webb (2004) argued that "using informal settings (home, etc.) can contribute to the learning experiences of pupils, but many pupils have not yet integrated such uses with their school experiences" (p. 47).

In Australia, the importance of students' ICT skills and capabilities was recognised in the Australian Curriculum. The Ministerial Council's paper (2008) recognised that "rapid and continuing advances in information and communication technologies are

changing the ways people share, use, develop and process information and technology."
(p. 5). In this digital age, students need to be familiar with using ICT and this was recognised in the Australian Curriculum ICT General Capability, which states that:

> *Students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. The capability involves students in learning to make the most of the digital technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment.* (Australian Curriculum Assessment and Reporting Authority, 2013, pp. 47-50)

However, some specific issues about school students' ICT use in the Australian Curriculum have been raised by Phillips (2015). He indicated that nearly half of Australian secondary school students were failing to meet minimum digital literacy standards. In 2014, just 55% of students in Year 6 achieved expected standards among the 10,500 students who have been assessed on their ICT knowledge, understanding and skills. Fifty two percent of students in year 10 were considered competent. There was a 6% and 13% decrease for years 6 and 10 respectively over the last three years.

School teachers' ICT application

Undoubtedly, teachers play a crucial role in the successful uptake of ICT in education. They have always been the key stakeholders in the utilisation of any educational development and innovation (Archibong, Ogbiji, & Anijaobi-Idem, 2010). As Rana (2012) stressed, ICT may not be successfully integrated into education if teachers are unwilling to use it in their teaching practice even if they have been equipped with sufficient ICT infrastructure. Moreover, teachers are important to the integration of ICT in education because teachers' ICT skills and attitudes can significantly affect their methodology and students' technological skills and attitudes (Paraskeva, Bouta, & Papagianni, 2008; Pelgrum, 2001; Torkzadeh, Chang, & Demirhan, 2006; Zhang, 2007). Previous research indicated that teachers' lack of ICT competence was a main barrier to their adoption and integration of ICT (Al-Oteawi,

2002; Pelgrum, 2001). Significantly, findings of recent studies support and extend this assertion by revealing that teachers' ICT competence is significantly related to their attitudes (Kim, Choi, Han, & So, 2012; Lin, Wang, & Lin, 2012; Prestridge, 2012), which supports previous theoretical and empirical arguments for the importance of ICT competence in determining teachers' attitudes toward ICT integration in teaching (Baker, Al-Gahtani, & Hubona, 2007; Cheon et al., 2012; Teo, 2012). It suggests that the previously discussed teachers' characteristics or their confidence and attitudes towards the use of ICT innovations could be influenced by their respective levels of ICT competence.

Peralta and Costata (2007) provide evidence that supports this assumption. They have done research about primary school teachers' competence and confidence level in five European countries. They believed that a teacher with more experience with ICT resources had greater confidence in their ability to use them effectively. A teachers' high ICT competence improves their perceived knowledge and skills to use any other ICT innovation, which leads to their positive attitudes.

Age would be one of the reasons for affecting teachers' ICT competence. An evaluation by the Department of Education and Training in Western Australia (2006, p. 22) on teacher ICT competence found that a relationship existed between age and ICT competence. As the age of the teacher increased, the average ICT competence decreased. The research highlighted that most teachers had a lower ICT competence compared to their students. Figure 2.1 illustrates that a teacher could have an average ICT competence difference of up to 22% less when compared to an average student in their class. The figure demonstrates as the age of the teacher raises from 24 the ICT competence decreases.
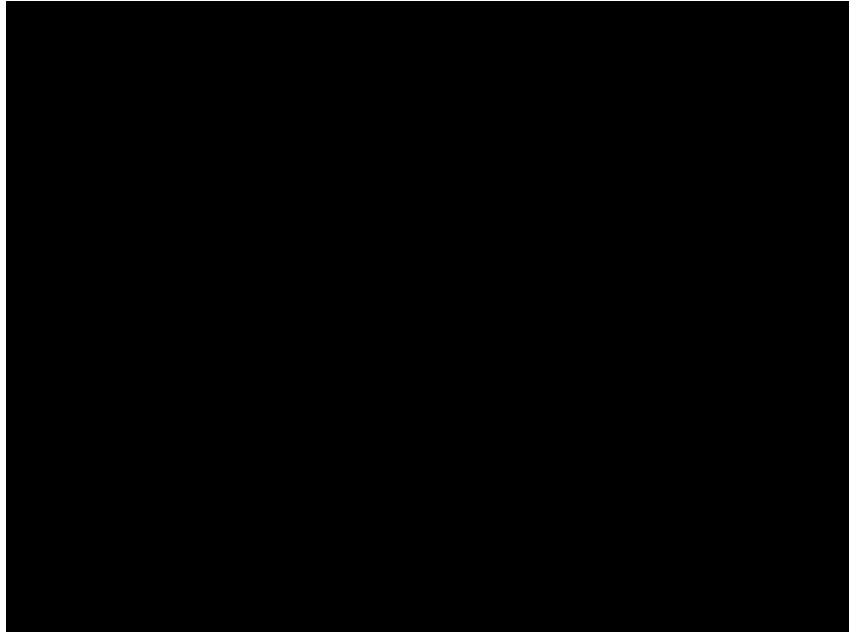
Figure 2.1 ICT competence index by age for Western Australian teachers

Research conducted by the Australian Communications and Media Authority (ACMA) (2011) also found a generational shift in the use of technology especially social media. It revealed that as people increased in age the less inclined they were to use online media. Figure 2.2 emphasises this view point, which shows that as the age rises,
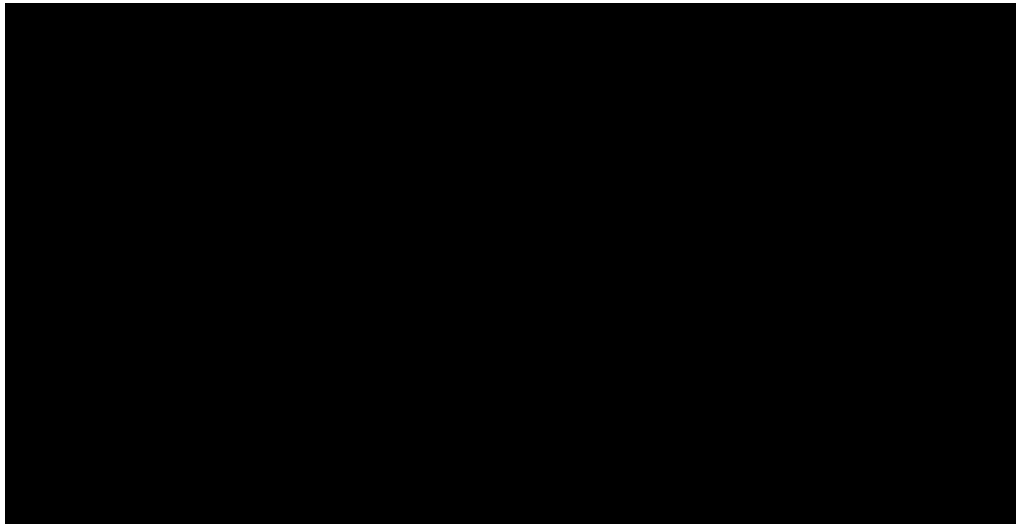
Figure 2.2 Summary of responses concerning the social media activities by age

TPACK

To understand the body of knowledge surrounding this study, the researcher conducted a literature review that included the theoretical framework TPACK as well as factors that relate to technology and its integration.

The technological pedagogical and content knowledge is the framework primarily designed around three central components: PK, CK, and TK. The TPACK framework, as shown in Figure 2.3, is built from Shulman's (1986) understandings of pedagogical content knowledge (PCK) and developed by Mishra and Koehler (2006), which combines teachers' content, pedagogy and technology knowledge together and provides a framework to describe the interactions between these three domains and a method for teachers to integrate ICT into teaching practice (Jamieson-Proctor et al., 2013; Romeo et al., 2012). Looking at the intersection of these ideas gives researchers a way to begin to understand the abilities of teachers to effectively use technology.

As TPACK is a widely used construct that has made significant impacts on classroom technology research (Koehler, Shin, & Mishra, 2011), the TPACK model is presented in Figure 2.3.
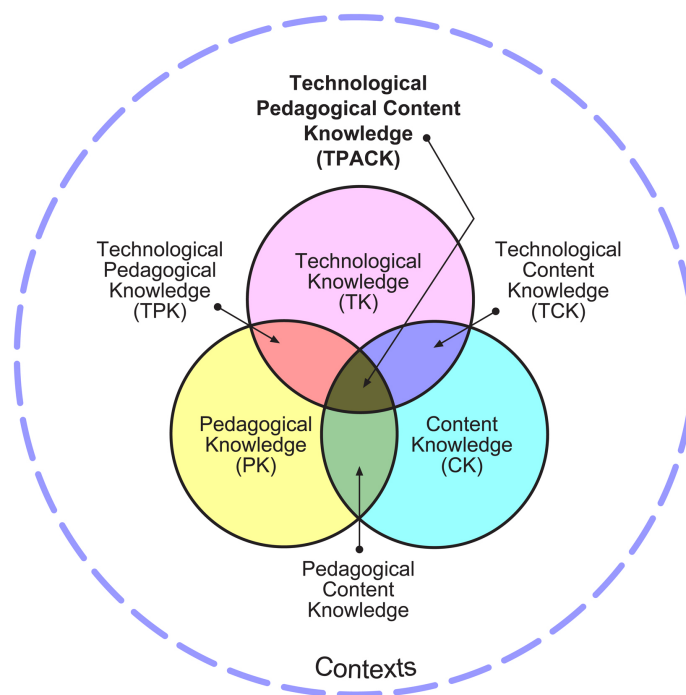
Figure 2.3 TPACK model

As shown in Figure 2.3, the diagrammatic presentation contains three main bodies of knowledge, which are Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK). CK varies from different disciplines because it is content-based. PK emphasises that teachers should learn strategies to construct and evaluate students' learning in classroom. Teachers' TK is different from time to time

because of the advent of new technologies. Therefore, it is important for teachers to continuously update their technological knowledge. The intersections between the three parts are Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK). Mishra and Koehler (2006) defined PCK as the teaching methods that fit the specific subjects. They stated that a teacher with PCK should know how to find different ways to arrange the content knowledge for better teaching. TCK defined to require teachers to choose the suitable technology according to the characteristics of different subjects because technology and content would interact with each other. According to Mishra and Koehler (2006), TPK is used to reveal how teaching and learning can change by using particular technologies. Finally, TPACK framework was proposed in order to underline the necessity of enhancing teachers' ICT skills.

Several studies indicated that pre- and in-service teachers were unwilling to change their teaching methods (Barak, 2007) and they used technology as a tool instead of combining it with pedagogical knowledge (Lloyd & Albion, 2009; Mishra & Koehler, 2006). This could lead to their failure of integrating technology into teaching (S. Liu, 2012; Maddux & Cummings, 2004; Moursund & Bielefeldt, 1999; Selinger, 2001). This failure has been discussed in DEEWR (2009) funded by the Australian Government's Department of Education, Employment and Workplace Relations (DEEWR). Furthermore, 55 publications between 2005 and 2011 reviewed by Voogt, Fisser, Pareja Roblin, Tondeur, and Van (2013) found that teachers' understanding of the importance of integration was a significant factor in determining teachers' uptake of technology in their teaching practices. The next section will discuss ICT application in teacher education, more specifically, how teacher educators and pre-service teachers use ICT in their teaching and learning.

Teacher Education

One of the most important teacher-based factors for ICT integration point to teacher training and preparation because it is perceived as the base of most of the

teacher-centred factors that affect teachers' attitudes towards ICT integration in their teaching. Lack of encouragement of pre-service teachers to use ICT by teacher educators in teacher training (Dunn & Ridgway, 1991; MacDonald, 2008; Wild, 1996) and lack of ICT experience and training in pre-service learning (Goktas, Yildirim, & Yildirim, 2009; Sang, Valcke, Braak, & Tondeur, 2010) coupled with lack of resources or lack of access to resources in initial teacher training institutions (Sang et al., 2010; Taylor, 2003; Wild, 1996), have been considered as the main reasons for unsuccessful ICT integration. Hew and Brush (2007) considered teachers' professional ICT development as important for both pre-service and in-service teachers. However, the rapidly changing nature of ICT requires more than skill-based training. Although teachers may have ICT skills, they still may not be able to consider using ICT in teaching and learning if their values and expectation regarding ICT use for teaching and learning are neither addressed nor appreciated.

Pre-service teacher education has an important role in ensuring that teachers are fully prepared to use ICT and develop their ICT pedagogy before teaching in schools (Jimoyiannis & Komis, 2007). If ICT is effectively integrated into the teacher education programmes, pre-service teachers would bring that experience to their school teaching (Vrasidas, 2015). The challenge for teacher education programmes is to provide systematic instruction in the effective use of ICT to support teaching and learning (Goktas et al., 2009). A qualified school teacher should be able to plan and design effective learning environments using ICT (Chai, Koh, Tsai, & Tan, 2011). Teacher education programmes should help pre-service teacher knowing how to design and implement curriculum plans for applying ICT in teaching. Pre-service teachers usually bring their learning experiences into their teaching, which means that they teach the way they were taught in university (Romeo et al., 2012). Teacher education programmes are expected to not only offer a course in training ICT, but they should also ensure that teacher educators model how to integrate ICT in their teaching (Chai et al., 2011). The challenge for teacher educators is to demonstrate effective ICT integration practices within a tertiary environment (Redmond & Albion, 2005).

ICT application in teacher education

Pre-service teachers' ICT application

ICT skills are regarded as a key point for university students (including pre-service teachers) using ICT in learning. Figure 2.4 shows the ICT skills required for graduate teachers (The University of Sydney School of Education and Social Work, 2019). It indicates that ICT skills such as building animations, using interactive whiteboards, using excel, etc. were needed for their future school teaching.

However, results were found in DEEWR (2009) where it was reported that Australian pre-service teachers had limited ICT skills in word processing and PowerPoint, and their skills did not improve while they were at university. Gosper et al. (2013) also indicated in their research that university students (including pre-service teachers) presented low-levels of ICT skills. Surveys conducted from 2010 to 2014 in Western Australia indicated that although 50% of the pre-service teachers at ECU were competent in a variety of computer skills (email, online learning, word processing, and social media), they were still weak in some skills such as video editing (Pagram, Cooper, Vonganusith, & Gulatee, 2015). This is not only the case for internal students, many students who are studying online are in same situation. For example, Blackley and Sheffield (2015) indicated in their research that B.Ed. students studying online through Open Universities Australia (OUA) also had been found not competent in using some Web 2.0 tools such dropbox and most of their ICT skills were self-taught. Finger, Jamieson-Proctor, and Grimbeek (2013) pointed out that many pre-service teachers were not fully prepared for teaching with technology because they had insufficient ICT skills. Yusuf and Balogun (2011) stressed the importance of developing ICT literacy training programmes for pre-service teachers. Therefore, the Teaching Teachers for the Future (TTF) Programme was created. This programme will be discussed in more detail in the National ICT policies section.

Browse by task

To find tutorials for a particular teaching task, browse the table below.

	Purpose	Type
	Animating diagrams in PowerPoint	Lesson preparation
	Building web animations	Lesson preparation
	Compiling a mark book	Administration
	Conducting a lesson using interactive whiteboards	Teaching and learning
	Conducting a presentation to stakeholders	Communication
	Conducting a presentation in class	Teaching and learning
	Conducting an online class or discussion	Teaching and learning
	Creating a quiz on PowerPoint using buttons and hyperlinks	Teaching and learning
	Creating a school newsletter or newspaper	Communication
	Creating a school publication	Communication
	Creating a talking book	Teaching and learning
	Creating a WebQuest	Lesson preparation
	Creating a worksheet	Lesson preparation
	Downloading images from the Internet	Lesson preparation
	Drawing a chart	Lesson preparation
	Drawing a table	Lesson preparation
	Inserting a video into a PowerPoint presentation	Lesson preparation
	Inserting pictures into an existing document	Lesson preparation
	Lesson notes	Teaching and learning
	Mail merge to create certificates	Teaching and learning
	Mail merge to create letters to parents	Communication
	Teaching students to write a report	Teaching and learning

Figure 2.4 ICT skills for graduate teachers

A series of surveys conducted in the School of Education at ECU from 2007 revealed that pre-service teachers' ICT ownership had changed as new technologies

were developed. For instance, students in School of Education were mainly using desktops and laptops with Microsoft Windows operating systems in 2007, while in 2014 there were more choices for computers with different systems and tablets such as the iPad had been introduced. In the 3G era, mobile devices have become more involved in assisting learning (Cooper & Pagram, 2009b; Pagram & Cooper, 2011, 2012, 2013; Pagram, Cooper, & Campbell, 2008; Pagram et al., 2015). Therefore, future teachers need to improve their ICT literacy and universities should provide more teaching and learning support.

Teacher educators' ICT application

Teacher education programmes play critical roles in preparing pre-service teachers for effective technology integration in their classrooms (Cochran-Smith, 2003; Foulger, Graziano, Schmidt-Crawford, & Slykhuis, 2017). Teacher educators play a key role and can be considered important stakeholders in preparing and enhancing pre-service teachers' ICT integration. Teacher educators should act as role models in the successful application of technology even it is a challenge for them (Liu, 2016; Ping, Schellings, & Beijaard, 2018). Several studies revealed that teacher educators' lack of ICT competency was one of the barriers in integrating technology into teacher education programmes (Uerz, Volman, & Kral, 2018). DEEWR (2009) also indicated that teacher educators' self-taught skills cannot satisfy the ICT skills that pre-service teachers need. As described in the research done by Peeraer and Van Petegem (2011), word processing and presentation software are frequently used by teacher educators while more sophisticated applications such as simulations are seldom used. This will be a problem because teacher educators who do not have sufficient ICT skills cannot properly train pre-service teachers.

Another problem for teacher educators is they need to choose the suitable technology and implement it effectively into teaching (Ellis & Goodyear, 2010). Therefore, teacher educators need to have a full understanding of TPACK (Foulger et al., 2013). However, preparing pre-service teachers for using educational technology is a complicated process (Aslan & Zhu, 2016; Ottenbreit-Leftwich, Ertmer, & Tondeur,

2015; Uerz et al., 2018). Teacher educators need to help pre-service teachers develop their ability to integrate ICT in teaching and learning processes.

There have been several publications regarding concerns with teachers' ICT application and some addressing pre-service teachers. Many researchers have focused on pre-service teachers' characteristics but less is known about the role of teacher educators. Only a few studies explore teacher educators' ICT application (Chowdhury, 2012; Reading & Doyle, 2013). Few studies have investigated teacher educators' ICT ownership and little is known in this regard although all teacher educators have access to significant technology through their workplaces. The ownership of technology is an essential part of future research as it is likely to be indicative of teacher educators' level of ICT literacy and will influence how they integrate technology into teaching.

Apart from the teacher educators' and pre-service teachers' ICT application, ICT policy and support is also important for the ICT integration.

ICT policy and support

ICT policy acts as a blueprint in education providers' implementation and teachers' integration of ICT because schools are able to describe their own expectations, goals, contents and actions concerning the implementation of the interventions and integration of the ICT provisions. This allows education providers to use ICTs in order to improve teaching and learning based on their own ICT vision, professional development, curricula strategies, planning and evaluation (van Braak & Goeman, 2003). Several studies suggest that school based professional development and ICT curricula strategies provide teachers with guidelines to support their instructional decision making and lesson planning processes for the use of the available ICTs in raising quality and enhancing learning (Bingimlas, 2009; Karagiorgi & Charalambous, 2004; Lim & Khine, 2006; Q. Wang & Woo, 2007). Vanderlinde, Dexter, and van Braak (2012) indicated that ICT policy acts as a standard for successful ICT integration. Kozma (2005) pointed out that investigate ICT policy is a crucial step towards the practical implementation of

the integrated use of ICT in education. National strategic ICT policies are important in providing a framework for ICT integration (Jhurree, 2005).

National ICT policies

This section presents national policies related to ICT in education and includes, the Teaching Teachers for the Future (TTF) Project and the Australian Curriculum.

TTF

Based on the Australian Professional Standards for Teachers (APST) in 2013, teachers should comprehend professional ICT skills and put them into teaching practice (Lloyd, 2014). The Teaching Teachers for the Future (TTF) Project was created because of the educational dilemma and crisis among Australian teachers.

The TTF Project was a 15-month long, $8 million project, funded by the Australian Government's ICT Innovation Fund and involving 39 Australian ITE providers. The aim was to train future teachers to better utilise ICT in the classroom (Department of Education & Employment and Workplace Relations, 2013) and to improve the ICT proficiency of all graduating teachers in all Australian teacher education institutions (Department of Education & Employment and Workplace Relations, 2013; Romeo et al., 2012).

Although more focus has been placed on training pre-service teachers' ICT skills, little effort has been made to help them know how to embed ICT in teaching. Thus, the TTF programme, with the TPACK framework, was designed to enhance pre-service teachers' TPACK capabilities. A survey was used to evaluate pre-service teachers' TPACK capabilities and to examine their pedagogical changes with applying technology (Jamieson-Proctor et al., 2013). It focused on ''systematic change in the ICT proficiency of pre-service teachers in Australia by building the ICT capacity of teacher educators and developing resources to provide rich professional learning and digital exemplar packages'' (Australian Government, 2010, p. 1).

Finger, Jamieson-Proctor, and Grimbeek (2013) further explained that the key point of the TTF project was for teacher educators to enhance pre-service teachers'

TPACK capabilities. Because pre-service teachers' ICT literacy and application of ICT will influence their students, they need to have adequate ICT skills and set a good example for their students (Bamigboye, Bankole, Ajiboye, & George, 2013). Therefore, these skills must be developed in teacher education programmes.

In the same way as pre-service teachers, most tertiary level teacher educators are not fully prepared for teaching with ICT (Drent & Meelissen, 2008). Although these teacher educators are training pre-service teachers to embed ICT into education, they are also struggling to successfully implement ICT in their own teaching practice (Swennen & Klink, 2009). Therefore, it is necessary to examine current teacher educators' and pre-service teachers' ICT integration.

Implementing the TTF involved a complex process of building the ICT capability of teacher educators, training pre-service teachers, rethinking the teaching of integrated ICT, redesign teacher education course, developing and implementing integrated ICT capabilities into individual subject areas and institutional collaboration (Heck & Sweeney, 2013; Masters, Carolan, & Draaisma, 2013; Zagami, 2013).

The Australian Curriculum

The Australian Curriculum addresses ICT through the ICT general capability and the digital technologies subject. The ICT general capability helps students to become effective users of ICT. The digital technologies curriculum assists students to become confident digital technology users and developers. The curriculum requires students to learn about applying social and ethical protocols and practices when using ICT and managing and operating ICT (Australian Curriculum and Assessment Reporting Authority, 2014).

ICT capability is a special case of technological capability (Kimbell, 2004). It is not just skills and knowledge of specific hardware and software. It is the ability to use knowledge, skills and dispositions towards ICT to perform relevant tasks and solve problems. As Newhouse (2013) stated:

> *Information and communications technology (ICT) capability refers to the capacity to use*
> *ICT appropriately and ethically to investigate, create and communicate ideas and*

information in order for individuals to function effectively at home, at school, at work and in their communities. (Australian Curriculum and Assessment and Reporting Authority, 2012, p. 30)

As indicated in the school students' ICT application section, students' ICT skills were decreasing (Phillips, 2015). Phillips pointed out that the new digital technologies curriculum was not working for ICT in schools for four reasons. Firstly, usually the new digital technologies curriculum will take too long to become fully embedded in schools, which will contribute to the students struggling to meet the basic minimum standards. Secondly, teachers were not equipped with the skills they needed and given enough professional support to understand how digital technologies can be used effectively in the classroom teaching. The third reason was there was too much choice of digital tools to use. Lastly, teachers' skills were out of date.

Technical Support

Besides teacher educators' and pre-service teachers' ICT skills, the level of ICT support that a university provides also affects ICT application. It is obvious that technologies and online access supplied in a university are vital for supporting teaching and learning practices. This technological support includes infrastructure such as computers, software and the internet, as well as ICT staff providing a support service for teacher educators and pre-service teachers (Dix, 2007). Niemi (2003) defined good technological infrastructure as up-to-date devices and fast network connections, which can satisfy teacher educators' and pre-service teachers' needs. In order to implement ICT into the classroom, universities have invested substantially in technological infrastructure to support teaching and learning.

Apart from the infrastructure, ICT staff and services are also important in supporting teaching and learning. Universities hire IT staff to provide services for teacher educators and pre-service teachers. They also employ technicians to provide technological support and hire specialists to support in e-labs, help with multimedia and offer ICT services such as repairing computers and improving teacher educators' ICT literacy. Additionally, internet access is also vital for integrating ICT with teaching and

learning. Teacher educators and pre-service teachers can access their computers via both Ethernet and wireless in universities. At Edith Cowan University in Western Australia, over 50% of pre-service teachers make use of university wi-fi (Pagram et al., 2015).

Despite evidence of a substantial level of services and support, ICT support problems are still identified as one of the major obstacles of integrating ICT in university. For example, limited availability of equipment or specific software in university was identified as one of the reasons for the ineffectiveness of embedding ICT in teaching and learning (DEEWR, 2009). Difficulty in connecting laptops with the internet was blamed for a low percentage of students accessing university wi-fi (Cooper & Pagram, 2009a). For example, students using laptops with some specific operating systems may have difficulties connecting to the internet. As the price of technology devices has decreased, equipment is not a problem for universities in developed countries such as Australia. However, other problems still exist among lecturers and university students. The research done by Gosper et al. (2013) suggested that the level of institutional support depends upon the institutions understanding of lecturers' and university students' expectations. They conducted surveys at three Australian universities, the results of which showed that half of the students were not satisfied with the facilities and services that universities provided, with lack of power outlets and internet speed being the main deficiencies. Liu (2016) found similar obstacles and suggested software availability was still an issue even when the university kept upgrading their infrastructure.

With the development of new technology, more portable devices can be used in higher education. At ECU a Bring Your Own Digital Device (BYODD) policy was considered to encourage pre-service teachers to bring their own devices to the university for their studies. On the one hand, it brings advantages such as accessing devices without time and place limits, and reduces the support that universities need to provide thus saving funds (Johnson, Adams, & Hall, 2015). On the other hand, because of different operating systems used in different devices, it raises questions about what ICT

infrastructure and services the university should provide for lecturers and university students. Newhouse, Cooper, and Pagram (2015) highlighted the implications of this approach in the article *Bring Your Own Digital Device in Teacher Education:*

> *There are many implications for university infrastructure, such as increased WiFi coverage and density, and more power outlets around campus, including classrooms, near outside seating, coffee shops, and library. It is likely that in the short term some specialist computer laboratories may still be needed where, for example, more powerful processing is needed. Additional forms of technical support are needed and may be provided online, and through self-service kiosks such as at NIE [Singapore's National Institute of Education].* (p. 71)

Most universities in Australia provide the learning management systems (LMS) such as Blackboard for supporting teaching and learning (Smithers, 2009). This provides benefits for both lecturers and university students, including easy access and tracking of results without time and place limits, quick feedback and time-saving (BBC Active, 2010). However, Heirdsfield, Walker, Tambyah, and Beutel (2011) indicated in their study that lecturers and university students have different preferences for using functions in Blackboard and both have difficulties in using some functions. Researchers further explained by giving examples, for instance, lecturers seldom used video/audio recorded lectures because it wasted time and decreased student attendance, while most of the university students preferred this function because it saved time and benefited off-campus students. Additionally, lecturers had difficulties in using some learning tools such as discussion forums, wikis, AV chat, and announcements and also found difficult to maintain student interaction in blogs. These differences and difficulties suggest that universities should take both lecturers' and university students' preferences into consideration when providing technological support. Teacher educators also need to know university ICT policy and pre-service teachers' ICT preference and capabilities in using various devices (Newhouse et al., 2015). As a result, it is critical that universities provide support such as improving network speed and increasing ICT support.

For school education, technical support is also essential because it affects school teachers' integration of ICT. Several research studies indicate that access to ICT

infrastructure and resources in schools is essential for teachers to integrate new technologies into education (Bingimlas, 2009; British Educational Communications and Technology Agency, 2004; Granger, Morbey, Lotherington, Owston, & Wideman, 2002; So et al., 2012). Effective adoption and integration of ICT into teaching depends mainly on the availability and accessibility of ICT resources. If teachers cannot access the ICT resources, then they will not use them (Buabeng-Andoh, 2012). Therefore, access to relevant, adequate, updated software and hardware are key elements to successful adoption and integration of ICT interventions.

British Educational Communications and Technology Agency (2004), Lin et al. (2012) and Tezci (2011) found that teachers were reluctant to use ICT because of fear of equipment failure and absence of ICT technical support. Lack of proper set up, service, maintenance and technical advice on the use of ICT resources interrupts the teaching and learning process and classroom activities. Teachers are likely to be easily frustrated with any technological problem in the use of ICT and tend to not use them regularly or effectively (Tondeur et al., 2012). These could lead to teachers' negative perceptions about the use of ICT. Therefore, technical support and maintenance are an important element in implementing ICT in education.

In addition to the aforementioned teachers' integration of ICT, the current study investigates whether teacher educators and pre-service teachers have been fully prepared in integrating ICT in their teaching and learning. This research also explores teacher educators' and pre-service teachers' ICT ownership, skills and use in the context of ICT policy and support provided by the university.

Conceptual framework

As a result of the literature review the conceptual framework shown below in Figure 2.5 has been developed.
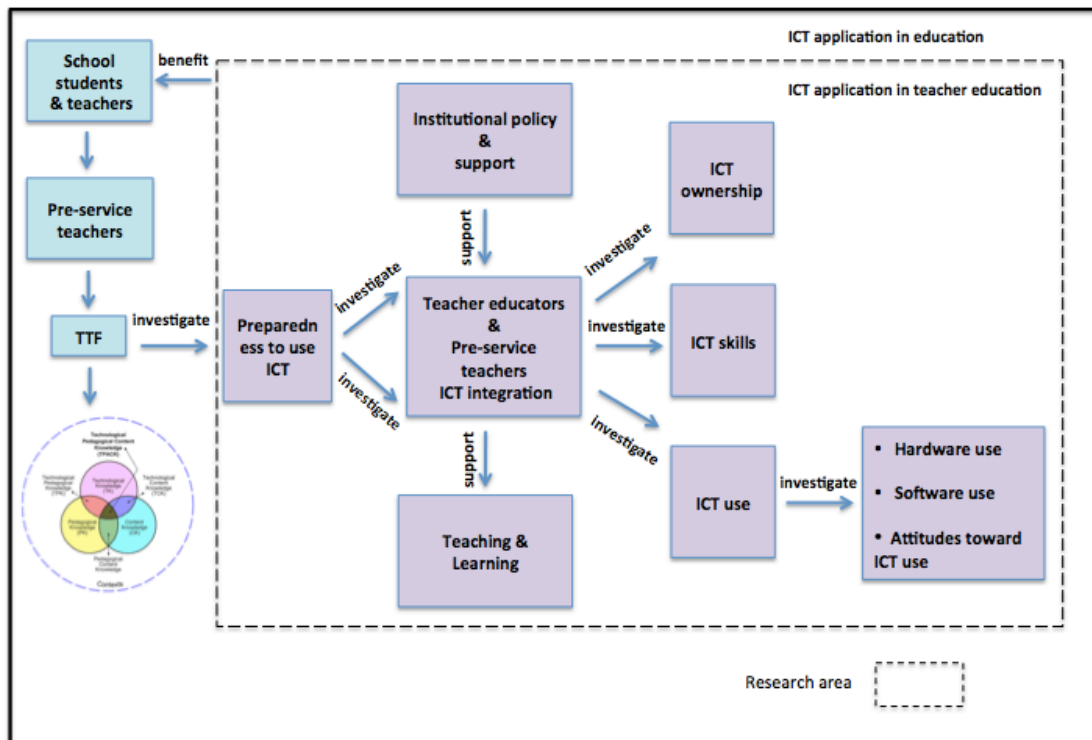
Figure 2.5 Conceptual framework

The first part of the framework illustrates that the university provides an environment, including ICT policies and support for both teacher educators and pre-service teachers. These policies and support combine with the ICT capabilities of the teacher educators (reflected in their ICT ownership, skills and use) to produce learning activities, created by the teacher educators, and participated in by the pre-service teachers. In creating and running these activities the teacher educators will utilise their TPACK. Meanwhile pre-service teachers will develop perceptions and make value-judgments regarding the ways in which ICT has been used in their classes and this will contribute to their own developing TPACK. Finally, when they graduate, these pre-service teachers will implement ICT to a greater or lesser degree in their classrooms, depending upon their perceptions and TPACK. The purple squares represent the part of the conceptual framework addressed by the research questions.

Summary

To sum up, little published research concerns itself with teacher education and only a few studies explore teacher educators' ICT application in training pre-service teachers (Chowdhury, 2012). Additionally, teacher educators' perspectives of ICT can dramatically affect their students' technological skills and attitudes (Paraskeva et al., 2008; Pelgrum, 2001; Torkzadeh et al., 2006; Zhang, 2007). Furthermore, there is a gap between the support that universities provided and expectations of teacher educators and pre-service teachers. As a result, this study will investigate the current institutional ICT policies and support for teacher educators and pre-service teachers; their respective ICT ownership, skills, and use in teaching and learning at three universities in Western Australia. This will facilitate an investigation into how teacher educators' use of ICT in teacher education and what are pre-service teachers' perceptions of integrating ICT in their future teaching practices. Hence, this study seeks to address how teacher educators and pre-service teachers use ICT in teaching and learning. The research design and approach will be discussed in the following chapter.

Chapter Three: Methodology

Overview

This chapter describes the methodology used in this study. The chapter begins by introducing the study's research questions, then presents the mixed-methods research design used and its underlying rationale, which incorporated both quantitative and qualitative data collection methods. This is followed with a detailed account of the implementation of the study, including participants, instrumentation, data collection procedures and methods of analyses. The final section deals with the issues of validity and reliability, ethics and issues of trustworthiness. The chapter concludes with a short summary.

Research questions

This study sought to answer: *How do teacher educators and pre-service teachers use ICT in teaching and learning within the context of the support provided by the institutions* through answering the following research questions.

1. What are teacher educators' ICT ownership, self-perceived ICT skills, and use of ICT in their teaching?

2. What are pre-service teachers' ICT ownership, self-perceived ICT skills, and use of ICT in their learning?

3. What are the universities' ICT policies and support for teacher educators and pre-service teachers?

4. Are there any synergies and differences in terms of ICT ownership, self-perceived ICT skills and use between teacher educators and pre-service teachers?

Research design and rationale

The overall aim of this study is to investigate the current ICT ownership, skills and use by teacher educators and pre-service teachers in pre-service teacher education within the context of the support provided by the institution. This study utilised a pragmatic research paradigm (Mackenzie, 2006) and was conducted in Schools of Education at two of the largest universities and one online higher education institution in Western Australia (Edith Cowan University, Curtin University and Open Universities Australia).

Pragmatism was developed from the research done by Peirce, James, Mead, and Dewey (Cherryholmes, 1992). As a practical philosophy, it avoids choosing a particular position (epistemological or ontological) and instead it places the focus on research problems and questions rather than particular methods (Creswell & Plano Clark, 2011; Ihuah & Eaton, 2013; Saunders, Lewis, & Thornhill, 2009). Creswell (2014) pointed out that a variety of approaches could be used in order to solve a given research

problem in practical way. In line with a pragmatist approach, this study uses a range of different methods, techniques, and procedures to investigate the research questions.

The overarching method employed was a quasi-ethnographic multiple case studies research design with quantitative and qualitative data collection through surveys, interviews and document analysis. A mixed methods design was employed in this study for two major reasons. Firstly, the mixed-methods research design allowed for the use of both quantitative and qualitative methods of data collection within a single stage or across various stages of the research process. The statistical nature of the quantitative approach is not ideally suited to "gain an overview of complicated social process" (Rubin, 1983, p. 348). Rather, it is preferable to adopt a qualitative method to "uncover the layers of truths from different perceptions of a situation by different individuals or group members" (Rubin, 1983, p. 343) and generate an in-depth understanding of the problem.

Secondly, the flexibility of mixed-methods design allows for the adaptation of different methods (Creswell, Goodchild, & Turner, 1996) and the triangulation of research results from both quantitative and qualitative data ensure the reliability of the results. Therefore, the mixed-methods research design was considered suitable for exploring a deeper understanding of teacher educators' and pre-service teachers' ICT ownership, skills and use in teacher education programme. These strengths and relationships are illustrated in the upper part of Figure 3.1.

Three universities in Western Australia comprised the case studies for this research. The use of multiple case studies in the research design enhanced the study of ICT conceptualisation, the implementation structure of ICT within universities and teacher educators' and pre-service teachers' practices and experiences in their natural setting and helped to generate explanations from practice. Case studies enabled an understanding of the nature and complexity of the processes taking place within the classrooms and the wider contexts in implementing and the integration of ICT for instruction. They were also an appropriate way of researching ICT integration in

universities, an area where previous studies are limited. Through an in-depth contextual study, the study was able to reveal existing dilemmas, tensions, and organisational gaps.

As the lower part of Figure 3.1 illustrates, having multiple case studies of each university facilitated investigation of the basis of differences between the individual entities, as well as highlighting the areas of congruence. These features enabled cross-case analysis for richer knowledge-building and helped to establish both broader and deeper understanding of the phenomenon. This would have been more difficult to achieve while focusing on a single case.

The multiple cases studies for this research involved three universities in Western Australia since the conceptual framework locates ICT integration activity as the interaction between teacher educators and pre-service teachers in the context of institutional policy and support that should be studied within an integral system (the teacher education system). While universities could be cases for this research, the objective of the study was to reveal how teacher educators and pre-service teachers use ICT in teaching and learning within the context of the support provided by the institutions. Having universities as cases of this study could have limited the study to the teacher educators' and pre-service teachers' ICT integration and their classroom practices.

The structure of the research design is represented in Figure 3.1. This figure presents an overview the scope of the mixed-method approach and the relationship of its various elements. It also shows the three case studies and their components. The differences between the different entities are highlighted as well as the areas of overlap. Finally, it shows how the case studies contribute to the operation of the mixed-method approach adopted in this study.

Part 1: Scope and elements of research design
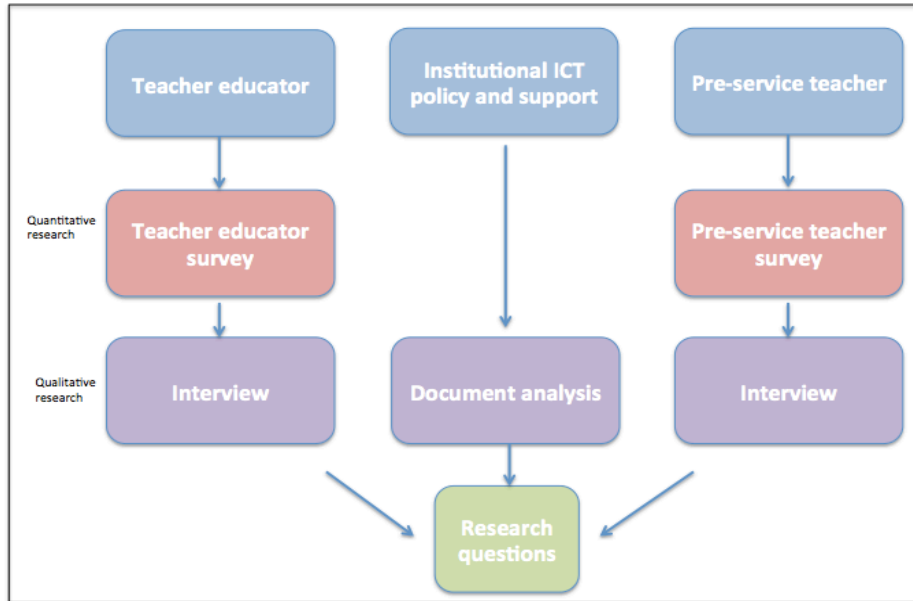
Part 2: Case studies
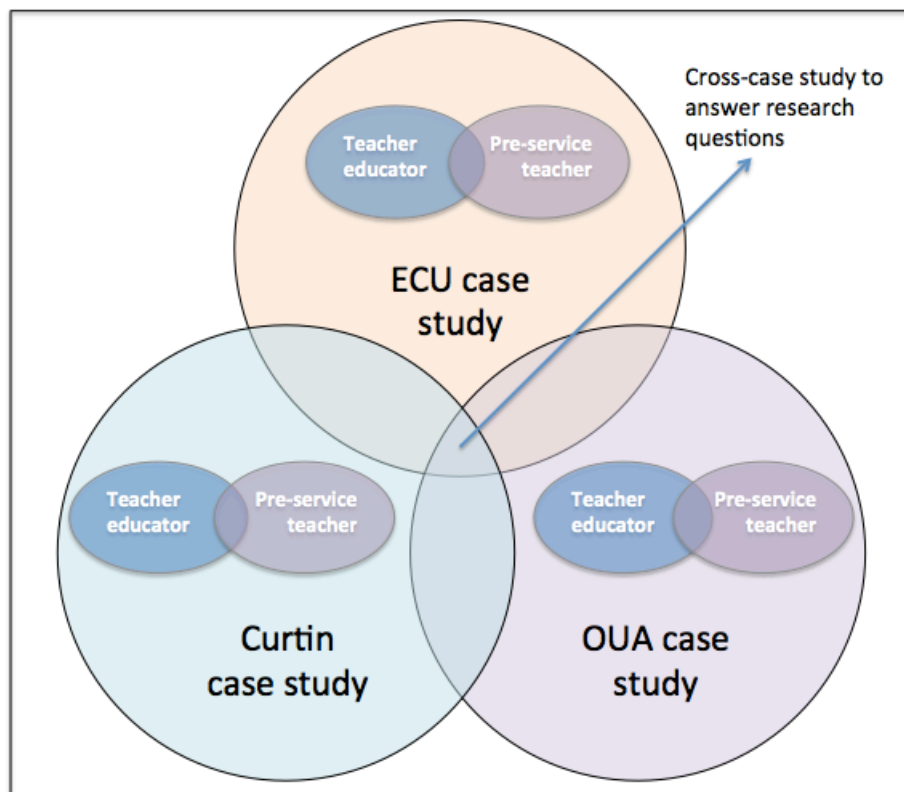
Figure 3.1 Research design

Participants

The study focused on two types of participants: teacher educators and pre-service teachers. The environment was within Schools of Education with access to ICT for the teacher educators to employ with pre-service teachers. The research was conducted at three largest teacher education providers available in Perth, Western Australia, which are Edith Cowan University, Curtin University and Open Universities Australia (a nation wide online university). These three universities were analysed as three individual cases and then all the data were combined and analysed as cross cases.

The primary data sources for this study, based on the conceptual framework, were drawn from the Schools of Education of the three largest teacher education institutions in Western Australia (Edith Cowan University [ECU], Curtin University and Open Universities Australia [OUA]) for the 2016-2017 academic years. The population targeted were pre-service teachers enrolled in undergraduate teacher education programmes and all the teacher educators who were teaching these pre-service teachers.

The sampling technique used was self-selection via online. Teacher educators and pre-service teachers at ECU, Curtin University and OUA were contacted by email and invited to participate in this research by completing a survey about their ICT use in teaching and learning within the context of the policy and support provided by the institution. There were different surveys for the teacher educators and for the pre-service teachers.

Teacher educators and pre-service teachers who elected to take part in the research clicked on a link in an email (provided by teaching staff or on a link in a learning management system announcement) to gain access to the survey, 76 teacher educators and 483 pre-service teachers across the three universities completed the survey.

Respondents who chose to include their email address (this was optional) as a part of the survey were invited to participate in the semi-structured interviews. From these 76 teacher educators, 15 were interviewed, and of the 483 pre-service teachers, 13 were interviewed. Because of the difficulties in getting a response from pre-service teachers and time limitations, only a small selection of pre-service teachers were interviewed.

Table 3.1 provides the breakdown for the number of teacher educators and pre-service teachers who completed the survey for each institution. The number who participated in the semi-structured interviews per institution is also provided.

Table 3.1

Number of Participants

Data collection method	Level	Participants	Number of participants
Online survey	ECU	Teacher educators	28
		Pre-service teachers	245
	Curtin	Teacher educators	24
		Pre-service teachers	152
	OUA	Teacher educators	24
		Pre-service teachers	86
Semi-structured interviews	ECU	Teacher educators	5
		Pre-service teachers	5
	Curtin	Teacher educators	5
		Pre-service teachers	5
	OUA	Teacher educators	5
		Pre-service teachers	3

Instrumentation

As illustrated in the research design (see Figure 3.1), the instruments used for data collection consisted of two separate online questionnaire surveys: one for teacher educator and one for pre-service teacher. Semi-structured interviews were also conducted with a smaller number of respondents from each group to obtain more detailed and in-depth data.

The survey designed was implemented via the Qualtrics Survey Engine for both teacher educators and pre-service teachers from each university. After completing surveys via online, teacher educators and pre-service teachers from each university were asked open-ended questions in the interviews. By combining this with the results from

document analysis of each institutions ICT policy and support, each case was analysed individually and cross-case analysis was used to interrogate their commonalities and differences. Through this process the research questions were addressed.

Online surveys: development and design

In a well-designed survey, the researchers must consider in detail the information they are trying to collect from the data in conjunction with the research objectives and questions (Crawford, 1990). The preparation of the survey questionnaires for this study addressed the research questions, and included academic dialogue with supervisors and other researchers, ideas derived from other questionnaires, and relevant literature from which the conceptual framework had developed.

The questionnaires for the surveys (see Appendix 3 & 4) were adapted from instruments created and validated by researchers in the Centre for Schooling and Learning Technologies at Edith Cowan University (CSaLT), (2008). These were developed for previous projects at Edith Cowan University which investigated pre-service teachers' ICT ownership, skills and use and had been used biannually with some amendments over the period from 2007 to 2014 (Cooper & Pagram, 2009a; Pagram & Cooper, 2011, 2012, 2013; Pagram et al., 2008; Pagram et al., 2015).

The pre-service teachers' questionnaire used in this research was revised from the ECU survey used in 2014. A new instrument was created for teacher educators by modifying the pre-service teachers' survey.

The questionnaires addressed the teacher educators' and pre-service teachers' ICT use by providing items associated with four scales: hardware use, software use, internet access and ICT attitudes. These scales were modified from those on the instrument developed by the Centre for Schooling and Learning Technologies (CSaLT, 2008). For example, the ICT use scale was constructed from items associated with a list of ICT applications (software/ hardware) commonly used in teacher education.

Survey design

In particular, the survey was used to collect data from teacher educators and pre-service teachers in the School of Education at three universities regarding their ICT ownership, skills and use in teaching and learning within the context of the policy and support provided by the institutions.

The online questionnaire (see Appendix 3) completed by the teacher educators consists of four scales constructed from the following sets of items: ICT ownership, ICT self-perceived skills, ICT use, ICT attitude and institutional ICT support. Each of the scales was linked directly to questions within the survey.

The pre-service teachers' online-based questionnaire (see Appendix 4) was similar in structure to that of the teacher educators' questionnaire. There were, however the differences in wording.

Questionnaire components

The questionnaire was made up of three sections and included a total of 21 or 20 closed questions (see Appendices 3 and 4). These questions were grouped according to the following categories:

1. The first section contains 8 statements regarding participants' demographic information such as their age, gender, educational qualification, work experience, subjects to teach (learn), full-time study or part time study.

2. The second section includes multiple choices questions concerning teacher educators' and pre-service teachers' ICT hardware ownership, software skills, hardware and software use and frequency of use.

3. The last section contains questions relating to institutional support and teacher educators' and pre-service teachers' attitudes toward ICT integration into teaching and learning.

The questionnaires were able to be completed anonymously. They were developed to be administered in-person to the participants and delivered via the Qualtrics Survey Engine. Each questionnaire takes about 10-15 minutes to complete. Teacher educators and pre-service teachers were informed of the survey via a link placed on Blackboard,

which is the learning management system. Figure 3.2 shows a screen capture from one of the questionnaires.

The quantitative data gathered in this process thus provided the background information regarding teacher educators' and pre-service teachers' ICT ownership, skills, ICT application in teaching and learning and support provided by the universities.

Figure 3.2 Example screen from the online survey

Semi-structured interviews

Arguably one of the key methods in qualitative data collection, semi-structured interview questions were prepared for use with participants. Semi-structured interviews are more flexible than structured interviews and potentially can provide a deeper understanding of the participants' views (Alvesson, 2011; Cohen, Manion, & Morrison, 2007).

Kvale (2007) offered a useful approach of designing an interview guide, which retains flexibility. The interview guide (see Appendix 5 & 6: Semi-structured interview guide 1 & 2) provides prompt questions aiming to cover as much area relating to the research questions as possible. Having an interview guide also allows for "comparison between cases" (Bryman, 2012, p. 472). Through the prompt questions, the researcher was able to further explore information provided by teacher educators' and pre-service teachers' about their practices and perception provided in their questionnaires.

Teacher educators and pre-service teachers participated in an audio-recorded interview of approximately 30 minutes to an hour long, conducted at the interviewees' institution. The interview consisted of four parts (see Appendix 5 & 6). The first section centered on interviewees' current implementation of ICT into teaching and learning practices; the second section focused on interviewees' ICT confidence; the third section explored their attitudes to ICT. The questions in this section were more open-ended to provide opportunities for suggestions and comments about ICT application in teaching and learning in future teacher education. The last section consisted of questions to explore how the universities provide ICT policy and support for teacher educators and pre-service teachers. The interview recordings were transcribed for analysis.

Document analysis

Apart from the documents from the each of the universities' websites related to ICT policies, other documents such as reports, plans and curriculum materials were considered as potential sources of empirical data for this study and reviewed to obtain relevant information. The information collected was analysed through document classification to evaluate whether they support teacher educators' and pre-service teachers' teaching and learning processes or not, and to identify gaps between the support that universities provided and expectations from teacher educators and pre-service teachers.

Data collection and analysis

As Bell and Waters (2014) pointed out that data collection is the process of collecting data from a variety of relevant sources in order to obtain an understanding of a phenomenon under examination. It also involves selection of appropriate methods to provide the data, which is an essential part of the research with potential for impacting on the quality of the results.

Data collection process

The data were collected in four interrelated stages. The first stage was a pilot study at ECU to collect background information about the pre-service teachers' ICT ownership, skills and use through an online questionnaire. The second collected data from teacher educators and pre-service teachers at all three universities. The third consisted of interviews with teacher educators and pre-service teachers selected from those who completed the online questionnaire. The fourth stage, involved collection and analysis of documents related to institutional ICT policies and support, by the researcher.

As shown in Figure 3.1, 28 teacher educators and 245 pre-service teachers at ECU completed the online survey between March to June 2017. Five ECU teacher educators and five pre-service teachers were interviewed. Twenty four teacher educators and 152 pre-service teachers at Curtin and 24 teacher educators and 86 pre-service teachers at OUA completed the online survey between March to May 2017. Five teacher educators and five pre-service teachers from Curtin were interviewed.

Five OUA teacher educators were interviewed. Because the OUA pre-service teachers were learning online and most of them were in other cities of Australia or other countries, it was not easy to contact with them and to have the face-to-face interviews. Only three pre-service teachers from OUA were willing to be involved in the interviews (conducted by telephone).

Stage 1: Pilot Study

In October 2016, a pilot study was conducted before the commencement of gathering the data. The researcher pilot-tested the online questionnaire with 148 pre-service teachers at ECU (self-selected) following ethics approval, in order to obtain background information for the context of the study while ensuring the anonymity of respondents. Some changes had been made to improve the questionnaire and strengthen its validity. Because of time limitations, the pilot test was only done at ECU. Nevertheless, the exercise improved the quality of the instrument.

Stage 2: Online survey

The anonymous online questionnaire was developed and distributed to participants with using Qualtrics, a web-based software. It obtains demographic and other relevant information from the teacher educators and pre-service teachers.

The questionnaire was launched at the beginning of March 2017 and available online until July 2017. It was forwarded with a covering letter and a link (provided by teaching staff or on a link in an LMS announcement) by e-mail to participants to invite them to complete the online questionnaire (see Appendix 3 & 4). The researcher provided an incentive in the form of potentially winning a gift card to encourage participation. The Human Research Ethics Committee of Edith Cowan University and Curtin approved inclusion of this incentive. It took between 15 to 20 minutes to answer the multiple-choice questions. Following completion of the questionnaire, participants were invited to attend an interview by leaving their email address and tick the box "I am willing to be contacted and to participated in an interview".

Stage 3: Semi-structured interviews

Teacher educators and pre-service teachers who completed the questionnaire and indicated they were willing to participate in the interview were randomly chosen and invited to an interview. The 15 teacher educators and 13 pre-service teachers who had volunteered for the interview were contacted by email. They were provided with information about the study with the information letter beforehand. This email was also used to arrange a date, time and venue for conducing the interview.

A semi-structured interview consisting of 17 questions (see Appendix 5 & 6) was used because it was convenient and enabled probing for clarification where necessary. This approach encouraged participants to feel at ease in a conversational setting. Most participants comfortably and openly expressed their experiences and emotions. Interviews were held individually and conducted face-to-face, with each lasting between 30 minutes to 1 hour. As recommended by Seidman (2013), they were kept to under an hour so as not to be too demanding on the participants.

At the beginning of each interview, the researcher provided all interviewees with an information letter (see Appendix 2), which stated the objectives of the interview and presented information about the research. Then the interviewee signed a consent form (see Appendix 1). To enable accuracy, all interviews were audio recorded with the interviewees' consent, which also allow the researcher to revisit the recordings when necessary. Body language and disruptions during the interviews were recorded as field notes.

Stage 4: Document analysis

Document analysis refers to both printed and electronic sources of data (Bowen, 2009), examined and interpreted to elicit meaning, gain an understanding and develop empirical knowledge (Corbin & Strauss, 2008).

The aim of document analysis in this study was to examine and gain an overview of institutional ICT policies. The document sources included published and unpublished policy documents, official reports and curriculum materials. These documents were mainly collected from the universities' websites. The results from the document analysis have been incorporated into later chapters to supplement the institutional ICT environment for teacher educators and pre-service teachers.

Analysis of data

Both quantitative and qualitative data were collected in this research. After collecting the data, it had to be organised and analysed so that conclusions could be drawn. The diagram below described how these data were used in answering the subsidiary research questions, and ultimately were used to resolve the principal research question.

The teacher educator and pre-service teacher survey data were analysed with the Statistical Package for the Social Sciences (SPSS) to produce histograms, frequency (counts and percentages), descriptive statistics (e.g. mean, median and standard deviation). Data from semi-structured interviews were analysed using thematic categorisation.

The findings related to research questions 1 and 2 were drawn principally from data collected through the teacher educator and pre-service teacher surveys and interviews. Those related to research question 3 were provided by the document analysis and interviews. All three forms of data collection contributed to conclusions regarding the implications for future teacher education of teacher educators' and pre-service teachers' use ICT in teaching and learning within the context of the support provided by their institutions.

Validity and reliability

According to Miller (2004), a study instrument's validity and reliability is considered a critical factor in establishing that study's efficacy. To assist with the reliability of the instruments used in this research, where possible, known instruments were adapted and used. The pre-service teachers' questionnaire was modified from that used in the ECU survey in 2014 which itself was developed from surveys from EDUCAUSE (ECAR), in which the validity and reliability had been tested. A new instrument created for teacher educators based on the pre-service teachers' questionnaire instruments were further assessed for reliability and validity by piloting the instruments with selected teacher educators and pre-service teachers in the School of Education at Edith Cowan University. Survey scales were tested statistically (e.g. Cronbach Alpha reliability coefficient) for reliability and feedback was sought with regard to understanding and meaning of the questions to assist with validity. Within the design of the study, triangulation was utilised by collecting both quantitative and qualitative data in order to provide different perspectives and thus provided more rigorous answers to the research questions.

Ethical considerations

Ethical clearance was gained from the Human Research Ethics Committee (HREC) of each university before the commencement of data collection. Each participant was

provided with information regarding the study before they were asked to participate in the data collection.

The interactions with participants and individual results were confidential and voluntary. They were also informed that they could withdraw without any penalty or impact as follows: For survey participants, they can withdraw before they submit but after, even if they withdraw from the study, their survey responses will remain since it is impractical to remove them due to the anonymity of the survey. For interviewees, they can withdraw within three months and their data will also be removed from the study (after this time period it will not be possible to remove their coded responses from the data-set). Participants will not be identified in any publication resulting from the research. There will be no sensitive information or information would have psychological impacts to participants contained in the research questions. The data is stored securely in a locked cabinet or in password protected computers and will be destroyed five years after the completion of the research

Summary

This chapter outlined the methodology of the current study. It explained the research design and instruments used to collect data, the data collection and data analysis processes employed for the quantitative and qualitative aspects of the research. It also discussed the validity, reliability and trustworthiness of the research findings and ethical considerations related to the study. The findings are presented and discussed in Chapters Four, Five and Six.

Chapter Four: Edith Cowan University case study

Introduction

This purpose of this chapter is to present and discuss the findings of the surveys and interviews of Edith Cowan University (ECU) teacher educators' and pre-service teachers' about their hardware ownership, self-perceived software skills and use of digital devices and software in their teaching and learning.

Teacher educators' views as revealed by the survey and interview data are outlined first, followed by those of pre-service teachers. Discussion of the results for each group concludes the chapter.

Twenty eight teacher educators and 245 pre-service teachers from ECU were involved in the online survey. Five teacher educators and five pre-service teachers who completed the survey took part in semi-structured interviews.

Background and context

Edith Cowan University (ECU) is one of the largest teacher education institutions in Western Australia offering four-year education courses for early childhood, primary and secondary teachers. Graduates from ECU have won the annual WA Education Awards. ECU education programme has been named in the world's top 250 for four years in a row. Moreover, ECU has established partnerships with other international education universities to conduct courses and programmes (Corbin & Strauss, 2008).

ECU quantitative data results

ECU teacher educators and pre-service teachers were invited to participate in taking the survey and participating in interviews. These results were used to identify their hardware ownership, self-perceived software skills, and how they applied these digital devices and software in their teaching and learning, how they accessed the internet and what were their attitudes toward ICT. This section presents the quantitative data results of ECU teacher educators and pre-service teachers, while the following section presents the qualitative data.

Demographics

Of the 28 teacher educator participants, 43% were male and 57% were female. Their age ranged from 40 to 65 years old. Those aged 53 and 57 constituted the largest group (11%). Thirty-six percent of ECU teacher educators had 8-15 years of work experience in higher education. Sixty-three percent of them had a doctoral degree. The teacher educators were teaching in different programs and disciplines. The majority of ECU teacher educators were teaching in the secondary program (61%) and fourteen percent were teaching Science, Humanities and Social Sciences.

Of the 245 ECU pre-service teacher participants, 26% were male and 74% were female. Their age ranged from 17 to 64 years old. Those aged 20 were the largest group (14%). Of ECU pre-service teachers, 14% had completed three years study at university. The majority of them were studying full-time (86%) and studying on campus (74%). The pre-service teachers were studying in different programs and disciplines. Most of ECU pre-service teachers were in secondary program (62%) with the largest group, 15% studying English.

ECU teacher educators' ICT ownership

The first section of the survey asked 28 Edith Cowan University (ECU) teacher educators to identify the hardware they owned and how long they had owned each item.

The survey, conducted in 2016, found a high level of ownership of all the devices listed in Figure 4.1. On average, almost 90% of teacher educators owned hardware devices, with the highest percentage owning printers and the lowest owning laptops and tablets. The breakdown per device is as follows: printer (96%); scanner (91%); smart phone (89%); desktop (85%); tablet (84%); and, laptop (83%). Despite this high overall level ownership across devices, at least 15% still did not own a desktop or a laptop.

The number of years teacher educators owned particular devices varied. As Figure 4.1 shows, nearly 70% or over of them possessed desktops, printers and scanners for five years or more and 67% owned laptops for a similar period of time. In contrast, only 42% possessed tablets and smart phones for five years or more. A sizeable percentage of teacher educators (20%) owned tablets for between three and four years. However, less than 5% owned smart phones for this period of time and 25% had them for only one to two years. Finally, 15% did not possess a tablet and 10% a smart phone.
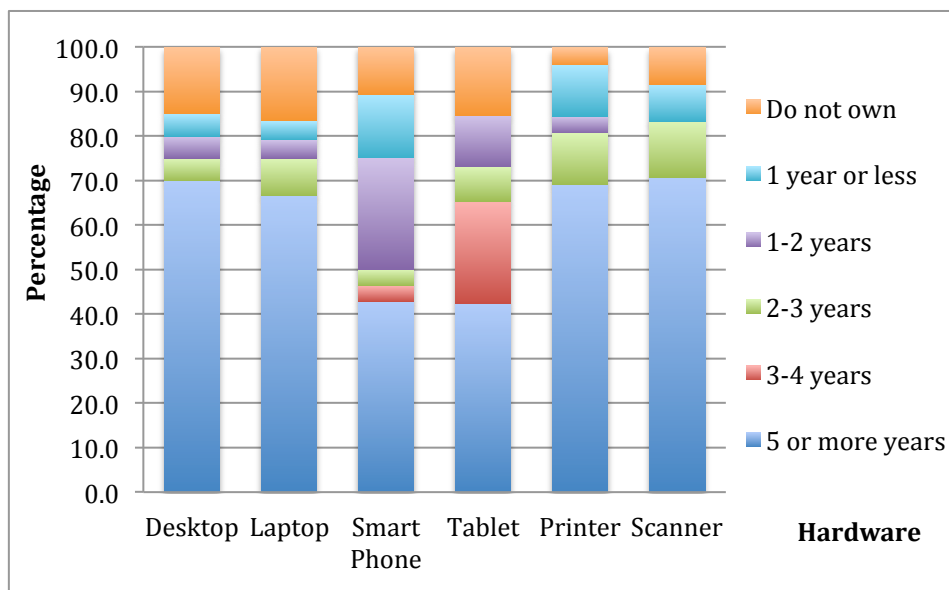
Figure 4.1 ECU TEs' hardware ownership

ECU teacher educators' ICT skills

An important aspect of the survey was the collection of data on teacher educators' self-perceived skills with a variety of software. Table 4.1 illustrates the software skills from the survey that been used to investigate how well teacher educators and pre-service teachers apply technology in their teaching and learning.

Table 4.1

Software Skills from the Survey

	Level 1	Level 2	Level 3	Level 4
Word processing	I can't do much	Print a document, change fonts, spell check, insert a footer and page numbers	Insert images, create tables, change page setup, change margins	Use columns and sections, set up styles, use templates and add-ins
Slideshows	I can't do much	Create a slideshow, insert images, change fonts and layout	Navigate during a presentation, add animation and transitions, insert hyperlinks	Edit the master slide, include sound, print handouts, add navigation buttons
Spreadsheets	I can't do much	Enter data, use sort, create charts (graphs) and modify them	Insert some calculations, format cells, insert and delete rows and columns	Use complex formulae, use absolute and relative cell referencing
Internet browsing	I can't do much	Navigate to know web sites, create Favourites, do basic searchers	Save images and text, use Advanced search tools, organize Favourites	Do complex searches, download and install plugins, use different browsers, alter browser preferences
Digital photography	I can't do much	Take photos or video, and transfer them to a computer	View images/video on the camera, adjust camera settings such as flash and close-up	Adjust camera menu options such as resolution and shutter speed
Image editing	I can't do much	Draw pictures and do simple editing such as crop, delete, colour, draw and add text	Change image size, file format and clearness	Do complex image editing using special effects, and layers
Video editing	I can't do much	Edit video on a computer such as join, split, delete and insert	Use software to add transitions, import and edit sound tracks, add titles and subtitles	Use advanced software to apply complex editing and special effects
Social media	I can't do much	Edit my profile and chat with friends	Post photographs, play games, and join groups	Share files, create and manage groups, edit privacy settings
Email	I can't do much	Send and access emails, add to and access the Address book	Store messages in folders, find Sent messages, manage the Address book	Add and edit 'Signatures', and add attachments
Learning Management System	I can't do much	Find and read course materials online	Download files and participate in online discussions	Submit my assignments

As a result of the survey, the teacher educators indicated some level of competency in all categories. According to the findings presented in Figure 4.2, no teacher educators at ECU reported knowing little about email, word processing, slideshows, the learning management system, internet browsing and digital photography. This indicates that teacher educators had at least basic knowledge and skills of using those types of software.

Teacher educators reported the highest level of advanced skills with email, followed by word processing, slideshows and the learning management system, with

over 80% on average rating themselves advanced. In contrast, only 15% of teacher educators reported having advanced skills in using video editing and nearly 35% indicated they knew little about video editing.
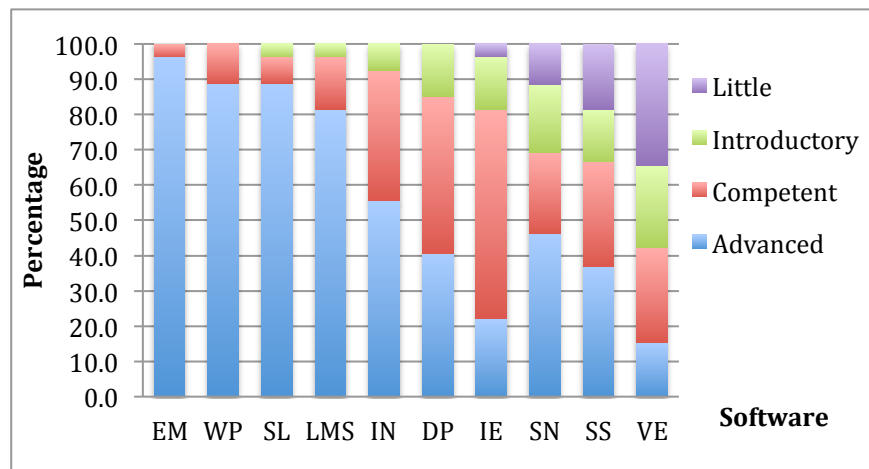
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 4.2 ECU TEs' software skills

ECU teacher educators' ICT use

The third part of the survey identified how ECU teacher educators used ICT, including what hardware and software they used, how frequently they used it, how they access the internet and their attitudes toward ICT.

Hardware use

Figure 4.3 shows the frequency of use for each of the hardware types utilised for teaching purposes. It is interesting to see that 100% of teacher educators were using laptops for their teaching at ECU. On the other hand, more than 52% did not use a desktop, 32% or over did not use a smart phone, a tablet or a scanner for teaching.

With regard to frequency of use, more than 81% used a laptop and 42% used a printer in daily frequency. It should be noted that even though a high percentage of teacher educators owned a desktop, a smart phone, a tablet and a scanner, quite a large number of them did not use these devices for teaching purposes.
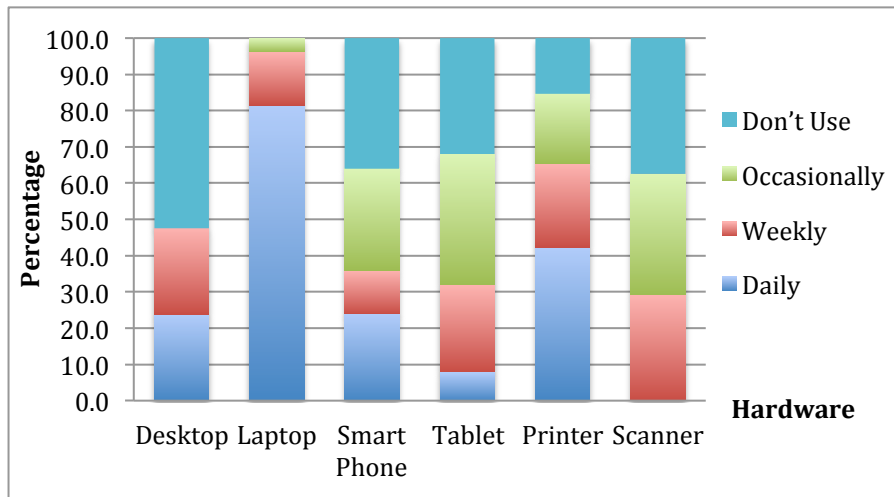
Figure 4.3 ECU TEs' hardware frequency of use

Software use

Figure 4.4 illustrates the frequency of use of the various software types used by teacher educators. All teacher educators at ECU reported using internet browsing in 2016. The majority of teacher educators (at least 50%) used email, word processing, the learning management system, internet browsing and slideshows on a daily basis.
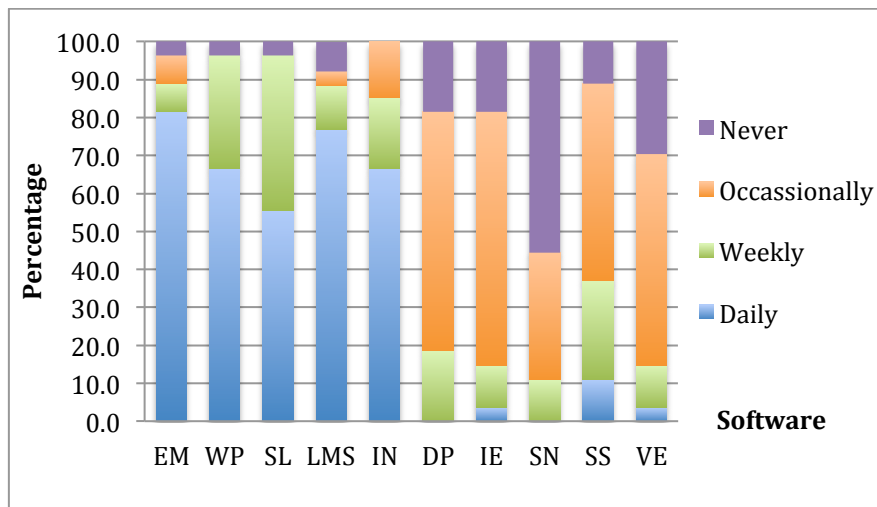
EM – Email	WP – Word Processing	SL – Slideshows	LMS – Learning Management System
IN – Internet Browsing	DP – Digital Photography	IE – Image Editing	SN – Social Networking
SS – Spreadsheeting	VE – Video Editing		

Figure 4.4 ECU TEs' software frequency of use

Least used were social networking and video editing. Over 55% of ECU teacher educators reported never using social networking for their teaching in 2016, and nearly 30% of them never used video editing. The frequency of teacher educator software use

was consistent with their software competence, and may suggest that through more frequent use, teacher educators are likely to become more ICT competent.

The tools or resources that ECU teacher educators used the most in their teaching was the learning management system known as Blackboard (see Figure 4.5). Ninety six percent always or often used it. Ninety three percent of ECU teacher educators used searching tools for teaching. However, few used polling tools, innovative computer interfaces and simulations or educational games. Ninety six percent of them never or seldom used polling tools and 89% of them never or seldom used innovative computer interfaces such as Virtual Reality (VR) and simulations or educational games as a teaching and learning tool.
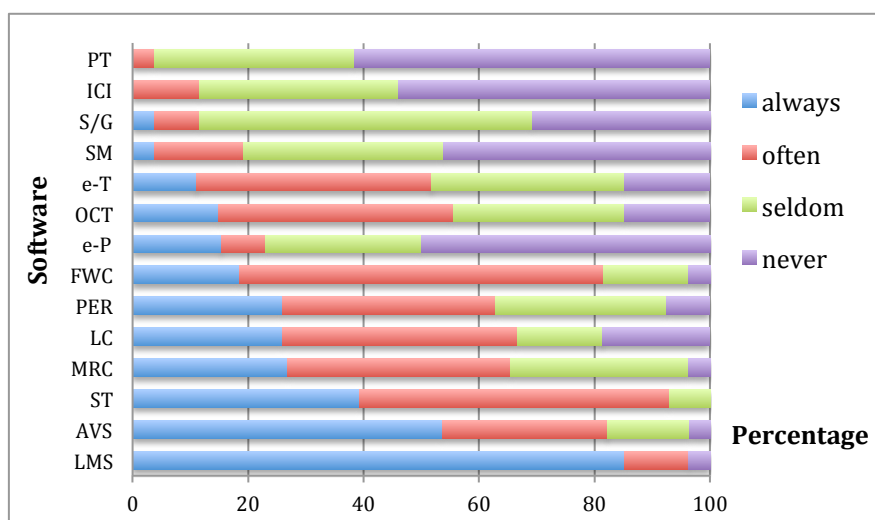
PT-polling tools	ICI-innovative computer interfaces	S/G-simulations or educational games	SM-social media
e-T-e-textbooks	OCT-online collaboration tools	PER-publishing electronic resources	FWC-free, web content
e-P-e-portfolios	AVS-academic validation software	MRC-multimedia resources creation	ST-search tools
LC-lecture capture	LMS-learning management system		

Figure 4.5 ECU TEs' software frequency of use

Internet Access

Teacher educators' use of internet types at ECU is presented in Figures 4.6. In 2016, most of the teacher educators at ECU had internet access at home or through their mobile device and 96% of them would access internet at home daily. Eighty two percent daily connected to the internet through their mobile (see Figure 4.6). Two thirds

of them also used the wi-fi provided by ECU on daily basis. All teacher educators at ECU used the university wi-fi, but only 44% used the university computer lab.
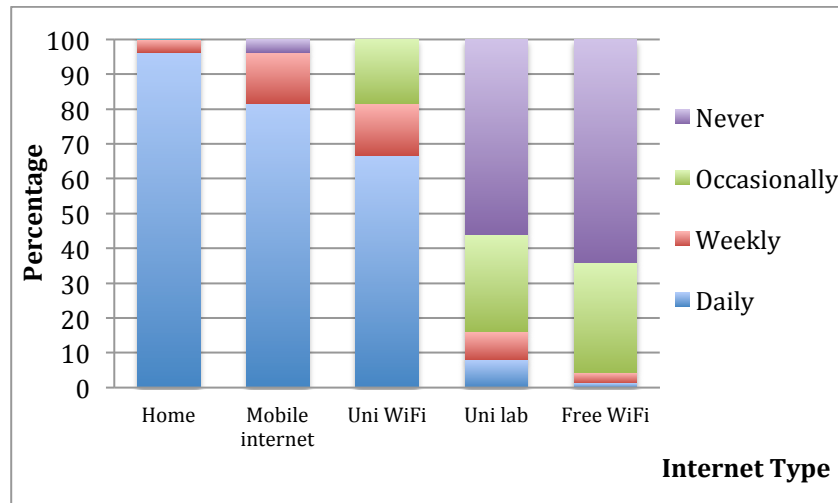
Figure 4.6 ECU TEs' use of internet type

Attitudes toward ICT

Figure 4.7 shows the uptake rate with which ECU teacher educators adopt new technology. It reveals that the majority of those surveyed (42%) preferred to wait until they saw others try the new technology before trying for it themselves. However, quite a large percentage were among the first to try out a new electronic device or gadget (35%). The remaining 23% tended to be conservative and would wait for a long time to try new technology. This may indicate that ECU teacher educators (77%) have a more positive attitude toward adopting new technologies.
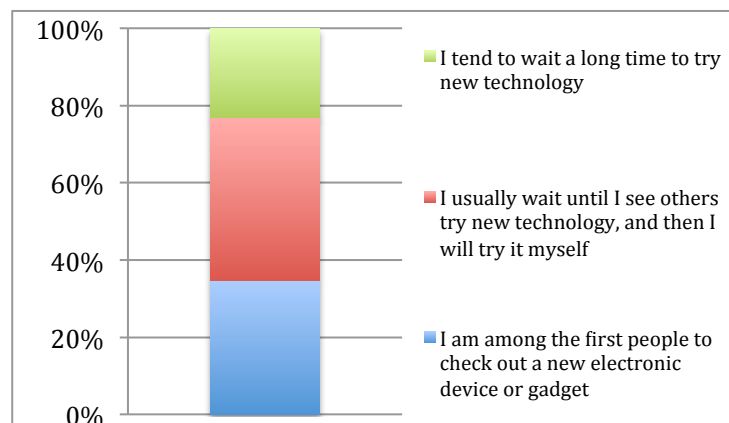
Figure 4.7 ECU TEs' tendency to adopt ICT

Nearly 82% of ECU teacher educators agreed or strongly agreed that they were able to solve technological problems related to their teaching (see Figure 4.8). Seventy

percent on average agreed or strongly agreed that the university offered them adequate maintenance and support for technology resources. Seventy seven percent were positive about the workshops related to ICT training offered and 80% about the online tutorials and technological instruction. However, nearly 30% still thought they needed more ICT support from ECU.
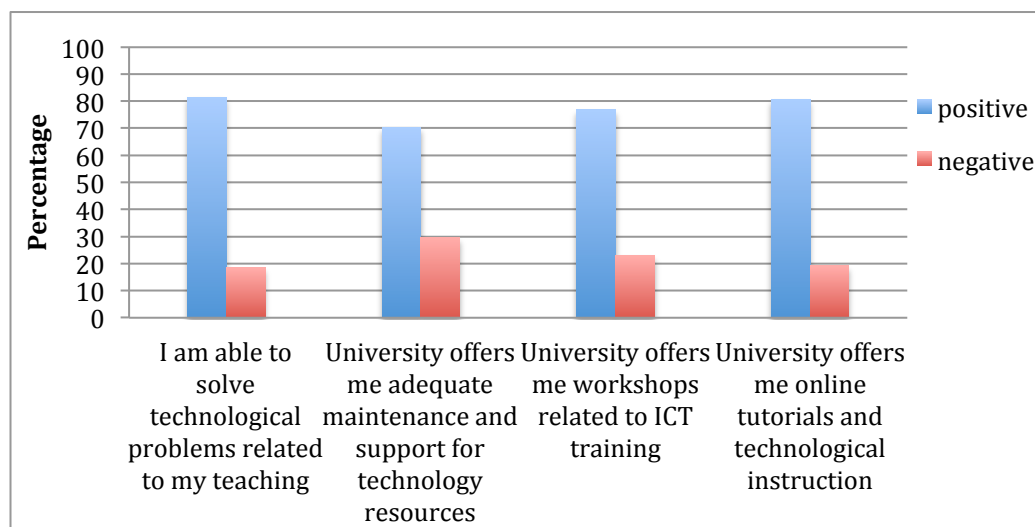
Figure 4.8 ECU TEs' attitudes to ICT support

ECU pre-service teachers' ICT ownership

The survey of ECU pre-service teachers covered the same areas as the teacher educator survey, that is ICT ownership, skills and use. They were asked to identify what hardware they owned and how long they had owned it.

As can be seen in Figure 4.9, the average ownership of hardware devices by ECU pre-service teachers was less than ECU teacher educators, especially the ownership of a desktop, a tablet and a scanner. The hardware device that the highest percentage of ECU pre-service teachers owned was a smart phone (99%). This was followed by a laptop (92%), a printer (82%) and a scanner (72%). However, over 50% of them did not own a desktop and 34% did not own a tablet.

As with ECU teacher educators, most ECU pre-service teachers possessed some of the hardware devices such as smart phones, printers, scanners and desktops for five or more years. Over 30% of them owned these devices for five or more years. This is not as a high percentage as teacher educators. Moreover only 8% pre-service teachers

owned a desktop in two years or less, but nearly 40% obtained a laptop in the last two years. It maybe because pre-service teachers are young and still rely on their parents, so they possessed a laptop since going into university.
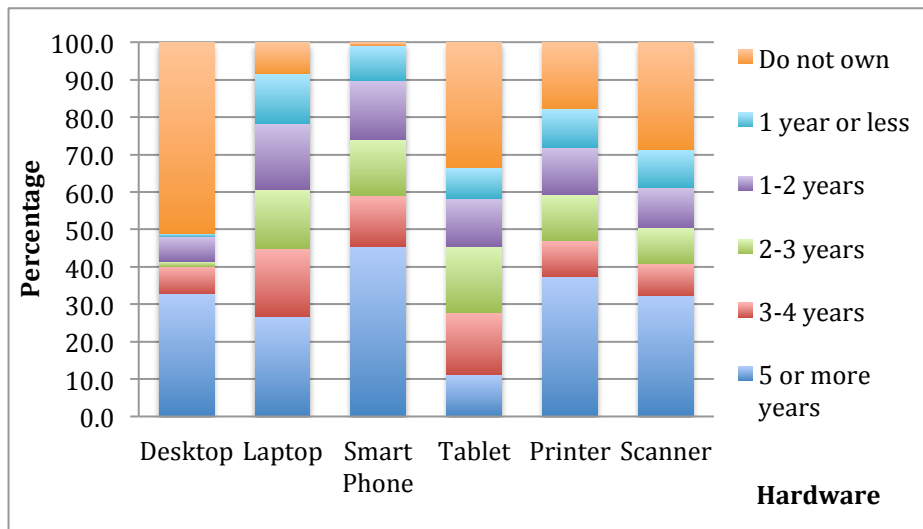
Figure 4.9 ECU PSTs' hardware ownership

ECU pre-service teachers' ICT skills

As shown in Figure 4.10, all pre-service teachers indicated some level of competency in the skills listed. According to the findings presented in Figure 4.10, no pre-service teachers at ECU reported knowing little about email, word processing and internet browsing, which indicates that the pre-service teachers at ECU had at least basic knowledge and skills in using these software. The greatest number of pre-service teachers who have the advanced self-perceived skill with software was in the social networking, over 85% of them were on advanced level in using social networking, followed by email, the learning management system (Blackboard). The same as ECU teacher educators, over 28% of ECU pre-service teachers knew little in video editing and 21% in spreadsheeting.
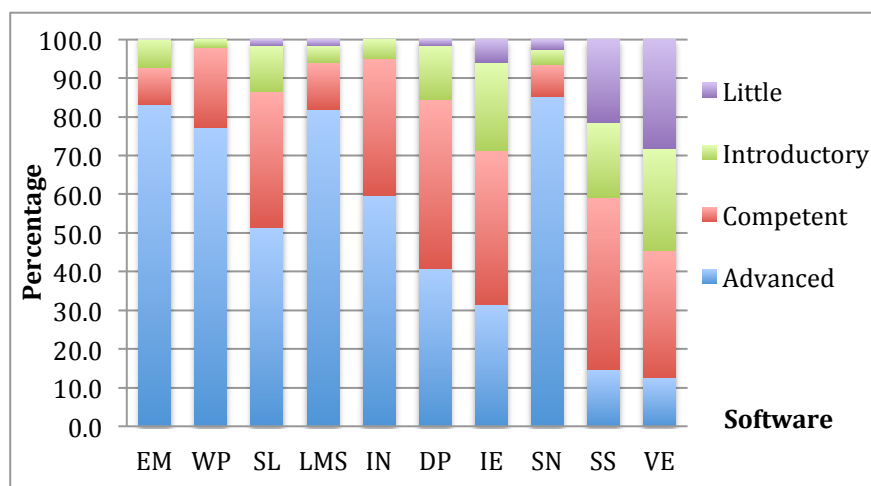
Figure 4.10 ECU PSTs' software skills

ECU pre-service teachers' ICT use

This section reveals how pre-service teachers use ICT, including their hardware use, software use, internet access and attitudes toward ICT.

Hardware use

This section examines the frequency of pre-service teachers ICT use in terms of hardware and software. Figure 4.11 shows the frequency of use for each of the hardware types utilised for study purposes. Again the mobile devices (laptops and smart phones) are the most frequently used, followed by desktop PCs and tablets. Over 73% and 40% respectively of pre-service teachers used a laptop and a smart phone at least daily in their studies. However, it should be noted that over 40% of pre-service teachers did not use a desktop computer for their studies. Tablets too were less frequently used in study, with a high percentage (45%) not making use of them. This probably reflects the low level of tablet ownership.
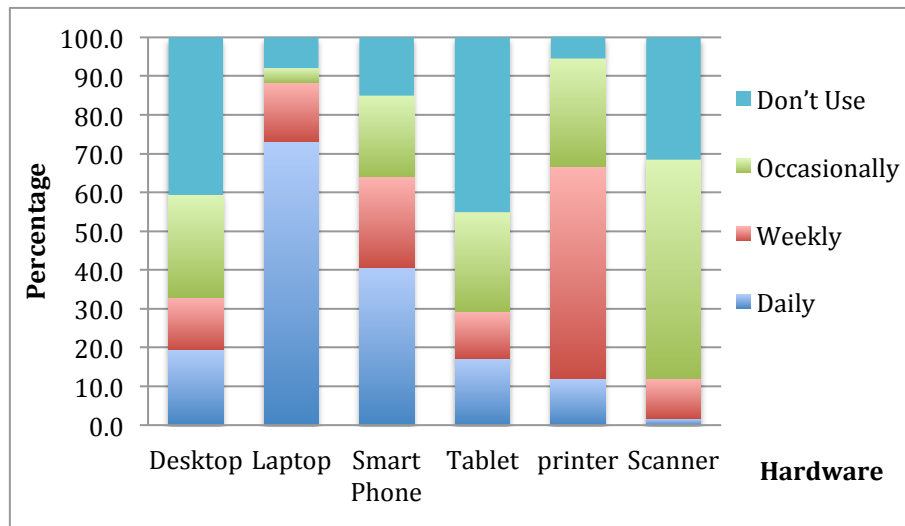
Figure 4.11 ECU PSTs' hardware frequency of use

Software use

Figure 4.12 illustrates the frequency of use for the various software types. In 2016, all pre-service teachers at ECU reported using email, the learning management system and internet browsing. The majority (at least 50%) used these software items and word processing at least on a daily basis.
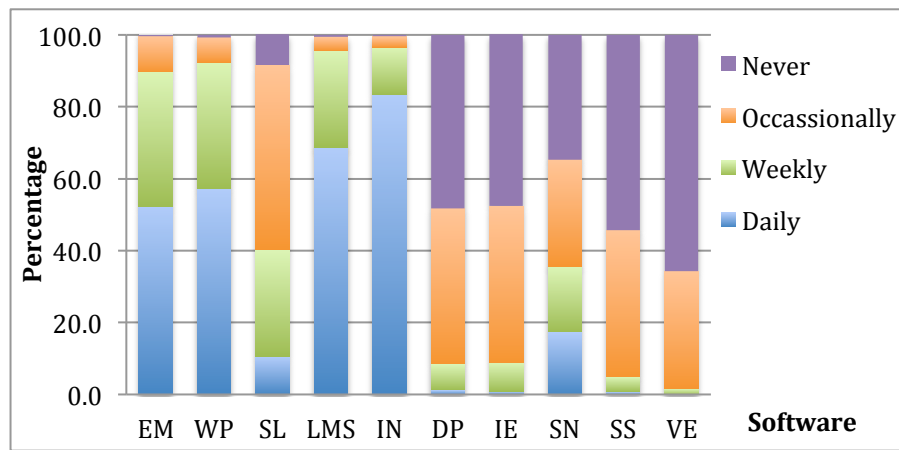
EM – Email	WP – Word Processing	SL – Slideshows	LMS – Learning Management System
IN – Internet Browsing	DP – Digital Photography	IE – Image Editing	SN – Social Networking
SS – Spreadsheeting	VE – Video Editing		

Figure 4.12 ECU PSTs' software frequency of use

Least used were video editing, spreadsheeting, digital photography and image editing. Over 65% of ECU pre-service teacher reported never using video editing for their learning in 2016, and nearly 50% or over a half of them never used digital photography, image editing, and spreadsheeting.

The frequency of pre-service teacher software use was consistent with their software competence, and may suggest that with more frequent use, pre-service teachers are likely to become more ICT competent.

The tool or resource that ECU pre-service teachers (93%) wished that their teacher educators used the most in their teaching is the learning management system (Blackboard at ECU) (see Figure 4.13). Ninety percent of ECU pre-service teachers want teacher educators to use lecture capture for teaching. However, few pre-service teachers want teacher educators to use polling tools, social media and innovative computer interfaces.
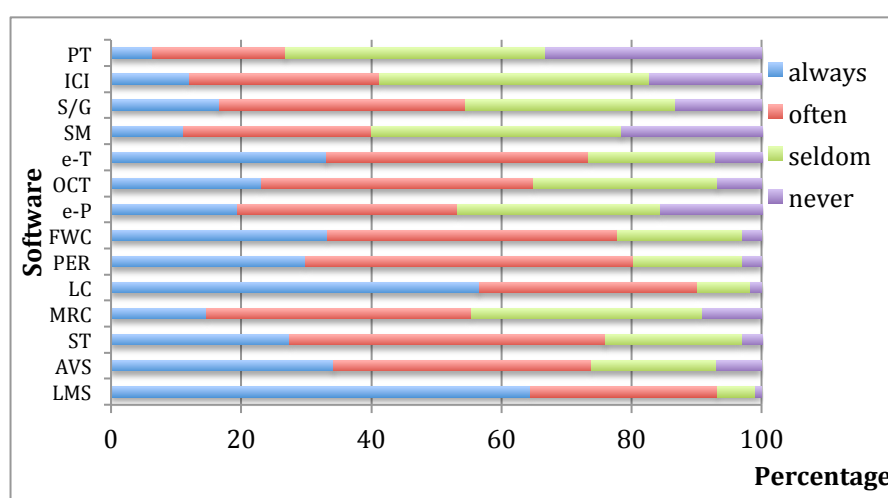
PT-polling tools ICI-innovative computer interfaces S/G-simulations or educational games SM-social media

e-T- e-textbooks OCT-online collaboration tools PER-publishing electronic resources FWC-free, web content

e-P-e-portfolios AVS-academic validation software MRC-multimedia resources creation ST-search tools

LC-lecture capture LMS-learning management system

Figure 4.13 ECU PSTs' expectation to TEs' software frequency of use

Internet access

As with teacher educators, most of the pre-service teachers at ECU accessed internet at home or through their mobile internet. Nearly 93% of them accessed the internet at home daily, while 73% connected with the internet through their mobile daily (see Figure 4.14). In contrast to teacher educators, pre-service teachers had more flexible schedules for learning on campus and some of them studied off campus, so not as many of them use the university wi-fi as teacher educators. Only 34% of them used the university wi-fi daily and 8% used the university computer lab daily.
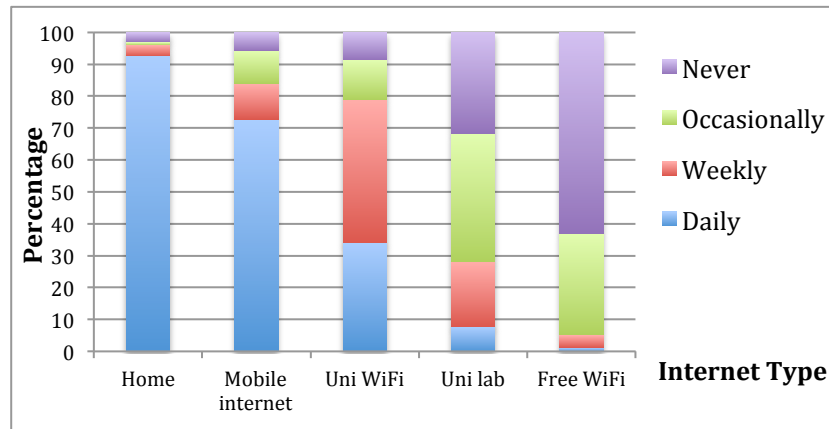
Figure 4.14 ECU PSTs' use of internet type

Attitudes toward ICT

Figure 4.15 shows the results of about adoption of new technology. It indicates that most (64%) ECU pre-service teachers preferred to wait for a while and see others try new technology and then try it themselves. Only 18% of them were early adopters and tended to be the first people to check out a new electronic device or gadget. The remaining 18% were conservative and waited for a long time to try new technology. These results suggest that ECU pre-service teachers have a less positive attitude to adopting new technology than teacher educators.
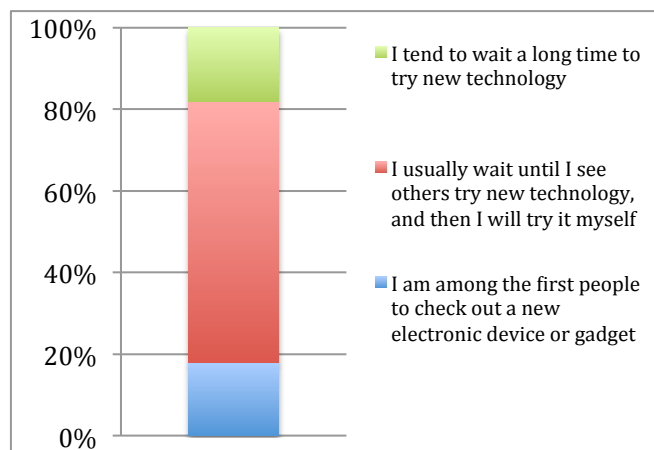
Figure 4.15 ECU PSTs' tendency to adopt ICT

Nearly 86% of ECU pre-service teachers agreed or strongly agreed that they were able to solve technological problems related to their learning (see Figure 4.16). Most of ECU pre-service teachers held a positive attitude towards university support. 81% agreed or strongly agreed that the university offered them adequate maintenance and support for technology resources. However, nearly 34% or over still thought they

needed the university to provide more ICT training and online tutorials and technological instruction.
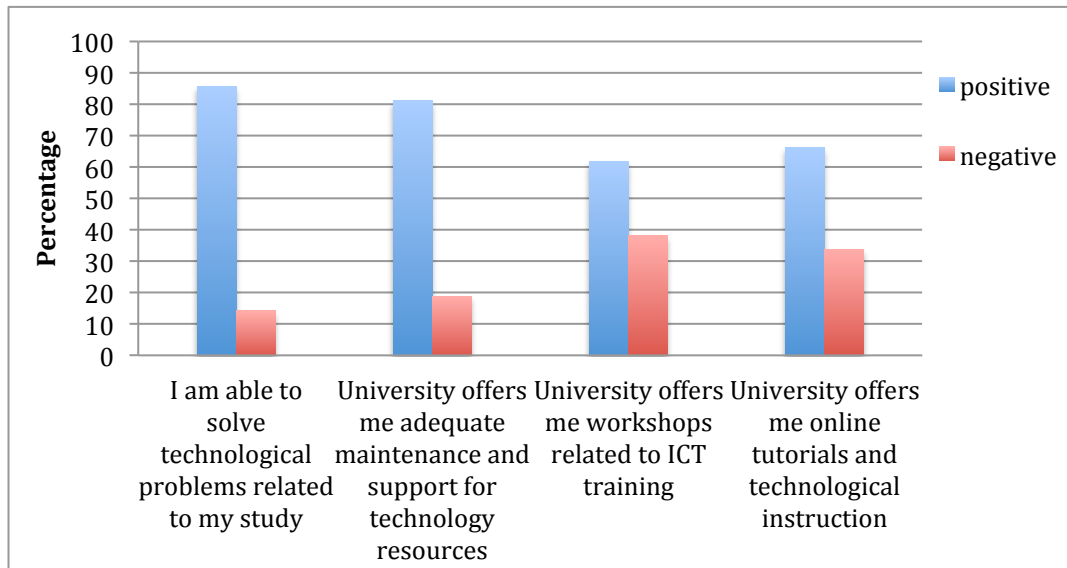
Figure 4.16 ECU PSTs' attitudes to ICT support

ECU qualitative data results

This section presents the qualitative data results regarding ECU teacher educators' and pre-service teachers' ICT confidence, ICT use and ICT policy and support.

ECU teacher educators' ICT confidence

Five teacher educators were asked *How confident are you using ICT in your teaching?* Responses to this question varied. This is described in more detail below.

Two teacher educator participants thought that they were very confident in using ICT in their teaching. One of them was using technology for a long time and it was also his hobby, as he said "I start using technology in teaching back in 1980s, I'm the earlier adopter of technology" (ETE1). Another participant also thought that ICT was her hobby and she can solve the problem out easily. "They call me IT support. I like solving when things get wrong and I just use technology assist the teaching" (ETE2).

Two teacher educator participants felt that they were only confident with the things that they were using at this moment, for example,

I feel confident with the things that I use and I don't feel confident in that sort of technology because I don't know it, I don't know it well enough to put it into practice and to use it (ETE3).

One of the teacher educator participants felt that he was an average user of ICT in teaching. He felt incompetent, awful or panicked when there were ICT problems, as he commented:

I'm trying to show the students something on YouTube and the internet is not working and it makes you appear incompetent and that's awful when you are trying to show the students how to teach and the technology is not working is very frustrating and embarrassing. (ETE4)

That's why he did not feel confident enough using ICT and tended to teach without it, however, he was still willing to learn.

ECU teacher educators' ICT use

The results from the interview question "*What ICT devices do you usually use and why?*" indicated that teacher educators usually used a desktop in the classroom and only used their own laptops when the desktop (in the classroom) was not working. They all mentioned they presented using PowerPoint, which means all of them used a projector. Two of them used a smart phone in the classroom for their teaching. One was an early adopter of new technology, and she liked playing with new devices and would adopt them if they made things easier. The other was teaching drama, so she used a smart phone for the music and the lights in productions and rehearsals. She also thought that she would use other mobile technology like a tablet if it would make things more efficient.

Both of the teacher educators also mentioned the disadvantage of using a smart phone or tablet, which was that these devices could be distracting for the students and negatively affect the learning process, if not used in the right way. Another teacher educator pointed out it was problematic to use tablets because it took a lot of time at the beginning of the lesson to make sure that everybody was online.

Other teacher educators rarely used tablets and smart phones for their classroom teaching because of software issues, as one teacher educator pointed out below:

The limitation with a tablet and a smartphone for what the lecturer teaches is the software. The students either need to have the access to the software which doesn't run on most tablets. The statistic software doesn't run on say iPad, for example, so they have limited use for what the lecturer teaches. The limitation of current generation of tablets is they don't run all software and it all probably is the case that the device the lecturer likes the students to bring to the class is a laptop computer or notebook computer or small one because it is so useful. The tablet is quite useful for school teaching but for university it is more limited. (ETE1)

The results from the interviews about their attitudes to adopting technology were consistent with the survey results reported above. Interview results showed that most of the teacher educators tended to wait a considerable period of time before using the latest technology. They also preferred to have someone to show them how to use it instead of reading instructions themselves, and they would only use it if seemed that it would be useful.

One teacher educator said it took her a long time to feel comfortable with a lot of new technology, but she was willing to try it if it did not take too much time and it was relevant, meaningful and useful. Another teacher educator used to be an early adopter but is no longer one because it was not that necessary to have the latest version, unless there was something really good. Yet another teacher educator was an early adopter because the latest technology made things easier, powerful and more engaging, especially for students, as it attracted their attention in a good way. That teacher educator also liked playing with and trying new devices and software, as this makes life exciting.

ECU pre-service teachers' ICT confidence

Five pre-service teachers were asked "*How confident are you using ICT in your learning and future teaching?*" Responses to this question were different. This is described in more detail below.

The interview data suggest pre-service teachers have different levels of confidence in using new technology in their learning. Some of them were confident because they were growing up with new technology. Others felt confident with particular devices like laptops and computers, but not with tablets or smart phones. Another only felt confident in using devices she already knew how to use.

ECU pre-service teachers' ICT use

Interview questions related to the usage of devices in learning reveal pre-service teachers use desktops and laptops most frequently, followed by smart phones. They indicated that desktops and laptops were more versatile, with all sorts of different software on them. However, one respondent did not like to use a laptop because he found the keyboard of a laptop annoying. Laptops and smart phones were considered fairly portable. Smart phones were mainly for checking emails or blackboard. Fewer used tablets, because of the lack of a proper keyboard. Tablets and smart phones were much slower than laptops, they did not have much process power, had terrible word processing and could not do as much as laptops.

Pre-service teachers gave a variety of reasons for delaying adoption. The price of new technology was high at the beginning, so it took a while to get an expensive new device such as a smart phone. One respondent wanted to do some research on the device before buying it. Another could not use a programme on Mac because he found it hard to use and he did not want to spend time learning it.

ECU ICT policy & support

The different institutions involved in the implementation of ICT interventions are compelled by their own conception of the ICT interventions as well as by the imperatives of their organisational goals. Universities, as the main implementers of all ICT interventions, are expected to develop teacher-based ICT policies as comprehensive teacher education guidelines providing a variety of strategic and operational elements

concerning the integration of ICT in teaching and learning (Frazier & Bailey, 2004; Tondeur et al., 2008).

ECU ICT policy

From analysing the ECU websites, the results indicated that ECU ICT policies were mainly about guidelines, standards and principles that support the safe use of the university's IT systems and services. The university set up numbers of guidelines such as how to use mobile devices and how to access the internet. The users should follow certain rules for their personal conduct, for example:

4.1.1 Any use of ECU information Systems must be in accordance with University policy including but not limited to the ECU Code of Conduct, Email Policy, Copyright Policy, Social Media Policy, Private Policy and the Information Security Policy;

4.1.2 When accessing the internet from ECU information Systems, Users must act in accordance with relevant University standards, values and rules as required by their role; and

4.1.3 When using information services that are supplied on a shared basis – for example shared laboratory computers, Users must comply with all written rules and guidelines for the facility. (Edith Cowan University, 2016)

ECU ICT policies put more emphasis on security, risk management and users' responsibility. For software use, users should have permission first, for example, "All Software Assets installed on University owned equipment must be fully Licensed and compliant with the relevant vendor's terms and conditions." (Edith Cowan University, 2019a, p. 2)

From the interview questions that related to knowledge of university ICT policy, the results indicated that three out of five teacher educators had been aware of ICT policies but they were not quite sure about what exactly they were. One teacher educator pointed out that she only became aware of the ICT policy when it was updated. Before this, she did not know what the policy was. Some teacher educators understood and appreciated the rules for protecting the university against security risks, while a number of them tried to be flexible, others had problems because they felt the policy

was "one size fits all" (ETE1). This indicates that the policy was restrictive for people who were doing research and creative work.

ECU teacher educators' view on ICT support

All of the teacher educators were aware of ICT support. All of them thought that it was excellent and helpful for a number of reasons. They could get help with all types of ICT issues such as problems with Blackboard. They could also get help in different ways and different places. For example, they could email the ICT support, give ICT support a phone call from office or drop-in or even do remote access at home. One teacher educator mentioned Centre for Learning and Teaching (CLT) that gives particular help with features of Blackboard itself to do with marks, grades and assessment.

Meanwhile, one teacher educator thought that it was ICT control instead of ICT support. He could fix the problems by himself if he could get permission (administrative rights) from them. As he points out below, getting permission isn't always simple or possible.

> *They (ICT support) can do what they can do very well, but if you ask some question that's not something they think should support, a piece of software you are using for your teaching, they cannot support you with that. They can support you with Microsoft office, they can support you with connecting your computer with network, their support is very restrictive. I had to ask them permission I don't have permission to do, so getting permissions I can support myself, that's the most the support I require from them, and I have to get permission to support myself, I have to get somebody else, you cannot get permission to support yourself on your own computer to install software. You have to get somebody higher. When I said support, I called support to get the permission to support myself, so they are limited for myself, but for others it maybe fine. (ETE1)*

Teacher educators interviewed offered a range of suggestions in response to *"What additional support would you like the university to provide?"* They required some training or workshops for something new or something unusual, like some new gadgets and programmes. They thought it would be better to have emails to inform them of the new technologies. They also wanted to know how to use devices more effectively

(whiteboards, smartboards), have some advanced training, and to have consistency of equipment between classrooms. Some of the difficulties created by these inconsistencies are outlined in the following respondent's comments:

> *So every room seems to have different system going, and again if you get a ECU laptop, it's okay, you can click in, but some have glass whiteboards, some have smartboards, some have regular whiteboards, so you always trying work out what room you are gonna be in to depend on what technology you might be using, so some have a computer connected to the projector, and others you are gonna bring your own laptop to plug in, so different every time. (ETE2)*

Some teacher educators say the school of education has provided great support for ICT, as they have someone who can help with that and one-to-one training. CLT also provides quite a lot of professional development. Some think that academic staff should have whatever technology they want, support themselves and ICT support should be about enabling that to happen.

ECU pre-service teachers' view on ICT support

The ECU pre-service teachers figured out the ICT support was quick and helpful when they came across problems in the classroom, but they also thought there should be assistance with how to use technologies physically and how to integrate these technologies into teaching. For example, help could be provided on how to use printers, scanners and projectors. Workshops or training for pre-service teachers on how to use an interactive whiteboard before they go out on their teaching practice were also needed. One pre-service teacher, however, did not expect the simple training on how to use computers, but thought that university students should have pre-established basic knowledge of using computers.

Overall ECU findings

The previous sections of this chapter examined teacher educators' and pre-service teachers' ICT ownership, skills and use within the context of ECU ICT policies and support. This part compares teacher educators' and pre-service teachers' employment of

and attitudes to ICT, with a particular focus on the congruity of the practices used by the two groups, as displayed in Figure 4.17 below.
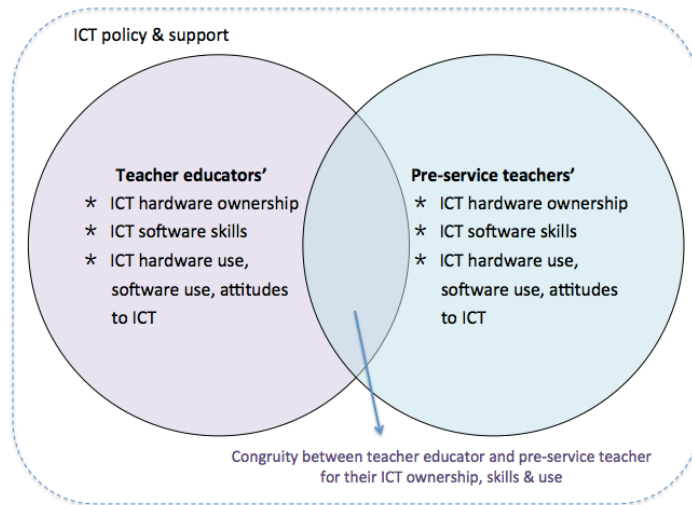
Figure 4.17 Structure of the overall findings

ECU teacher educators and pre-service teachers owned various technology devices, as can be seen from Figure 4.18. The hardware devices that most ECU teacher educators owned were a printer, followed by a scanner, a smart phone, a desktop, a tablet and a laptop. On the other hand, a greater percentage of pre-service teachers owned was a smart phone, followed by a laptop, a printer, a scanner, a tablet and a desktop. The average ownership of hardware devices as listed for ECU pre-service teachers was less than teacher educators, especially the ownership of desktops, tablets and scanners.

The different patterns of ownership by teacher educators and pre-service teachers have a number of possible explanations. Teacher educators have a high level of ownership of both desktops and tablets and this may be because they were early adopters of these devices. More teacher educators than pre-service teachers owned printers and scanners because they needed to use the devices for preparing handouts and printing out pre-services teachers' assignments when they were working at home.

Pre-service teachers' higher level of ownership of portable devices such as laptops and smart phones than teacher educators maybe due to alternative access for the teacher educators such as university owned devices.
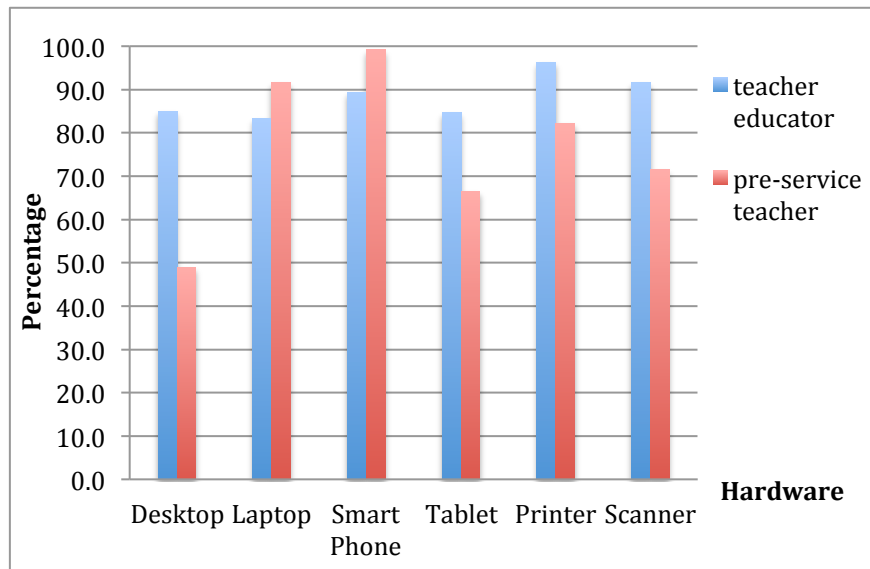
Figure 4.18 ECU TEs' and PSTs' ICT ownership comparison

The teacher educators at ECU indicated some level of competency in all categories. They had at least basic knowledge and skills of using all types of software, especially email, word processing, slideshows, the learning management system, internet browsing and digital photography, but only a small number of ECU teacher educators had at least competent skills in using video editing (see Figure 4.19).
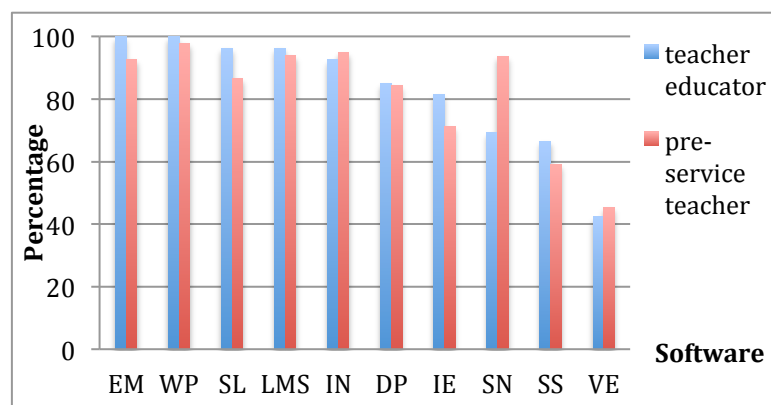
EM – Email	WP – Word Processing	SL – Slideshows	LMS – Learning Management System
IN – Internet Browsing	DP – Digital Photography	IE – Image Editing	SN – Social Networking
SS – Spreadsheeting	VE – Video Editing		

Figure 4.19 ECU TEs' and PSTs' ICT skills (advanced or competent) comparison

The pre-service teachers also indicated some level of competency in all categories, especially word processing, internet browsing, the learning management system, social networking and email. Like ECU teacher educators, ECU pre-service teachers knew

little about video editing, but different from teacher educators, the greatest number of pre-service teachers demonstrated advanced self-perceived skill with software was in the social networking software.

This is probably because pre-service teachers are members of a younger generation who use social media much more than teacher educators. This is supported by the 2018 statistics regarding social media use in Australia by age group, which shows that 94% of respondents from Australia aged between 12 and 24 years reported to currently use any social media (see Figure 4.20). The statistics from the Yellow Social Media Report (2018) also indicates that age groups under 40s (most pre-service teachers in these groups) use social media more frequently than age groups over 40s (most teacher educators in these groups).
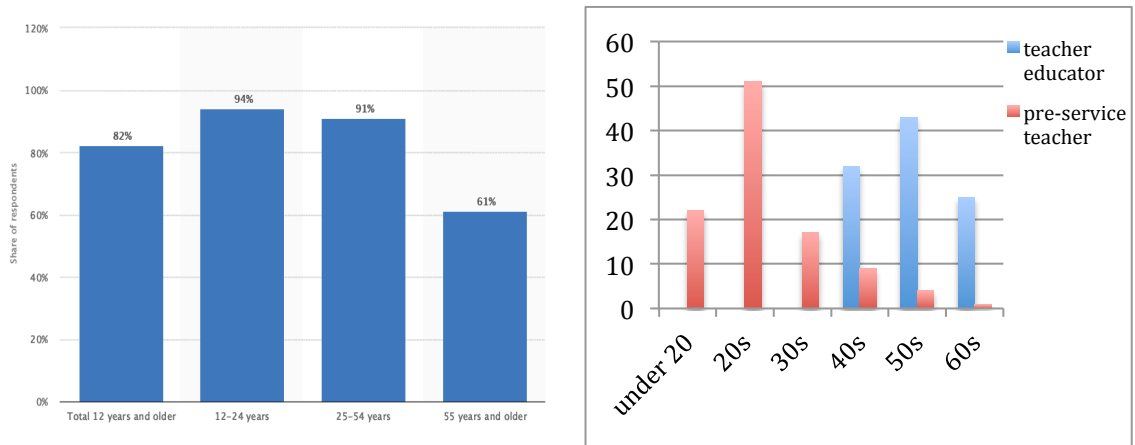
Frequency of using social networking sites	Total Sample (1516) %	Male (757) %	Female (755) %	18-29 (296) %	30-39 (303) %	40-49 (304) %	50-64 (309) %	65+ (304) %
More than 5 times a day	34	26	41	55	52	38	19	6
Every day (1-4 times)	28	27	28	26	27	31	30	24
Most days	13	13	13	11	11	13	15	13
A few times a week	7	8	5	4	4	3	12	11
About once a week	3	4	3	1	2	5	4	6
Less often	4	6	2	1	1	4	6	7
Never	12	16	8	2	4	6	15	33

Figure 4.20 Social media use in Australia, by TE and PST

(Yellow Social Media Report, 2018)

For the frequency of use, laptops and printers were more frequently used rather than desktops, smart phones, tablets and scanners (see Figure 4.21). Based on the results of the interviews, the pre-service teachers used a laptop more frequently than a desktop because the laptop was portable and convenient to use. Teacher educators used desktop more than pre-service teachers because they used a desktop in the classroom for

teaching. Pre-service teachers used smartphones more frequently because they used it as a supplementary device for checking emails, blackboard or social media. They did not use tablets much because of the keyboard and limitations of using some software such as word processing.
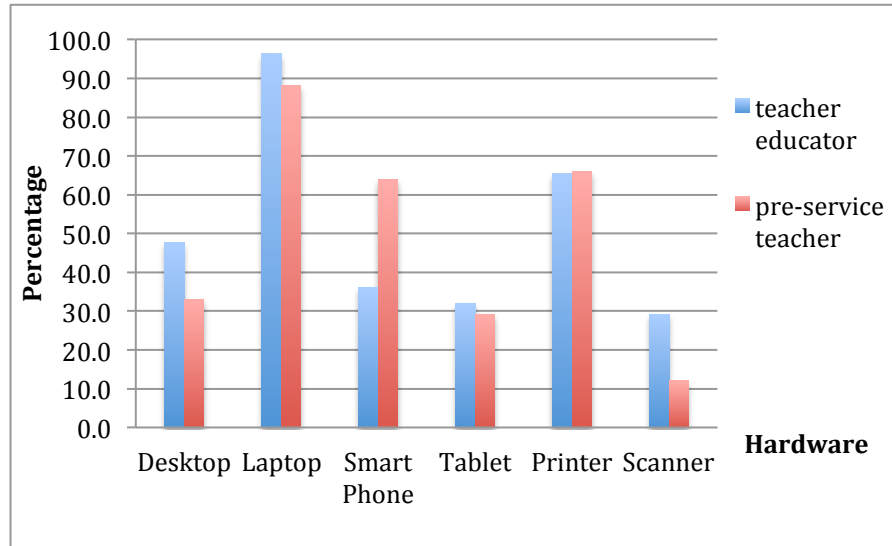
Figure 4.21 ECU TEs' and PSTs' hardware frequency (daily or weekly) of use

For the software use, teacher educators most frequently used word processing, slideshows, email, the learning management system and internet browsing but less used image editing, video editing, digital photography and social networking (see Figure 4.22). The same as teacher educators, pre-service teachers more frequently used internet browsing, the learning management system, word processing and email, less used slideshows, spreadsheeting, image editing, video editing and digital photography. However, teacher educators used slideshows and spreadsheeting more than pre-service teachers perhaps because teacher educators prepared teaching keynotes and figures for their lectures and did research for writing their papers more than pre-service teachers. Pre-service teachers used social networking more than teacher educators because as the younger generation they felt more comfortable of using social networking for their learning.
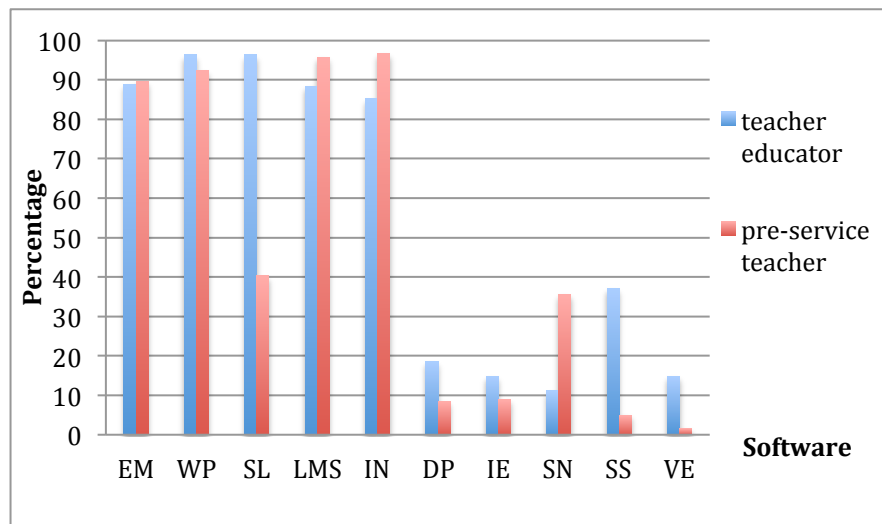
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 4.22 ECU TEs' and PSTs' software frequency (daily or weekly) of use

    Both ECU teacher educators and pre-service teachers preferred to wait for awhile to try new technology rather than being an early adopter (see Figure 4.23). However, there were more pre-service teachers in this category and a higher percentage of teacher educators were the first people to check out a new electronic device or gadget which means the pre-service teachers were more conservative or perhaps this was because of the cost of the new technology according to the interviews. The teacher educators tended to wait because they felt uncomfortable with using a lot of new technology and would like to have someone to show them how to use unless the technology was relevant, meaningful and useful as indicated in interviews.
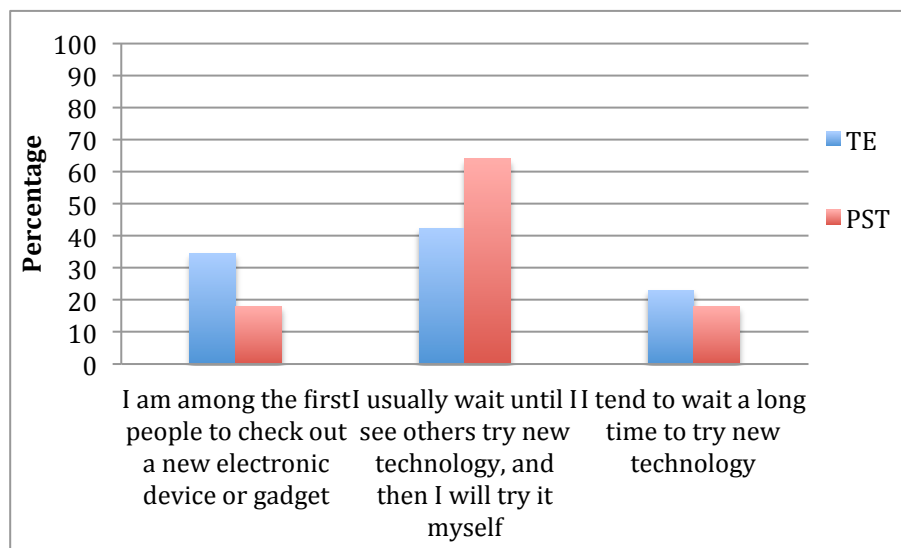
Figure 4.23 ECU TEs' and PSTs' tendency to adopt ICT

For ICT support that ECU provided to teacher educators and pre-service teachers, most of the teacher educators and pre-service teachers agreed or strongly agreed that they were able to solve technological problems related to their teaching or learning (see Figure 4.24). Less teacher educators agreed or strongly agreed that the university offered them adequate maintenance and support for technology resources than pre-service teachers. However, more teacher educators held positive attitudes about the workshops related to ICT training offered and the online tutorials and technological instruction than pre-service teacher.
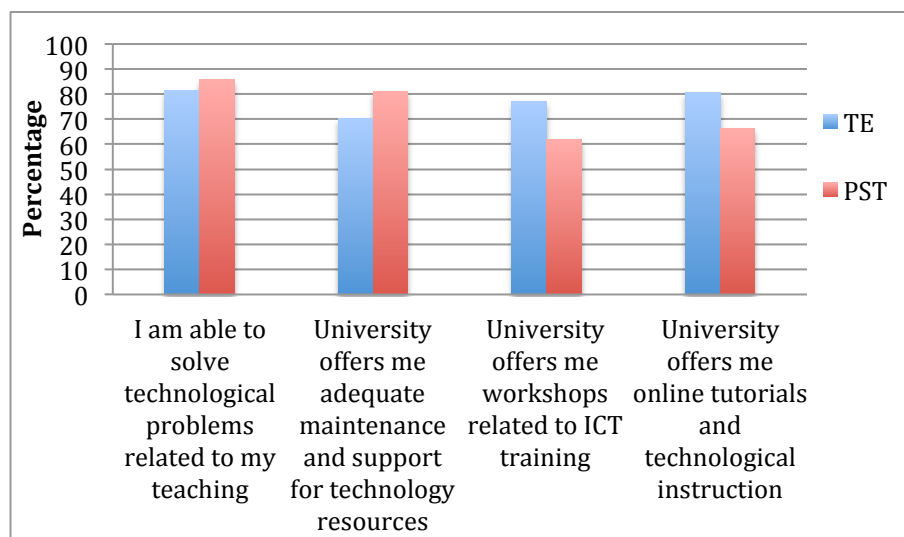
Figure 4.24 ECU TEs' and PSTs' positive attitudes to ICT support

All the teacher educators interviewed had been aware of ICT support and held positive attitude towards university support, however, some felt it was more ICT control

rather than ICT support. The ECU teacher educators also indicated that they required some training or workshops when new or unusual technologies were introduced or how to use devices more effectively. Both teacher educators and pre-service teachers held positive attitudes toward university support but they also expected some workshops and training on how to use technology such as the interactive whiteboard before pre-service teachers' school teaching practice.

Summary

This chapter has presented the findings of case study of Edith Cowan University which document teacher educators' and pre-service teachers' ICT ownership, skills, use and the institutional ICT policy and support. Some of key insights provided by these findings include:

For ECU teacher educators, they had an average high ownership of each hardware device, especially printers, scanners and smart phones. The most ECU pre-service teachers owned were smart phones, laptops and printers. For pre-service teachers, their average of ownership of devices was lower than teacher educators, especially the ownership of desktops, tablets and scanners.

For ICT skills, both ECU teacher educators and pre-service teachers indicated some level of competency, especially email, word processing, the learning management system, and internet browsing. They all had lower level of using video editing. However, it was important to notice that pre-service teachers had advanced skill in using social networking.

For the application of ICT, laptops and printers were more frequently used by both ECU teacher educators and pre-service teachers. However, ECU teacher educators used desktops more than pre-service teachers because of the classroom teaching. Pre-service teachers used a laptop more because it was portable and convenient. Similar to ICT skills, both ECU teacher educators and pre-service teachers more frequently used email, word processing, the learning management system and internet browsing but less used video editing and other software. Pre-service teachers used social networking more than

teacher educators. Both ECU teacher educators and pre-service teachers were more prefer to wait for awhile to try the new technology. However, pre-service teachers were more conservative than teacher educators.

For ICT support that ECU provided, both ECU teacher educators and pre-service teachers held a positive attitude. However, more teacher educators felt negative in ICT maintenance and support, while more pre-service teachers disagreed with the ICT workshops and training.

The following chapter provides the case study results of Curtin University.

Chapter Five: Curtin University case study

Introduction

This purpose of this chapter is to present the findings and analysis regarding Curtin teacher educators' and pre-service teachers' hardware ownership, self-perceived software skills, and use of digital devices and software in their teaching and learning, as identified within this phase of the research.

Twenty Four teacher educators and 152 pre-service teachers from Curtin were involved in the online survey and five teacher educators and five pre-service teachers who have participated in the survey agreed to the semi-structured interviews.

Background and context

As one of the leading universities in Western Australia and a member of Australian Technology Network (ATN), Curtin is famous for its academic and practical research, especially combining technology with the academic fields. Since 1975, the School of Education has offered courses that encourage pre-service teachers to learn teaching theory and practice in an innovative way by using technologies (Curtin University, 2019b), with the aim of preparing highly skilled and informed pre-service teachers who can teach and work in a fast-changing world. Besides, Curtin offers online learning platforms such as Massive Open Online Courses (MOOCs) and is part of Open Universities Australia (OUA).

Curtin quantitative data results

As with the research that has been done at ECU, Curtin University teacher educators and pre-service teachers were invited to participate in the survey and interviews, which sought to identify their hardware ownership, self-perceived software skills, how they apply digital devices and software in their teaching and learning and how they access the internet and what are their attitudes toward ICT. This section presents the quantitative data results from Curtin teacher educators and pre-service teachers.

Demographics

Of the 24 teacher educator participants, 42% were male and 58% were female. Their age ranged from 35 to over 66 years old. Those aged over 66 were the largest group (14%). Thirty-eight percent of Curtin teacher educators had 8-15 years of work experience in higher education. Forty-six percent of them had a doctoral degree. The teacher educators were teaching in different programs and disciplines. The majority of Curtin teacher educators were teaching in the primary program (46%) and 17% were teaching Maths, Humanities and Social Sciences.

Of the 152 Curtin pre-service teacher participants, 15% were male and 85% were female. Their age ranged from 17 to 60 years old. Those aged 19 were the largest group (32%). Of Curtin pre-service teachers, 35% had completed half a year study at university. The majority of them were studying full-time (95%) and studying on campus (90%). The pre-service teachers were studying in different programs and disciplines. Most of Curtin pre-service teachers were in primary program (55%) with the largest group, 36% studying Science.

Curtin teacher educators' ICT ownership

The first section of the survey asked 24 Curtin teacher educators to identify the hardware they owned and how long they had owned each item.

The survey, conducted in 2016, found a high level of ownership of all the devices, as shown in Figure 5.1. On average, over 70% of teacher educators owned hardware devices, with the highest percentage owning laptops and smart phones and the lowest owning desktops. The breakdown per device is as follows: laptop (100%); smart phone (100%); printer (95%); scanner (90%); tablet (86%); and, desktop (71%). Despite this high overall level ownership across devices, at least 14% still did not own a desktop or a tablet.

The number of years teacher educators owned particular devices varied. As Figure 5.1 shows, 68% of them possessed printers for five years or more and 66% owned scanners for a similar period of time. In contrast, only 47% possessed tablets and 50% possessed smart phones for five years or more. A sizeable percentage of teacher educators (8%) owned smart phones for between three and four years. However, none of them owned tablets for this length of time and 19% had them for only one to two years.
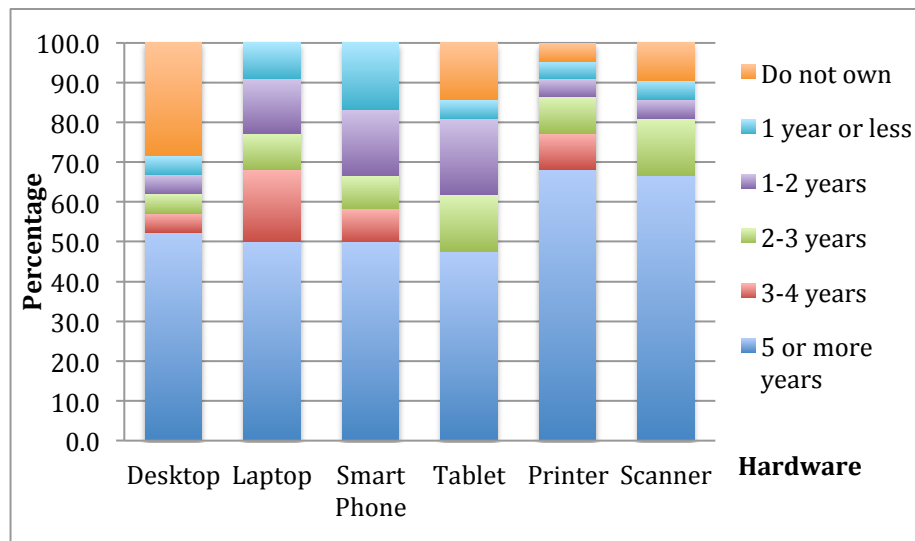
Figure 5.1 Curtin TEs' hardware ownership

Curtin teacher educators' ICT skills

Teacher educators reported some level of competency in all categories. According to the findings presented in Figure 5.2, no teacher educators at Curtin reported having little knowledge about email, word processing, slideshows, the learning management

system, internet browsing and digital photography. This indicates that teacher educators had at least basic knowledge and skills of using those types of software.

Teacher educators reported the highest level of advanced skills with the learning management system, followed by email, word processing and slideshows, with nearly 80% or over rating themselves advanced. In contrast, only 12% of teacher educators reported having advanced skills in using video editing and nearly 42% indicated they knew little about video editing.
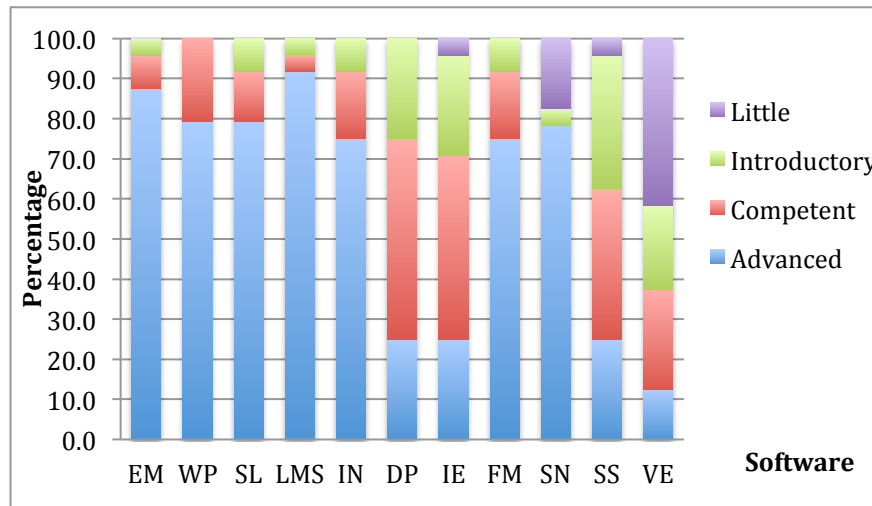
EM – Email	WP – Word Processing	SL – Slideshows	LMS – Learning Management System
IN – Internet Browsing	DP – Digital Photography	IE – Image Editing	SN – Social Networking
SS – Spreadsheeting	VE – Video Editing		

Figure 5.2 Curtin TEs' software skills

Curtin teacher educators' ICT use

The third part of the survey identified how Curtin teacher educators used ICT, including what hardware they used, how frequently they used it, how they accessed the internet and their attitudes towards ICT.

Hardware use

Figure 5.3 shows the frequency of use for each of the hardware types utilised for teaching purposes. Ninety percent of teacher educators were using desktops for their teaching at Curtin. On the other hand, more than 40% did not use a smart phone, more than 32% did not use a tablet, a printer or a scanner for teaching.

With regard to frequency of use, nearly 46% used a laptop and 45% used a desktop daily. It should be noted that even though a high percentage of teacher educators owned a smart phone, a tablet, a printer and a scanner, quite a large number of them did not use these devices for teaching purposes.
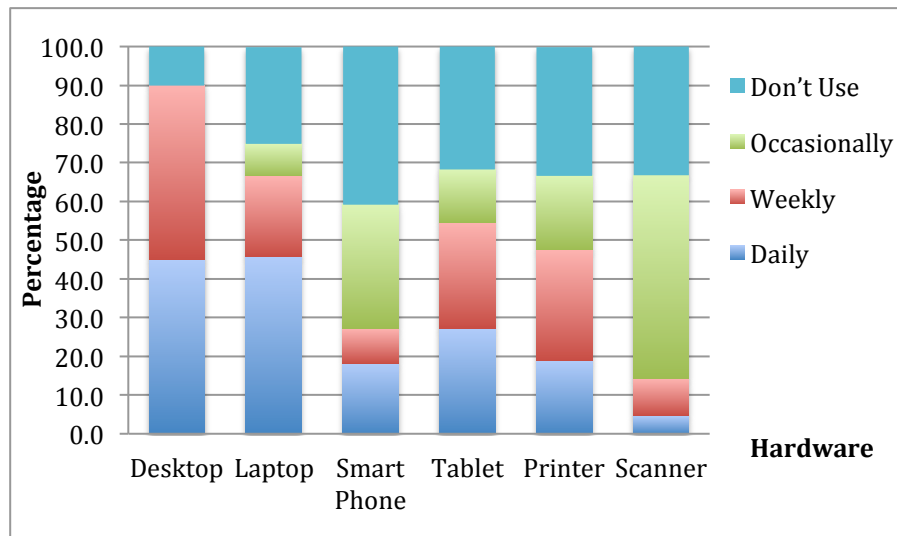
Figure 5.3 Curtin TEs' hardware frequency of use

Software use

Figure 5.4 illustrates the frequency of use of the various software types. In 2016, all teacher educators at Curtin reported using email, word processing and internet browsing. The majority (at least 50%) used these software items and the learning management system at least on a daily basis.

Least used were video editing, social networking and image editing. Over 52% of Curtin teacher educators reported never using video editing for their teaching in 2016, and over 40% of them never used social networking and image editing.

The frequency of teacher educator software use was consistent with their software competence, and may suggest that with more frequent use, teacher educators are likely to become more ICT competent.
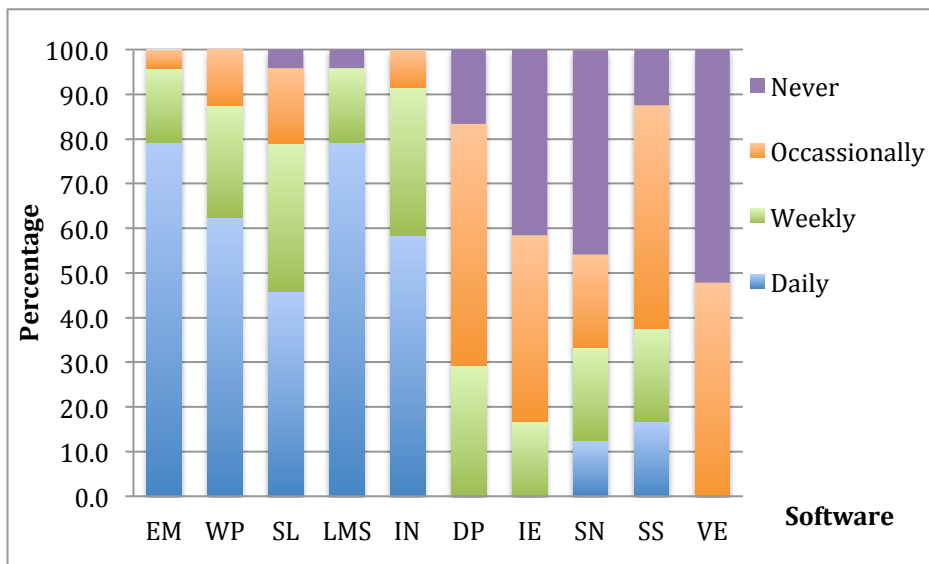
EM – Email WP – Word Processing SL – Slideshows LMS – Learning Management System

IN – Internet Browsing DP – Digital Photography IE – Image Editing SN – Social Networking

SS – Spreadsheeting VE – Video Editing

Figure 5.4 Curtin TEs' software frequency of use

The tools or resources that Curtin teacher educators used the most in their teaching was the learning management system known as Blackboard (see Figure 5.5). Ninety six percent always or often used it. Searching tools were also widely used, with 92% of Curtin teacher educators utilising them for teaching. However, few used polling tools, innovative computer interfaces and simulation or educational games. Eighty one percent never or seldom used polling tools and 91% never or seldom used innovative computer interfaces such as Virtual Reality (VR).
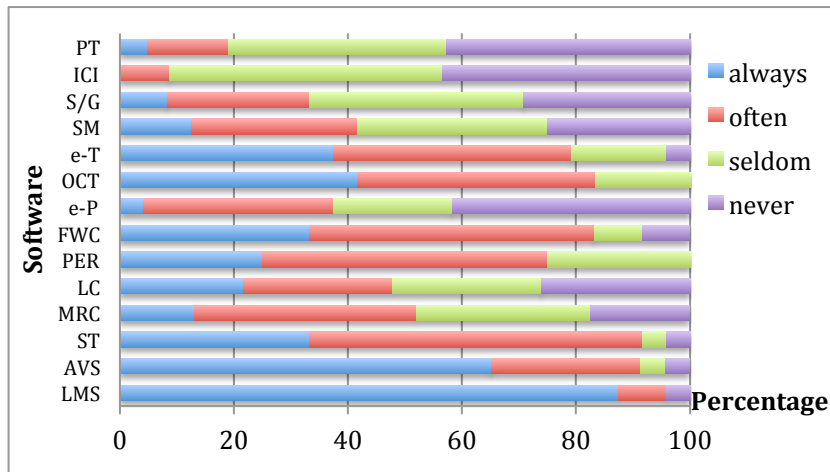
PT-polling tools ICI-innovative computer interfaces S/G-simulations or educational games SM-social media

e-T-e-textbooks OCT-online collaboration tools PER-publishing electronic resources ST-search tools

e-P-e-portfolios AVS-academic validation software MRC-multimedia resources creation

LC-lecture capture LMS-learning management system FWC-free, web content

Figure 5.5 Curtin TEs' software frequency of use

Internet access

Teacher educators' use of internet types at Curtin is presented in Figure 5.6, and subsequently discussed. In 2016, most of the teacher educators at Curtin had accessed the internet at home or through their mobile and 88% of them accessed the internet at home daily. Eighty three percent connected to internet through their mobile daily (see Figure 5.6). Over two thirds of them used the wi-fi provided by Curtin, but only 44% used the university computer lab.
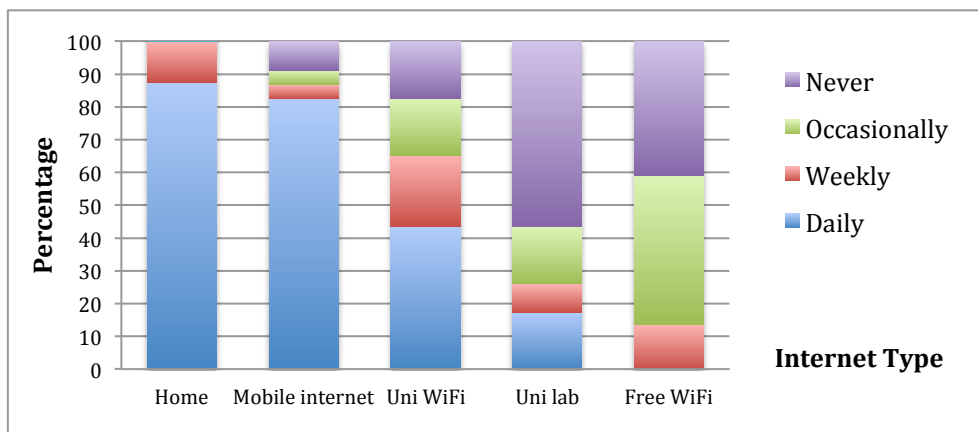
Figure 5.6 Curtin TEs' use of internet type

Attitudes toward ICT

Figure 5.7 shows the speed with which Curtin teacher educators adopt new technology. It reveals that the majority of those surveyed (63%) preferred to wait until they saw others try the new technology before trying it themselves. However, quite a large percentage were among the first to try out a new electronic device or gadget (29%). The remaining 8% tended to be conservative and would wait for a long time to try new technology. These results indicate that just under a third of Curtin teacher educators have a very positive attitude toward adopting new technology and almost two thirds are willing to try it once they see it used successfully by colleagues.
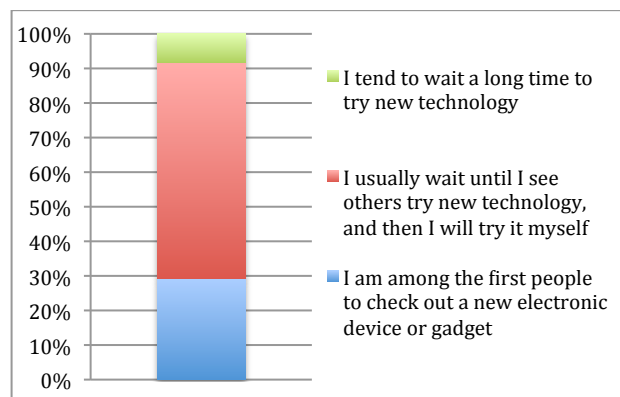
Figure 5.7 Curtin TEs' tendency to adopt ICT

Nearly 96% of Curtin teacher educators agreed or strongly agreed that they were able to solve technological problems related to their teaching (see Figure 5.8). Ninety five percent on average, agreed or strongly agreed that the university offered them adequate maintenance and support for technology resources. All of them were positive about the workshops related to ICT training offered and 91% about the online tutorials and technological instruction.
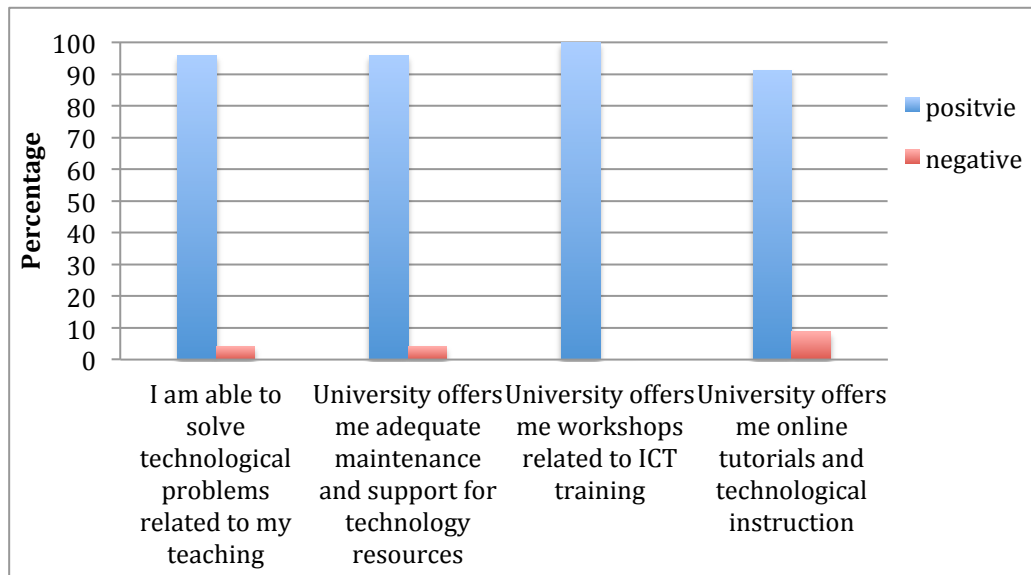
Figure 5.8 Curtin TEs' attitudes to ICT support

Curtin pre-service teachers' ICT ownership

Curtin pre-service teachers were asked to identify what hardware they owned and how long they had owned it.

As can be seen in Figure 5.9, the average length of hardware devices by Curtin pre-service teachers was less than Curtin teacher educators, especially the ownership of desktops, tablets, printers and scanners.

The hardware device that the highest percentage of Curtin pre-service teachers owned was a laptop (100%). This was followed by a smart phone (97%), a printer (75%) and then a scanner (63%). However, over 60% of them did not own a desktop and 43% did not own a tablet.

As with Curtin teacher educators, most of Curtin pre-service teachers possessed some of the hardware devices such as smart phones, printers, laptops and scanners for five or more years. Over 30% of them owned these devices for five or more years. This is not as high a percentage as teacher educators. Moreover, 29% pre-service teachers owned a laptop for two years or less. This maybe because pre-service teachers are young and still rely on their parents, so they only possessed a laptop since going into university.
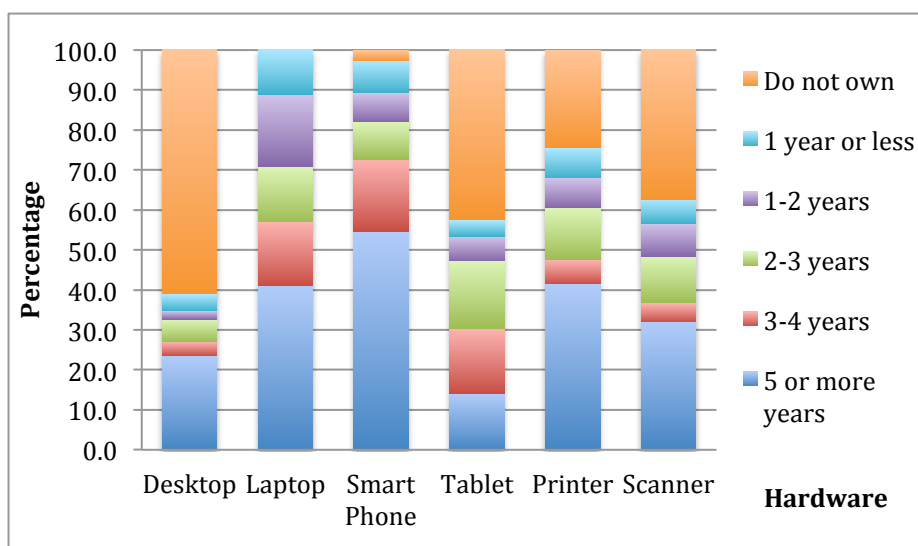
Figure 5.9 Curtin PSTs' hardware ownership

Curtin pre-service teachers' ICT skills

As shown in Figure 5.10, pre-service teachers indicated some level of skills in using the all the software listed.

Pre-service teachers reported the highest level of skills in social networking, with over 90% considering themselves at advanced level and over 5% at competent level. They also reported high advanced or competent skill levels in use of the learning management system, word processing, internet browsing, email and slideshows with the percentage of advanced users ranging from 80%+ to less than 50% and of competent users ranging from to 40%+ to 10%.

As with Curtin teacher educators, the areas in which pre-service teachers reported the lowest percentage of advanced skills and the highest percentage of minimal knowledge was spreadsheeting and video editing. Only 15% and 10% respectively considered themselves advanced and 13% considered they had little knowledge of these two areas.
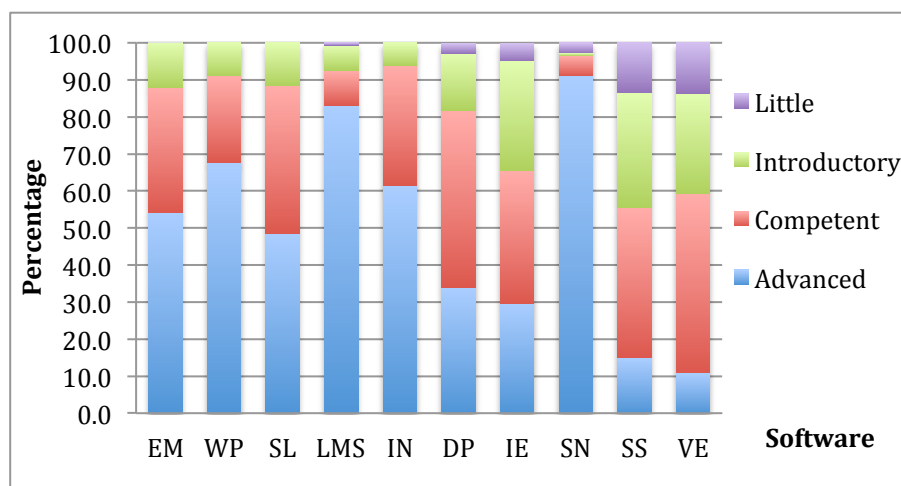
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 5.10 Curtin PSTs' software skills

Curtin pre-service teachers' ICT use

This section reveals how pre-service teachers used ICT, including their hardware use, software use, internet access and attitudes toward ICT.

Hardware use

This section reports on the frequency that pre-service teachers ICT use in terms of hardware and software. Figure 5.11 shows the frequency of use for each of the hardware types utilised for study purposes. Again, the mobile devices (laptops and smart phones) are those most frequently used. Over 91% and 36% respectively of pre-service teachers used a laptop and a smart phone at least daily in their studies. The next most frequently used devices were printers and desktops. However, it should be noted that over 67% of pre-service teachers did not use desktops for their studies. Tablets too, were less frequently used in study, with a high percentage (64%) not making use of them. This probably reflects the low level of tablet ownership.
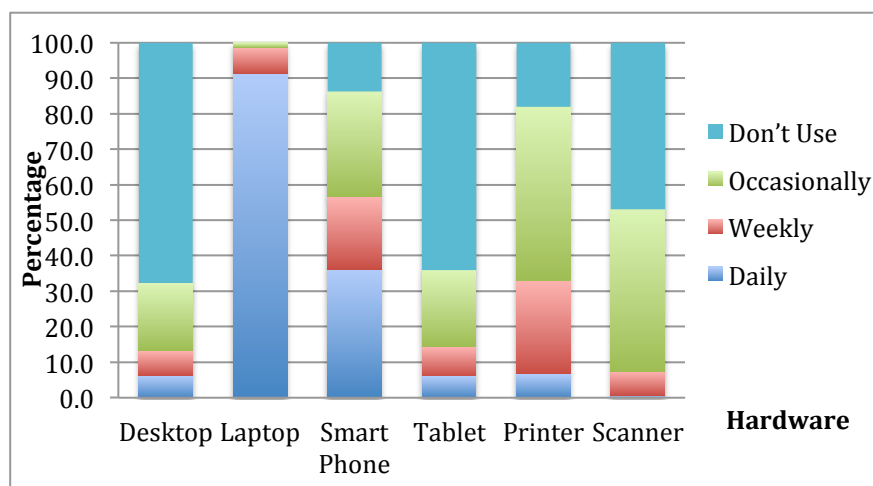
Figure 5.11 Curtin PSTs' hardware frequency of use

Software use

Figure 5.12 illustrates the frequency of use for the various software types. In 2016, all pre-service teachers at Curtin reported using email, the learning management system and internet browsing. The majority (at least 50%) used these software items and word processing at least on a daily basis. Least used were spreadsheeting, digital photography, social networking and image editing. Over 60% of Curtin pre-service teacher reported never using spreadsheeting for their learning in 2016, and over 30% of them never used digital photography, social networking and image editing. The frequency of pre-service teacher software use was consistent with their software competence, and may suggest that with more frequent use, pre-service teachers are likely to become more ICT competent.

EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 5.12 Curtin PSTs' software frequency of use

   The tool or resource that Curtin pre-service teachers expected their teacher educators to use the most in their teaching was also the learning management system. At Curtin 87% in total thought teacher educators should always or often use the LMS (see Figure 5.13). Eighty three percent of pre-service teachers also wanted teacher educators to use free, web-based content. However, few pre-service teachers wanted teacher educators to use polling tools.
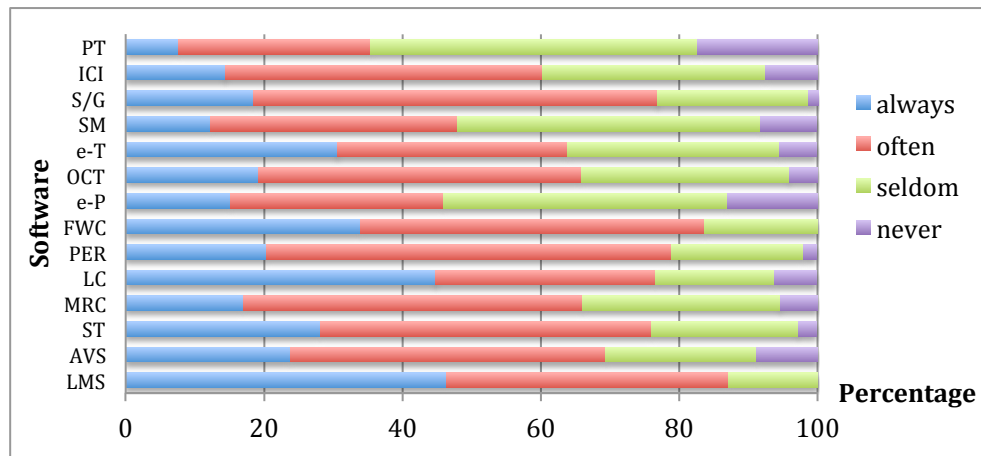
PT-polling tools	ICI-innovative computer interfaces
e-T-e-textbooks	OCT-online collaboration tools
e-P-e-portfolios	AVS-academic validation software
LC-lecture capture	LMS-learning management system

PT-polling tools   ICI-innovative computer interfaces   S/G-simulations or educational games   SM-social media

e-T-e-textbooks   OCT-online collaboration tools   PER-publishing electronic resources   FWC-free, web content

e-P-e-portfolios   AVS-academic validation software   MRC-multimedia resources creation   ST-search tools

LC-lecture capture   LMS-learning management system

Figure 5.13 Curtin PSTs' expectation to TEs' software frequency of use

Internet access

As with teacher educators, most of the pre-service teachers at Curtin accessed the internet at home or used their mobile internet. Nearly 92% of them accessed the internet at home daily, while 72% connected with the internet through their mobile daily (see Figure 5.14), 55% of them used the university wi-fi daily. Only 7% of them used the university computer lab daily to access the internet.
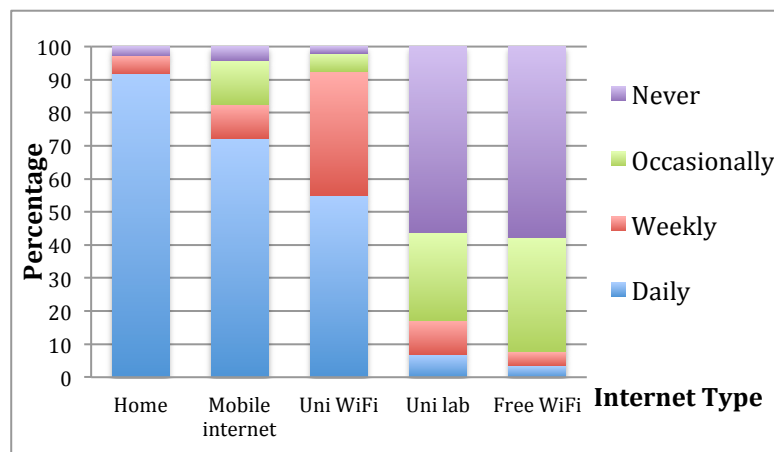
Figure 5.14 Curtin PSTs' use of internet type

Attitudes toward ICT

Figure 5.15 shows the results of survey questions about adoption of new technology. It indicates that most (71%) Curtin pre-service teachers preferred to wait for a while and see others try new technology and then try it themselves. Only 16% of them were early adopters and tended to be the first people to check out a new electronic device or gadget. The remaining 13% were conservative and waited for a long time to try new technology. These results suggest that Curtin pre-service teachers have a less positive attitude to adopting new technology than teacher educators.
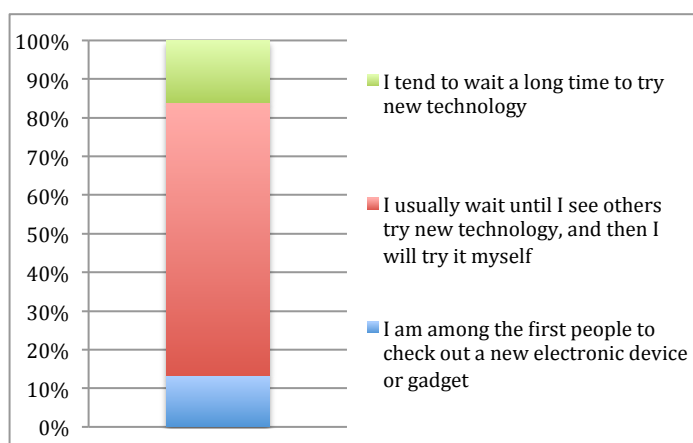
Figure 5.15 Curtin PSTs' tendency to adopt ICT

Ninety one percent of Curtin pre-service teachers agreed or strongly agreed that they were able to solve technological problems related to their learning (see Figure 5.16). Most of Curtin pre-service teachers held a positive attitude towards university support. Eighty one percent agreed or strongly agreed that the university offered them

adequate maintenance and support for technology resources. However, nearly 21% or over still thought they needed the university to provide more ICT training and online tutorials and technological instruction.
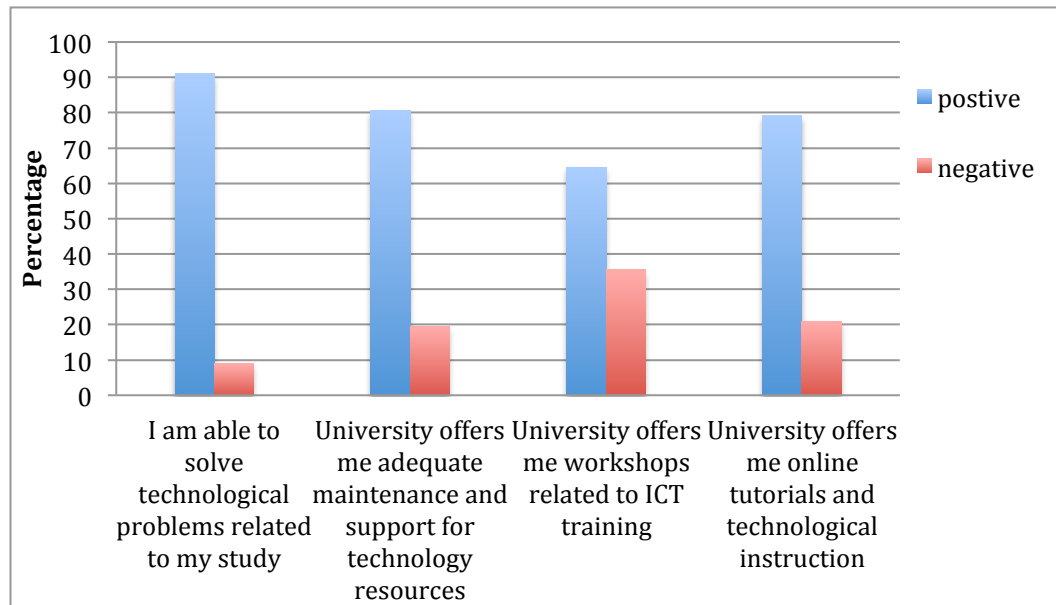
Figure 5.16 Curtin PSTs' attitudes to ICT support

Curtin qualitative data results

This section presents the qualitative data results regarding Curtin teacher educators' and pre-service teachers' ICT confidence, ICT use and ICT policy and support.

Curtin teacher educators' ICT confidence

Five Curtin teacher educators were interviewed about how confident they were using ICT in their teaching. They were asked to rate their level of confidence as: very confident; confident with technologies used; and, less confident. All rated themselves on the first two levels, as is shown in their comments below.

Three participants thought that they were very confident in using ICT in their teaching. A typical reason given was, "I always use it, so I feel very confident" (CTE3). This participant felt he could easily sort things out if he came across problems. Other two participants were comfortable with using technology and everything worked for them. One of them said, "[I'm confident] Because I'm teaching adults. If something goes wrong, someone there can fix things for me" (CTE4).

Two participants felt that they were only confident with technologies that they were using at the moment, for example, "I'm confident using what I want to use" (CTE1). Another said he was only confident working at a basic level, he claimed, "I just put the basics of using the desktop, using projector, doing PowerPoints, using a USB or plug in my own PC, all these things on, developing and preparing the material I'm very confident" (CTE2).

Curtin teacher educators' ICT use

The interview questions related to ICT use in teaching revealed that most of the teacher educators at Curtin used the desktop and the projector in the classroom. Some of them brought their own laptops just in case of problems with the desktop at university, but most of the time this desktop worked. Some of the teacher educators used their own iPads for presenting their lectures. They also used their smart phones to check emails or tried to encourage pre-service teachers to use smart phones more often because some schools integrated smart phones into their teaching.

The university also provides a limited number of iPads for teaching and learning. However, the devices were not always charged and needed to be booked beforehand, especially for courses like the Mathematics. Tablets were generally not used because of problems with the wi-fi connection and interfacing with the projector. Teacher educators thought the day of the tablet was past as students saw little value in tablets now that smart phones were quite large. One of the teacher educators pointed out that it was hard to read on a phone, but thought that this difficulty could be overcome by using appropriate learning apps.

Most Curtin teacher educators interviewed were not early adopters. Early adoption depended on the type of new technology being introduced and the affordances of the technology. For example, if the teacher educator really wanted the students to be able to do something, he/she would still adopt it in their classroom teaching, even if the new technology was not stable.

One teacher educator mentioned he would start experimenting and using new technology such as Virtual Reality, which is a current area of technology development, if the university obtained it. Teacher educators indicated they did not intend to adopt the latest technology, like the latest Mac, because it was expensive. On the other hand, others were still aware of the new technology, but did not necessarily use them because it was not always important to have the latest technology as most PCs can do all that is required. However, even teacher educators who said they preferred to delay adoption were willing to learn the new technology by themselves or from others if they thought it would enhance their teaching.

Curtin pre-service teachers' ICT confidence

All of the five pre-service teachers interviewed were very confident in using the devices they had for learning because of their familiarity with the technology. One had problems with Discussion Board in Blackboard, but as it was not a priority for him, he did not see the value of using it, and was not bothered by the difficulties.

Even though all interviewees were very confident with using technology, one was still learning new programs like Mathspace or Kahoot. Another pointed out:

> *Workshops and training should be provided for new students when they first came to the university because, at the beginning, it took them quite a long time to determine how to find readings, use Blackboard properly and get textbooks online.* (CPST3)

Interviewees were not very confident about their ability to use technology in their future teaching. Only one of the pre-service teachers interviewed felt very confident about this. She thought teaching practice would help her to prepare for using technology in the classroom in future. Others felt a little scared of using technology as school teachers, for while they felt confident with what they have already knew, they worried about how they would cope with new technology or the technologies that schools used but they were not familiar with. They were also afraid of technology going wrong or not working in the classroom, but they still wanted to be able to use it because of its benefits.

Curtin pre-service teachers' ICT use

The Curtin pre-service teachers interviewed indicated they used devices such as laptops, iPads and smart phones.

All pre-service teachers used laptops, while only some used smart phones or tablets. Some of the pre-service teachers pointed out that they used laptops because it was easier to read on big screen than on an iPad or smart phone screen. The small screen was difficult to read and to use for writing assignments, so they preferred to use smart phones to check emails, grades, assessment due dates or unit outlines. One pre-service teacher used only a laptop, as her phone was quite old. Another pre-service teacher had a laptop, a smart phone and a tablet, but mainly used the laptop as she didn't feel comfortable using a number of devices when teaching.

Some interviewees found smart phones distracting for study because of the notifications popping up. One pre-service teacher preferred a laptop to a smart phone or a tablet because she preferred to use a keyboard rather than a touch screen. Two others found tablets acceptable because they could be used in a similar way to a laptop and were therefore convenient. However, tablets also had limitations such as restrictions in their use at university and the fact that some apps could not been downloaded onto them.

Mobile devices rather than desktops were used because they were portable, convenient, wireless and able to be used at the university. Desktops were occasionally used in the library, especially if pre-service teachers forgot their own laptops.

The attitudes to ICT of the Curtin pre-service teachers interviewed tended to be conservative. They preferred to wait and see how the technology worked. Two of the pre-service teachers thought that there was no need to try the new technology; they preferred to stay within their comfort zone and were happy with what they had at the moment. They did not rush to get the new technology because what they had worked perfectly for what they needed to do. Another two pre-service teachers said that they were not familiar enough with the new technology and found it was scary, so they were

hesitant to try it. One of them would have liked to see other people use it and would then try it if it worked.

Curtin ICT policy and support

This section presents the findings from document analysis and views of teacher educators and pre-service teachers about Curtin's ICT policy and support, as revealed by the interview data.

ICT policy

Curtin IT Service (CITS) have set up ICT policies and procedures to ensure users use ICT facilities and services in an appropriate, secure and risk-appropriate manner. From analyzing the documents from Curtin University websites, the results indicated that Curtin University ICT policies were several standards and guidelines such as how to access the internet and how to use mobile devices. Users also need to comply with the requirements outlined in these procedures and in the related information security policies, for example:

> *b. Download and/ or access files or click on ay links to websites without exercising Reasonable Care and considering whether the content may adversely affect ICT Assets.*
>
> *e. Upload, download, install or distribute unlicensed or inappropriately licensed software.*
>
> (Curtin University, 2019b)

Curtin ICT policies also put more emphasis on security, control and monitor users' behaviour. For personal devices use, users should have to ensure appropriate security controls are applied to non-University devices, as it states that "Installation and continued operation of Curtin software to control or monitor the non-University device." (Curtin University, 2019a, p. 2)

From the interviews, teacher educators at Curtin appeared not to be aware of any ICT policies at Curtin. However, some of them mentioned regulations around assessment and about uploading or use of inappropriate materials, copyright requirements and the need to get administrative approval to download software.

Curtin teacher educators' view on ICT support

At Curtin, there is central ICT support for as general support for the whole university. There is also a learning support team in the School of Education to help teacher educators with using ICT in the classroom teaching and setting up Blackboard. In addition, there is ICT training every three months, formal training for how to use Blackboard and Turnitin for new teacher educators and informal training if teacher educators have problems.

In the interviews, teacher educators were all aware of the ICT support provided by the university. They made positive comments about this ICT support, saying it was very helpful, solved problems quite quickly as they came to where they were working and showed them what to do.

Most of the teacher educators interviewed did not expect more support from the university, but one of them mentioned a problem, which was that ICT support was not available online on the weekends or holidays. One of them expected to have some more training in what they could offer their students. Some also mentioned the problem with downloading and installing software, as they cannot install anything on their own but need to get administrative approval to do this.

One teacher educator was against the university having compulsory training sessions because he felt he didn't need them and he would rather learn what he needs, when he needs it.

Curtin pre-service teachers' view on ICT support

From the interviews, the Curtin pre-service teachers were all aware of the ICT support provided by the university. One of them felt the ICT support was helpful, as she said, "the ICT staff were knowledgeable and they would give step by step assistance on how to use technology" (CPST2). Three pre-service teachers did not use ICT support that much or ask for help but knew about the ICT support available in the library or from the School of Education.

With regard to getting extra help, one of the pre-service teachers felt it would be handy to know the terminology for different cables, what connected to what and how it

all worked. He thought that units on ICT or use of technology were very challenging for some pre-service teachers because they hadn't worked in that way before, but also thought that it was the stage at which they should get involved. Another first year pre-service teacher thought training or workshops on how to use specific apps that can be used in the classroom would be helpful and beneficial because they did not really cover that material in class. However, another interviewee took the opposite view. She did not need to attend a workshop unless it was on a new piece of technology that she had not seen before, as what the university provided was enough because it was not that hard to learn the technology. Finally, one pre-service teacher considered that the "Teaching the Digital World" unit was really good. It was beneficial that the unit was done in the first semester because it introduced pre-service teachers to websites that were not only excellent for teaching, but also for their own learning and that they could use repeatedly.

Overall Curtin findings

The previous sections of this chapter examined teacher educators' and pre-service teachers' ICT ownership, skills and use within the context of Curtin ICT policies and support.

The final part of this chapter compares teacher educators' and pre-service teachers' employment of and attitudes to ICT, with a particular focus on the congruity of the practices used by the two groups, as displayed in Figure 4.17.

Drawing on the findings presented throughout the chapter, Figure 5.17 compares hardware device ownership of Curtin teacher educators and pre-service teachers. It shows that, as with ECU, both Curtin teacher educators and pre-service teachers owned the various devices listed and preference for similar types of devices. Laptops and smart phones had the highest percentage of ownership for both teacher educators and pre-service teachers (90% and between 87%-90% respectively). Interestingly, there were similarities and differences for the two groups in the pattern of ownership for printers, scanners, tablets and desktops. Both groups had a higher percentage of

ownership for printers, scanners and tablets than for desktops. However, the average ownership of these devices for pre-service teachers was notably lower than for teacher educators. The results for laptops, smart phones and tablets suggest that both teacher educators and pre-service teachers have a preference for portable devices. The higher percentage of ownership by teacher educators of printers and scanners can be explained by their need to use a printer and a scanner for preparing handouts and printing out students' assignments when they work at home.
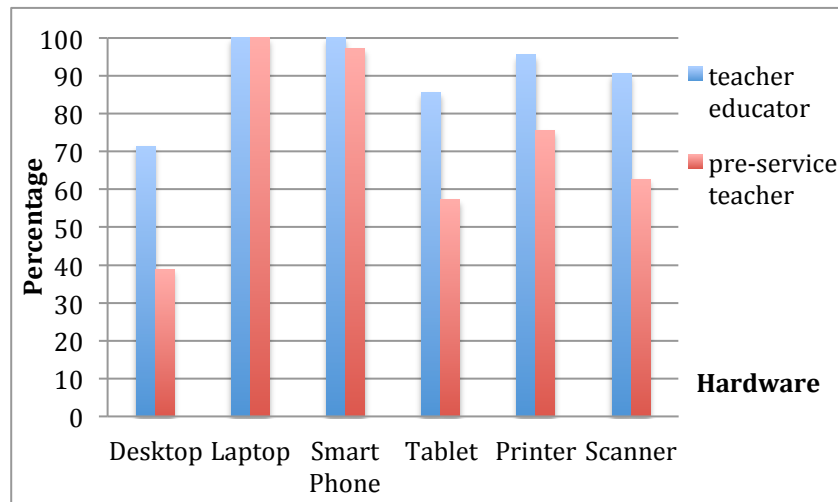
Figure 5.17 Curtin TEs' and PSTs' ICT ownership comparison

As Figure 5.18 demonstrates, teacher educators and pre-service teachers at Curtin reported at least basic knowledge and skills in using all the types of software listed. The percentage reporting skill levels for email, word processing, the learning management system, slideshows, internet browsing and social networking was very high for both groups (between about 78% and 100%), with teacher educators generally higher than pre-service teachers, except for social networking, where pre-service teachers reported a higher skill level. This is probably because pre-service teachers are younger generation who use social media much more than teacher educators.

There was a similar pattern for the other types of software. A smaller percentage of teacher educators than pre-service teachers reported advanced or competent skills in digital photography and the difference for using video editing was very large – just over 10% for teacher educators and almost 60% for pre-service teachers. Again, this is probably because pre-service teachers are younger generation who use this type of software much more than teacher educators.
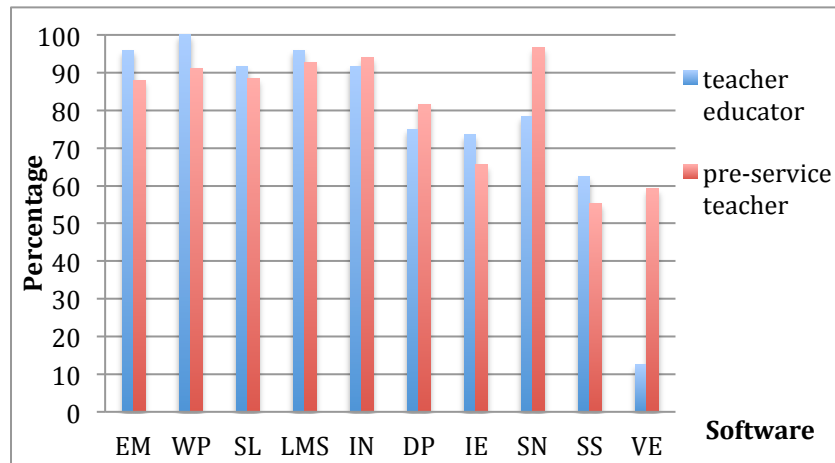
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 5.18 Curtin TEs' and PSTs' ICT skills (advanced or competent) comparison

The picture for frequency of use of hardware devices by teacher educators and pre-service teachers shows contrasts between the two groups. Figure 5.19 shows that desktops and laptops were the most frequently used by teacher educators, while tablets, printers, smart phones and scanners were less frequently used. That teacher educators were using desktops more than laptops suggests a preference for the former in the classroom teaching. In contrast, Figure 5.19 reveals that pre-service teachers used laptops and smart phones a great deal more frequently than teacher educators, but printers, tablets, desktops and scanners were less frequently used. Pre-service teachers' high frequency of use of smart phones may be because smart phones are used for checking emails, Blackboard or social media as indicated in the interviews.
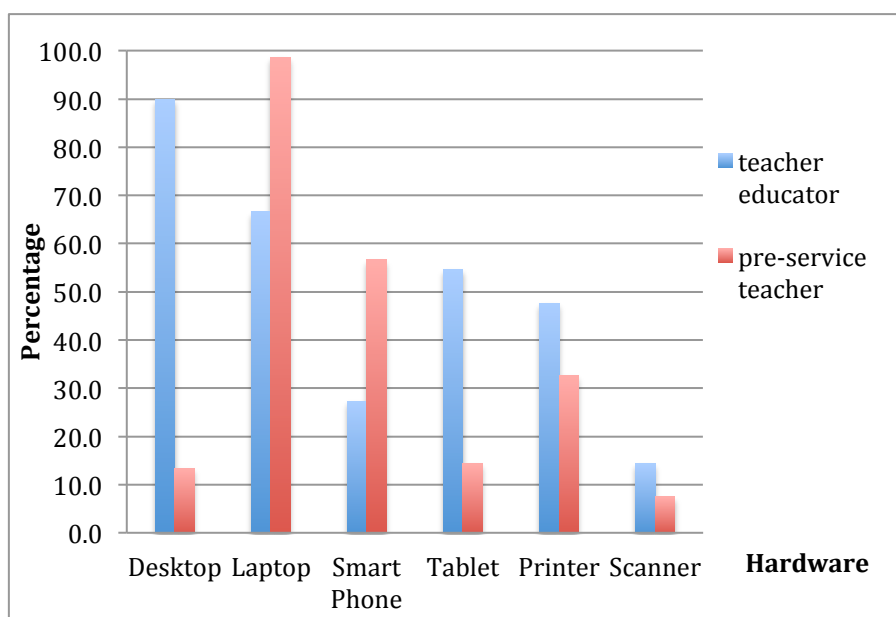
Figure 5.19 Curtin TEs' and PSTs' hardware frequency (daily or weekly) of use comparison

The frequency of software use by Curtin teacher educators and pre-service teachers revealed similarities and differences (see Figure 5.20). Both groups used email, the learning management system, internet browsing, word processing and slideshows with a high levels of frequency (between 63% and 97%). Interestingly, pre-service teachers used word processing, the learning management system and internet browsing more often than teacher educators.

There was a much lower frequency of use for the other five types of software by both teacher educators and pre-service teachers (between 4% and 39%). Pre-service teachers used digital photography and image editing significantly less often than teacher educators and even social networking less often. However, they prepared slideshows slightly more often than teacher educators and were the only ones to do any video editing.
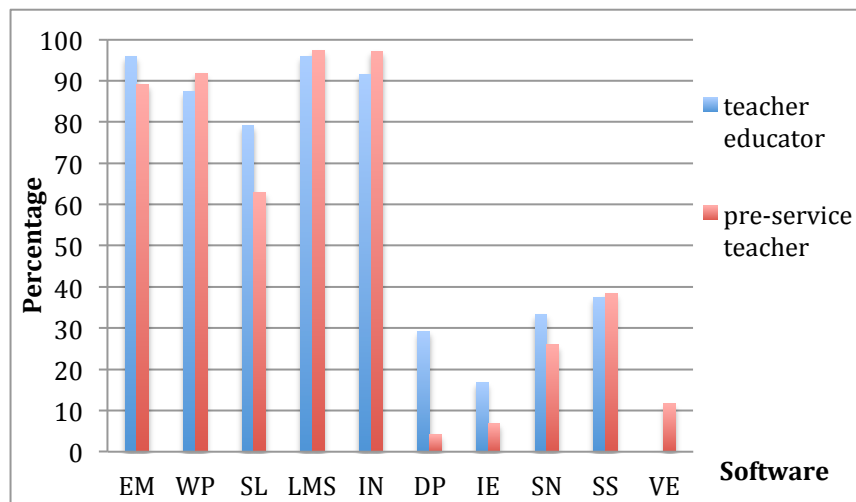
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 5.20 Curtin TEs' and PSTs' software frequency (daily or weekly) of use comparison

Curtin teacher educators and pre-service teachers showed similar tendencies in their approach to adoption of ICT, but differed in the extent of these tendencies (see Figure 5.21). The majority in both groups (62% teacher educators and 70% pre-service teachers) preferred to wait before trying the new technology rather than being an early adopter.

Some teacher educators interviewed indicated they preferred to wait but were willing to learn the new technology by themselves or from others if it would enhance their teaching. This may be why almost 30% of teacher educators were the first people to check out a new electronic device or gadget compared with just over 10% of pre-service teachers, which suggests pre-service teachers tend to take a more conservative approach and not rush to get the new technology.

A smaller percentage of teacher educators (<10%) than pre-service teachers (16%) tended to wait a long time before getting the new technology. Interview data indicated that this is because what the pre-service teachers felt they had worked perfectly for what they needed to do. Teacher educators interviewed said they tended not to adopt the latest technology because it was expensive and because it was not important to have to buy the latest technology all the time as most PCs can do everything.
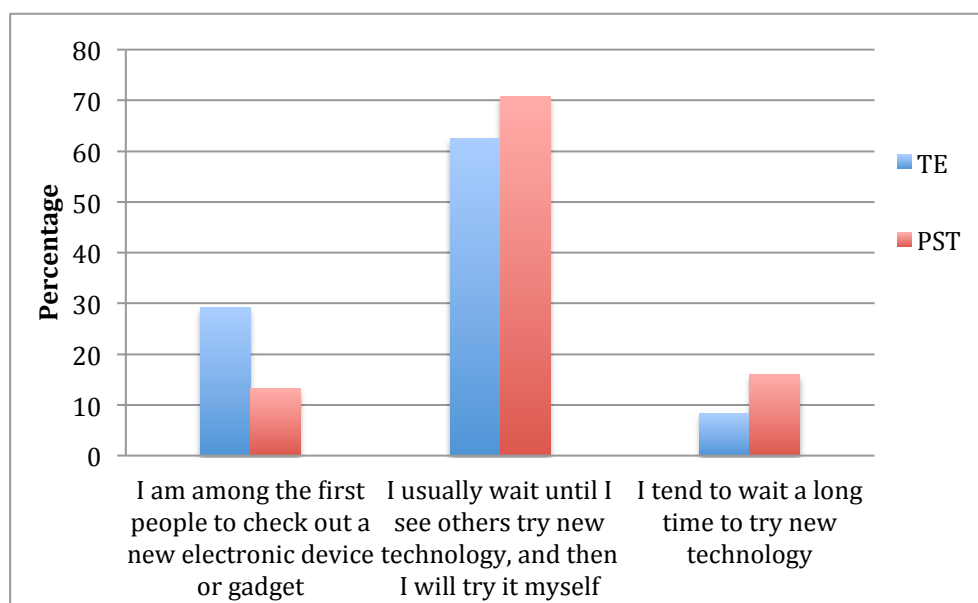
Figure 5.21 Curtin TEs' and PSTs' tendency to adopt ICT

For ICT support that Curtin provided to teacher educators and pre-service teachers, most of the teacher educators and pre-service teachers agreed or strongly agreed that they were able to solve technological problems related to their teaching or learning (see Figure 5.22). Especially, all the teacher educators agreed or strongly agreed that the university offered them the workshops related to ICT training, but less pre-service teachers held positive attitudes in this category. As teacher educators interviewed stated that they had some formal training for how to use Blackboard and Turnitin for new teacher educators and some informal training if teacher educators have problems. However, pre-service teachers were showing less positive views than teacher educators. The reason was indicated in the interviews that they did not use ICT support that much or they did not ask for help but they knew there was ICT support in the library or in the school of Education. The statement "university offers workshops for ICT training" was the least positive one because as some pre-service teachers interviewed mentioned that the training or workshops would be beneficial for pre-service teachers because they did not really cover this content in class.
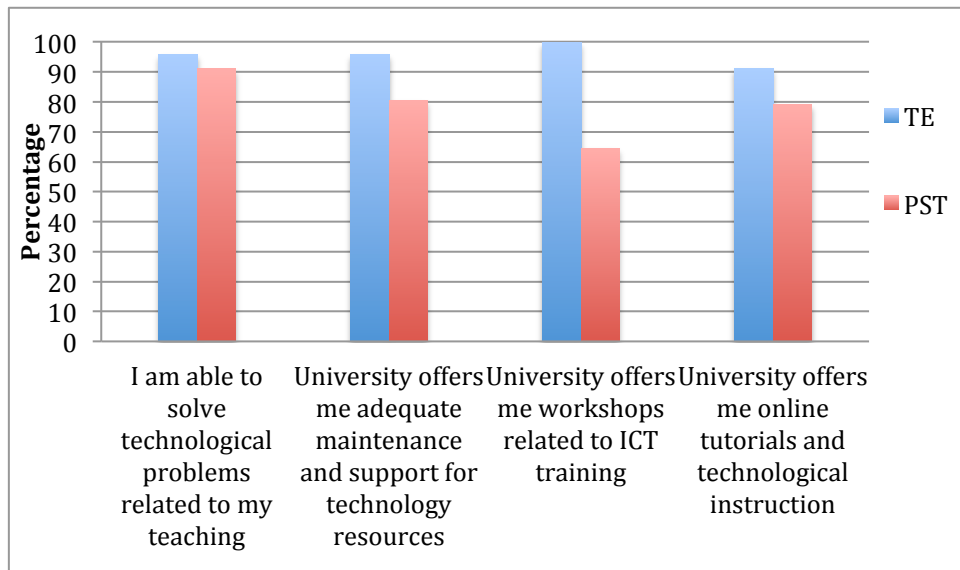
Figure 5.22 Curtin TEs' and PSTs' positive attitudes to ICT support

Summary

This chapter has presented the findings of case study of Curtin University which document teacher educators' and pre-service teachers' ICT ownership, skills, use and the institutional ICT policy and support. Some of key insights provided by these findings include:

For ICT ownership, both teacher educators and pre-service teachers at Curtin owned the various devices especially the laptops and smart phones, which suggests that both of the groups prefer to have portable devices. However, the average ownership of printers, scanners, tablets and desktops for pre-service teachers was much lower than teacher educators.

Teacher educators and pre-service teachers at Curtin reported high ICT skill levels for email, word processing, the learning management system, slideshows, internet browsing and social networking. Teacher educators were in higher level than pre-service teacher, except for social networking. The same for video editing, more pre-service teachers had advanced or competent skills in video editing.

For ICT use, desktops and laptops were the most frequently used by Curtin teacher educators, laptops and smart phones were the most frequently applied by pre-service teachers. The interviews indicated that pre-service teachers used smart phones for

checking emails or social media. Both groups frequently used email, the learning management system, word processing and slideshows, but less often used other software such as video editing. They all preferred to wait before trying the new technology rather than being an early adopter, and pre-service teachers were more conservative than teacher educators.

For ICT support that Curtin provided, both of teacher educators and pre-service teachers held positive attitudes to it. However, pre-service teachers were showing less positive opinions, especially relating to ICT training and workshops.

The following chapter provides the case study results of Open Universities Australia (OUA).

Chapter Six: Open Universities Australia case study

Introduction

This purpose of this chapter is to present and discuss the findings of the surveys and interviews of Open Universities Australia (OUA) teacher educators' and pre-service teachers' about their hardware ownership, self-perceived software skills and use of digital devices and software in their teaching and learning.

Teacher educators' views as revealed by the survey and interview data are outlined first, followed by those of pre-service teachers. Discussion of the results for each group concludes the chapter.

Twenty four teacher educators and 86 pre-service teachers from OUA were involved in the online survey. Five teacher educators and three pre-service teachers who completed the survey took part in semi-structured interviews.

Background and context

Open Universities Australia (OUA) is an online higher education organisation based in Australia. Seven Australian-based universities control the ownership of the organisation. Through OUA, students can enroll in different courses (including courses of Early Childhood, Primary and Secondary Education) online, which are provided by Australian universities and other education providers (Open Univerisities Australia, 2019). OUA allows students to complete education courses online with online support and services including access to its online learning system at anytime and through different devices and apps, and learning resources provided by experienced teacher educators.

OUA quantitative data results

OUA teacher educators and pre-service teachers invited to participate in the survey and interviews, in order to identify their hardware ownership, self-perceived software skills, how they apply these digital devices and software in their teaching and learning, and how they access the internet and what are their attitudes toward ICT. This section presents the quantitative data results of OUA teacher educators and pre-service teachers.

Demographics

Of the 24 teacher educator participants, 25% were male and 75% were female. Their age ranged from 33 to over 66 years old. Those aged 60 constituted the largest group (17%). Thirty-eight percent of OUA teacher educators had 8-15 years of work experience in higher education. Fifty-eight percent of them had a master degree. The teacher educators were teaching in different programs and disciplines. The majority of OUA teacher educators were teaching in the primary program (96%) and 30% were teaching Humanities and Social Sciences.

Of the 86 OUA pre-service teacher participants, 9% were male and 91% were female. Their age ranged from 19 to 64 years old. Those aged 36 were the largest group (9%). Of OUA pre-service teachers, 68% had never or only completed half a year study at university. The majority of them were studying full-time (63%). The pre-service teachers were studying in different programs. Most of OUA pre-service teachers were in primary program (71%) with the largest group.

OUA teacher educators' ICT ownership

The first section of the survey asked 24 Open Universities Australia (OUA) teacher educators to identify the hardware they owned and how long they had owned each item.

The survey, conducted in 2016, found a high level of ownership of all the devices listed in Figure 6.1. On average, almost 70% of teacher educators owned hardware devices, with the highest percentage owning laptops and smart phones and the lowest owning desktops and tablets. The breakdown per device is as follows: laptop (100%);

smart phones (100%); printer (96%); scanner (92%); tablet (87%); and, desktop (68%). Despite this high overall level ownership across devices, at least 13% still did not own a desktop or a tablet.

The number of years teacher educators owned particular devices varied. As Figure 6.1 shows, 54% of them possessed laptops and printers for five years or more and 50% owned smart phones and scanners for a similar length of time. In contrast, only 35% possessed tablets for five years or more. A sizeable percentage of teacher educators (12%) owned smart phones for between three and four years. However, 25% had them for only one year or less.
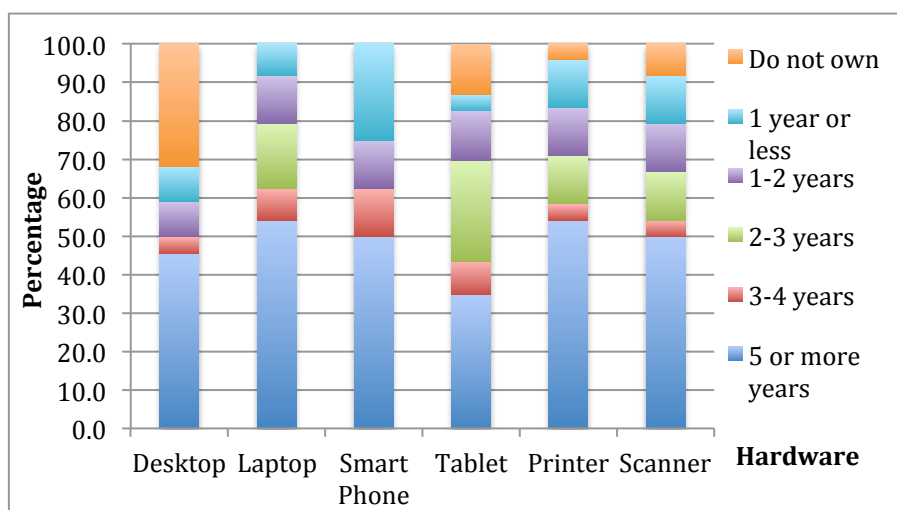
Figure 6.1 OUA TEs' hardware use

OUA teacher educators' ICT skills

As a result of the survey, the teacher educators indicated some level of competency in all categories. According to the findings presented in Figure 6.2, no teacher educators at OUA reported having little knowledge about email, word processing, slideshows, the learning management system, internet browsing and digital photography. This indicates that teacher educators had at least basic knowledge and skills of using those types of software.

Teacher educators reported the highest level of advanced skills with the learning management system, followed by email, word processing and slideshows, with over 60% on average rating themselves advanced. In contrast, only 12% of teacher educators

reported having advanced skills in using video editing and nearly 46% indicated they knew little about video editing.
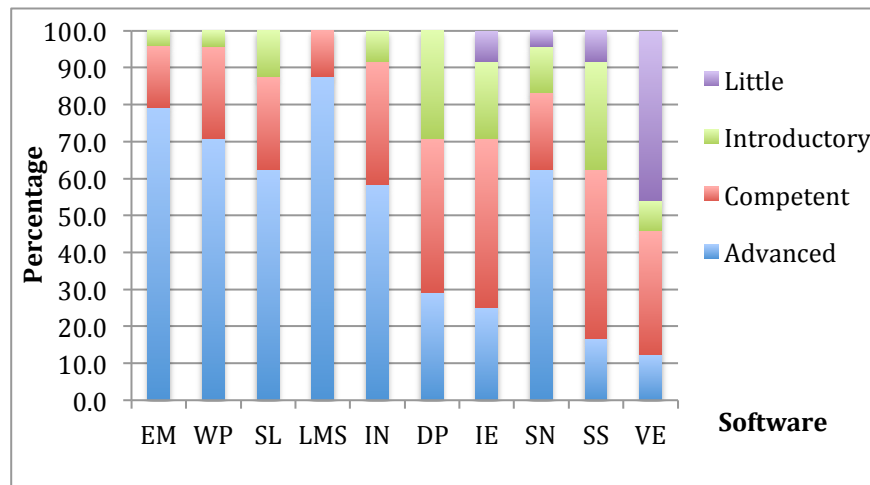
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 6.2 OUA TEs' software skills

OUA teacher educators' ICT use

The third part of the survey identified how OUA teacher educators used ICT, including what hardware they used, how frequently they used it, how they access the internet and their attitudes towards ICT.

Hardware use

Figure 6.3 shows the frequency of use for each of the hardware types utilised for teaching purposes. Ninety one percent of teacher educators for OUA courses at Curtin were using printers for their teaching. On the other hand, more than 42% did not use a tablet, more than 27% did not use a desktop, a smart phone or a scanner for teaching.

With regard to frequency of use, more than 60% used a laptop and 54% used a desktop daily. It should be noted that even though a high percentage of teacher educators owned a desktop, a smart phone, a tablet and a scanner, quite a large number of them did not use these devices for teaching purposes.
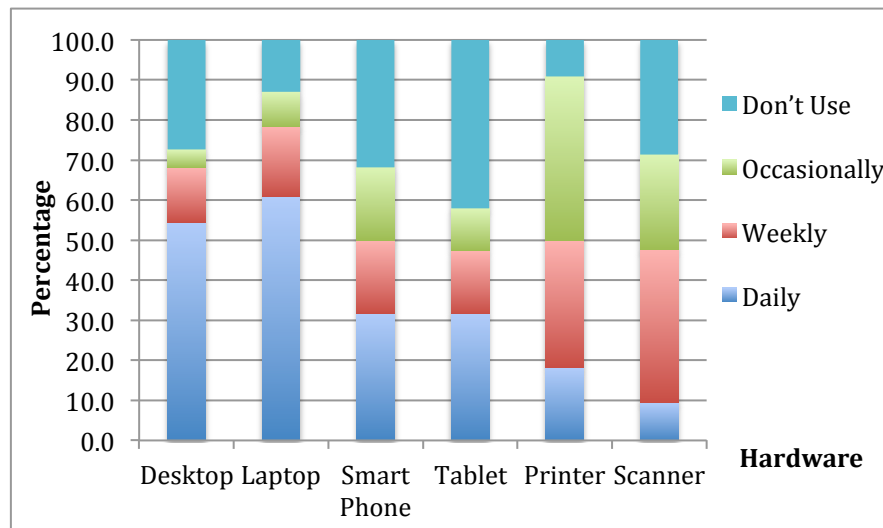
Figure 6.3 OUA TEs' hardware frequency of use

Software use

Figure 6.4 illustrates the frequency of use of the various software types. In 2016, all teacher educators at OUA reported using email, word processing, slideshows and the learning management system. The majority (at least 50%) used emails, word processing, the learning management system and internet browsing at least on a daily basis.

Least used were social networking, video editing and digital photography. Half of OUA teacher educator reported never using social networking for their teaching in 2016, and over 30% of them never used video editing and digital photography. The frequency of teacher educator software use was consistent with their software competence, and may suggest that with more frequent use, teacher educators are likely to become more ICT competent.
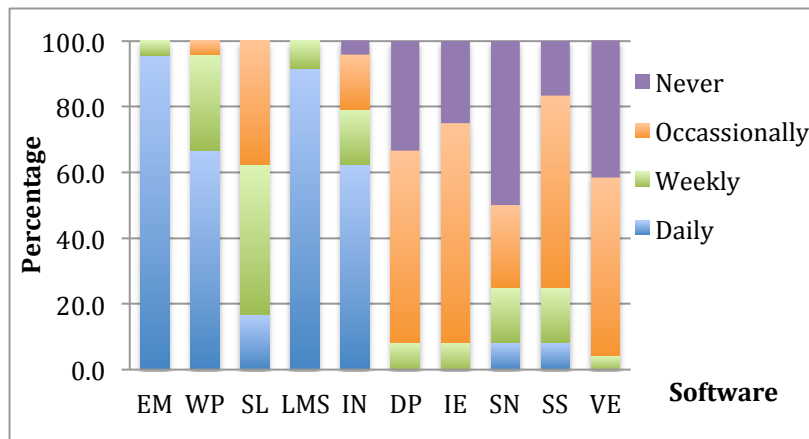
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 6.4 OUA TEs' software frequency of use

Because of the characteristics of online education, software used for OUA teaching and learning were slightly different from the other two universities. As seen in figure 6.5, discussion board was the most frequently software used in classroom teaching, with all OUA teacher educators using it in their teaching, academic validation software, e-textbooks and collaboration tools were the next most frequently used. Simulations/games/google earth were least used by OUA teacher educators.
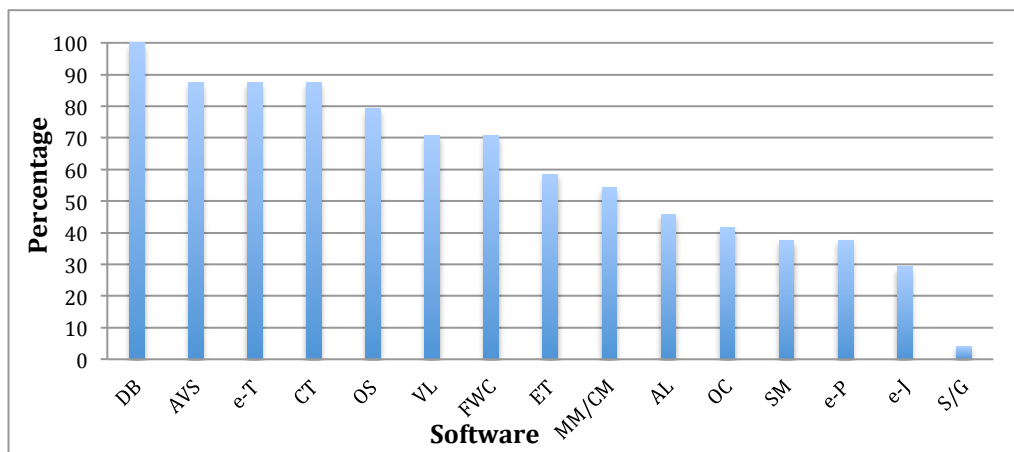
DB-Discussion board   AVS-Academic validation software   e-T-e-textbooks   CT-Collaboration tools

OS-Online software   MM/CM-Mind-mapping/concept mapping   FWC-Free web content   ET-Electronic quizzes/ tests

VL-Video lectures   OC-Online classroom-live with lecturer   SM-Social media   e-P-e-portfolios

e-J-e-journals   S/G-Simulations/games/google earth   AL-Audio lectures

Figure 6.5 OUA TEs' software use

The tools that OUA teacher educators used the most in their teaching was academic validation software, with 100% reporting they always or often used it (see Figure 6.6). Ninety six percent of OUA teacher educators used online collaboration tools for teaching. However, few used social media, lecture captured audio, simulations or educational games. Seventy four percent reported never or seldom using social media, 73% never or seldom used lecture captured audio and 71% never or seldom used simulations or educational games as a teaching and learning tool.
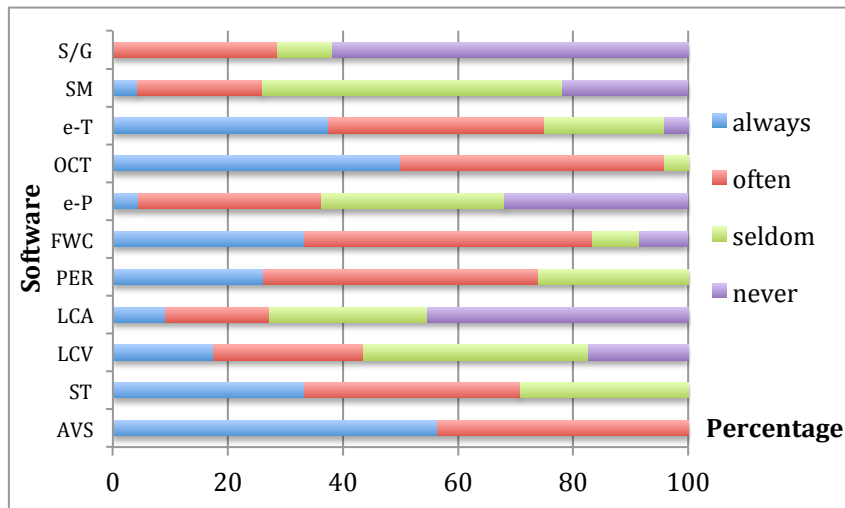
LCA-lecture captured audio	LCV-lecture captured video	S/G-simulations or educational games	SM-social media
e-T-e-textbooks	OCT-online collaboration tools	PER-publishing electronic resources	ST-search tools
e-P-e-portfolios	AVS-academic validation software	FWC-free, web content	

Figure 6.6 OUA TEs' software frequency of use

Internet access

Teacher educators' use of internet types at OUA is presented in Figures 6.7, and then discussed.

In 2016, most of the teacher educators at OUA had accessed internet at home or used mobile internet and 100% of them accessed the internet at home daily. Fifty eight percent connected daily to internet through their mobile (see Figure 6.7). Half of them did not use the wi-fi or the computer lab provided by the university that hosted the OUA courses (Curtin).
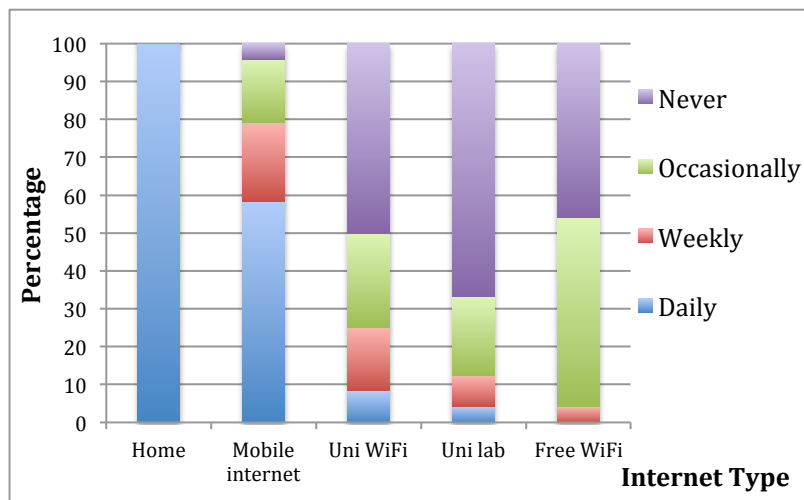
Figure 6.7 OUA TEs' use of internet type

Attitudes toward ICT

Figure 6.8 shows the speed with which OUA teacher educators adopted new technology. It reveals that the majority of those surveyed (54%) preferred to wait until they saw others try the new technology before trying it themselves. However, quite a large percentage were among the first to try out a new electronic devices or gadgets (38%). The remaining 8% tended to be conservative and would wait to try new technology. These results suggest that OUA teacher educators have positive attitudes towards adopting new technology and are willing to try it.
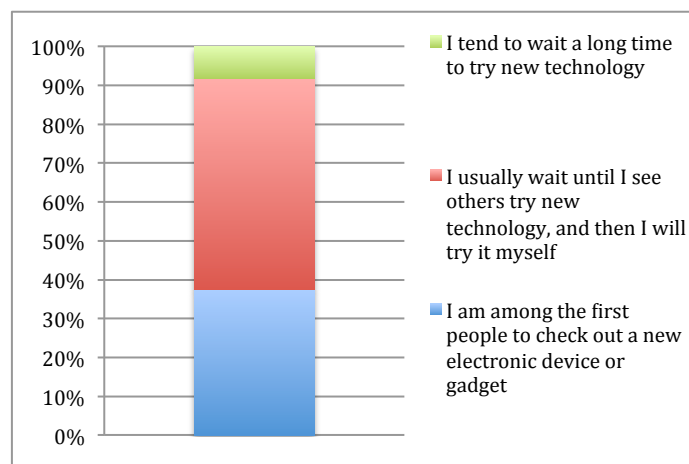
Figure 6.8 OUA TEs' tendency to adopt ICT

Because OUA teacher educators are teaching online, so no statement "University offers me workshops related to ICT training" for them, the same for OUA pre-service teachers. Nearly 92% of OUA teacher educators agreed or strongly agreed that they

were able to solve technological problems related to their teaching (see Figure 6.9) and most held positive attitudes towards support offered by the university. Ninety one percent agreed or strongly agreed that the university offered them adequate maintenance and support for technology resources. Ninety six percent were positive about the online tutorials and technological instruction.
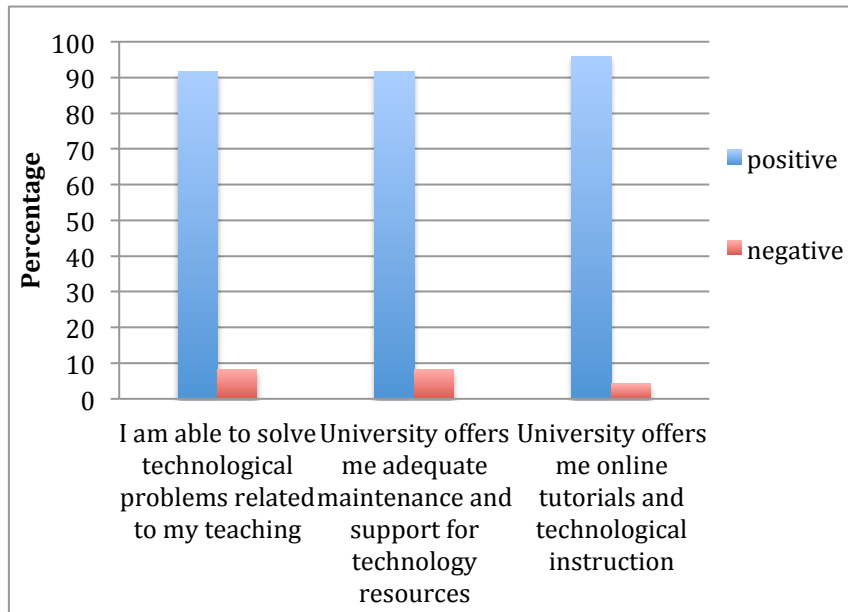
Figure 6.9 OUA TEs' attitudes to ICT support

OUA pre-service teachers' ICT ownership

Eighty six Open Universities Australia (OUA) pre-service teachers completed the survey. In this section, they identify what hardware they owned and how long they had owned it.

As can be seen in Figure 6.10, the average ownership of hardware devices by OUA pre-service teachers was less than OUA teacher educators, especially the ownership of desktops, tablets, printers and scanners.

The hardware device that the highest percentage of OUA pre-service teachers owned was a smart phone (97%). This was followed by a laptop (93%), a printer (77%) and a tablet (75%). However, over 53% of them did not own a desktop and 35% did not own a scanner.

As with OUA teacher educators, most of OUA pre-service teachers possessed hardware devices such as smart phones, desktops, laptops and printers for five or more

years. Nearly 30% or over of them owned these devices for five or more years. This is not as high a percentage as for teacher educators. Moreover 38% pre-service teachers owned a laptop in two years or less, and nearly 29% obtained a printer in the last two years.
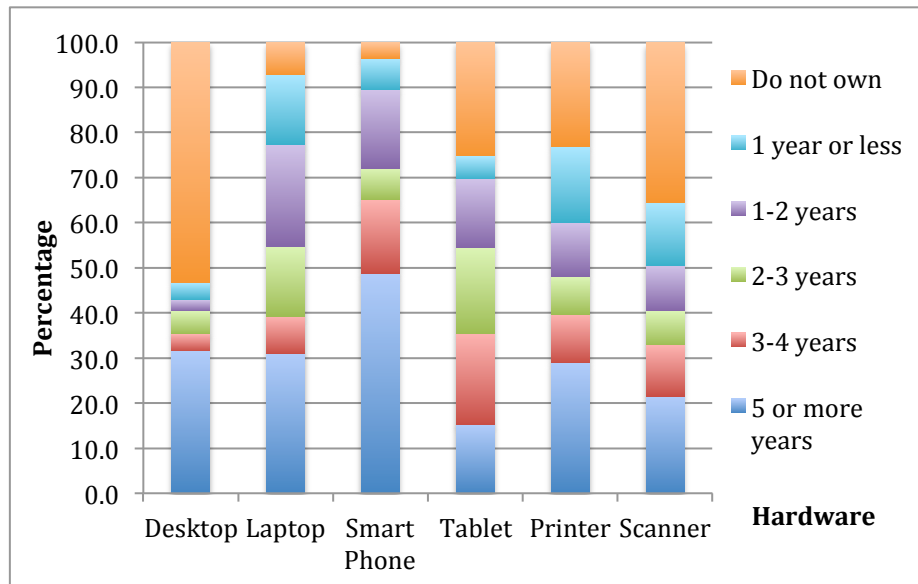
Figure 6.10 OUA PSTs' hardware ownership

OUA pre-service teachers' ICT skills

As shown in Figure 6.11, all pre-service teachers indicated some level of competency in the skills listed. According to the findings presented in Figure 6.11, all pre-service teachers at OUA reported having at least basic knowledge and skills in using email, word processing and internet browsing. Over 85% of pre-service teachers reported having advanced self-perceived skills with software for social networking, followed by the learning management system for which just under 80% reported having advanced skill levels. As with OUA teacher educators, over 44% of OUA pre-service teachers reported having low levels of skill in video editing.
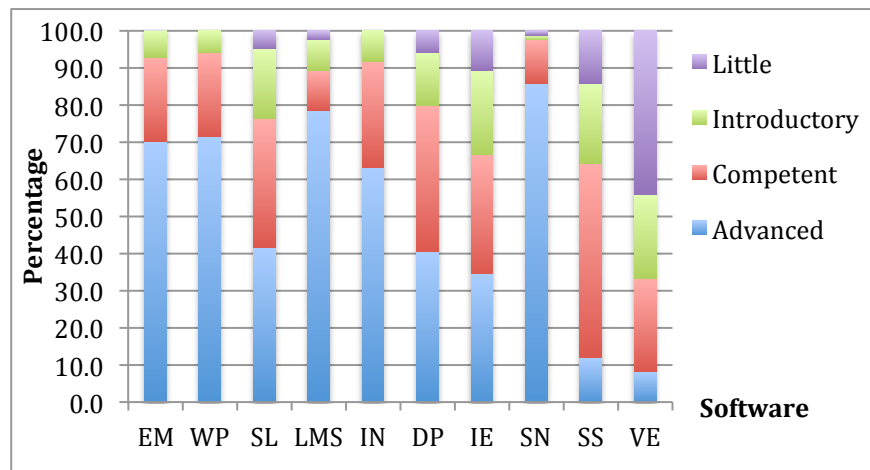
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 6.11 OUA PSTs' software skills

OUA pre-service teachers' ICT use

This part reveals how pre-service teachers use ICT, including their hardware use, software use, internet access and attitudes toward ICT.

Hardware use

This section examines the frequency pre-service teachers' ICT hardware use. Figure 6.12 shows the frequency of use for each of the hardware types utilised for study purposes. Again, mobile devices (laptops and smart phones) are the most frequently used. Over 70% and 45% respectively of pre-service teachers used a laptop and a smart phone at least daily in their studies. Just under 15% and 20% respectively made no use of these devices.

In contrast, desktops and tablets were less frequently used on a daily basis for study than mobile devices (27% and just under 20% respectively), with a high percentage (over 50% and 45% respectively) not making use of them at all. This probably reflects the low level of desktop and tablet ownership.

Daily use of printers and scanners among of pre-service teachers was very low, with these devices used mostly weekly or occasionally. A high percentage of pre-service teachers (57%) did not use scanners for their studies.
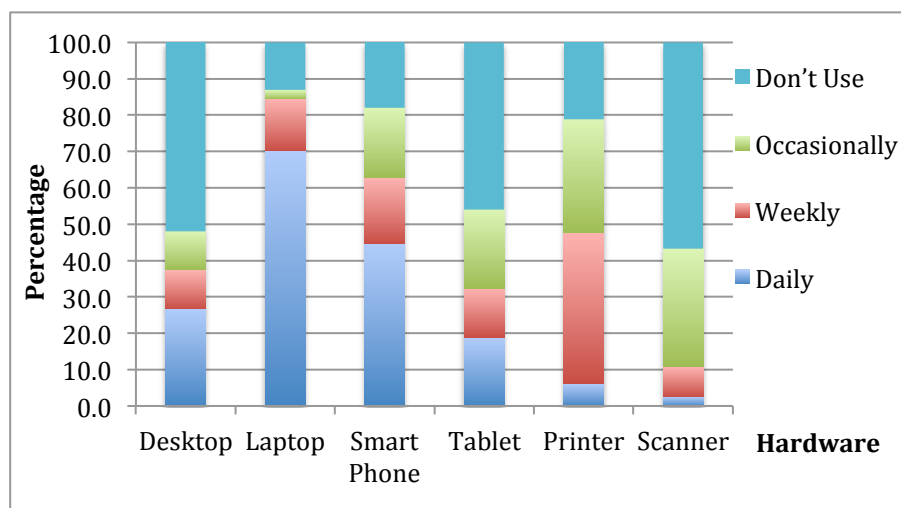
Figure 6.12 OUA PSTs' hardware frequency of use

Software use

Figure 6.13 illustrates the frequency of use for the various software types. In 2016, all pre-service teachers at OUA reported using internet browsing. The majority (at least 50%) used email, word processing, the learning management system and internet browsing at least on a daily basis.

Least used were spreadsheeting, digital photography, video editing, image editing and social networking. Over 50% of OUA pre-service teacher reported never using spreadsheeting, digital photography and video editing for their learning in 2016, and over 30% of them never used image editing and social networking. The frequency of pre-service teacher software use was consistent with their software competence, and may suggest that with more frequent use, pre-service teachers are likely to become more ICT competent. Interestingly some (a very small number) pre-service teachers reported not using things like word processing and the learning management system while being enrolled in an online course. The researcher is unable to provide and explanation to this unless it was a misunderstanding of the question asked.
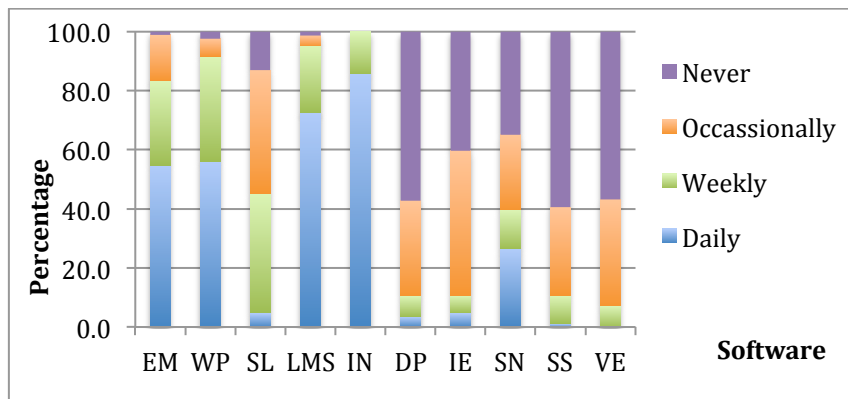
EM – Email	WP – Word Processing	SL – Slideshows	LMS – Learning Management System
IN – Internet Browsing	DP – Digital Photography	IE – Image Editing	SN – Social Networking
SS – Spreadsheeting	VE – Video Editing		

Figure 6.13 OUA PSTs' software frequency of use

Figure 6.14 shows that pre-service teachers, like OUA teacher educators, used discussion board most frequently in classroom learning. Ninety two percent of OUA pre-service teachers used this software for their learning practices. The next most frequently used were collaboration tools, video lectures and academic validation software. There were decreasing levels of use for social media, mind-mapping/concept mapping and e-Portfolios. Simulations/games/google earth were the least used by OUA pre-service teachers.
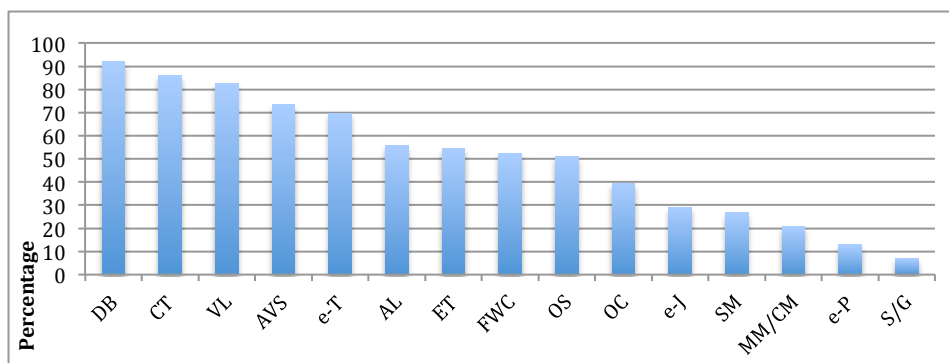
DB-Discussion board	AVS-Academic validation software	e-P-e-portfolios	e-T-e-textbooks
OS-Online software	MM/CM-Mind-mapping/concept mapping	CT-Collaboration tools	FWC-Free web content
VL-Video lectures	OC-Online classroom-live with lecturer	ET-Electronic quizzes/tests	SM-Social media
e-J-e-journals	S/G-Simulations/games/google earth	AL-Audio lectures	

Figure 6.14 OUA PSTs' software use

The tool or resource that OUA pre-service teachers would like their teacher educators to use the most in their teaching was lecture captured video. Ninety four

percent of pre-service teachers in total always or often would like their teacher educators to used it (see Figure 6.15). Ninety two percent of OUA pre-service teachers also wanted teacher educators to use online collaboration tools for teaching. However, few pre-service teachers wanted teacher educators to use social media.
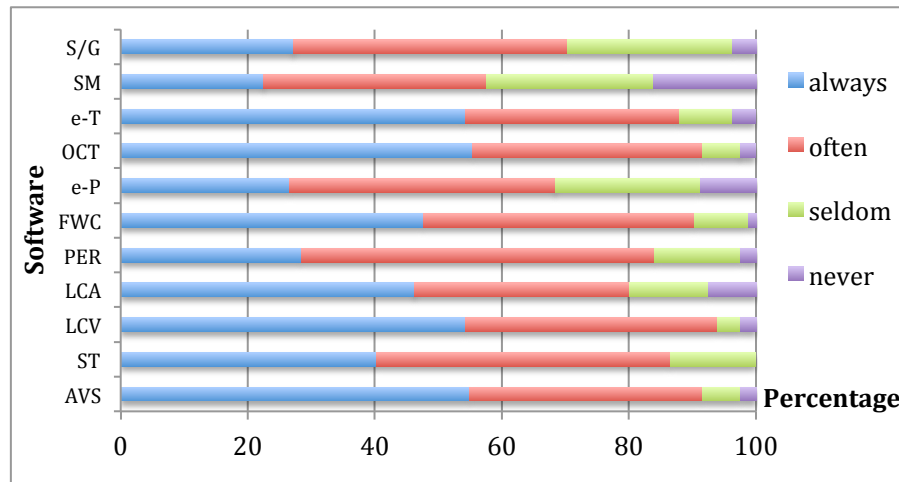
FWC-free, web content	LCV-lecture captured video	S/G-simulations or educational games	SM-social media
e-T-e-textbooks	OCT-online collaboration tools	PER-publishing electronic resources	ST-search tools
e-P-e-portfolios	AVS-academic validation software	LCA-lecture captured audio	

Figure 6.15 OUA PSTs' expectation to TEs' software frequency of use

Internet access

As with teacher educators, most of the pre-service teachers at OUA accessed internet at home or through their mobile internet. Nearly 93% of them accessed the internet at home daily, while 55% connected with the internet through their mobile daily (see Figure 6.16). Because pre-service teachers at OUA were studying online, few of them used the university wi-fi and computer lab.
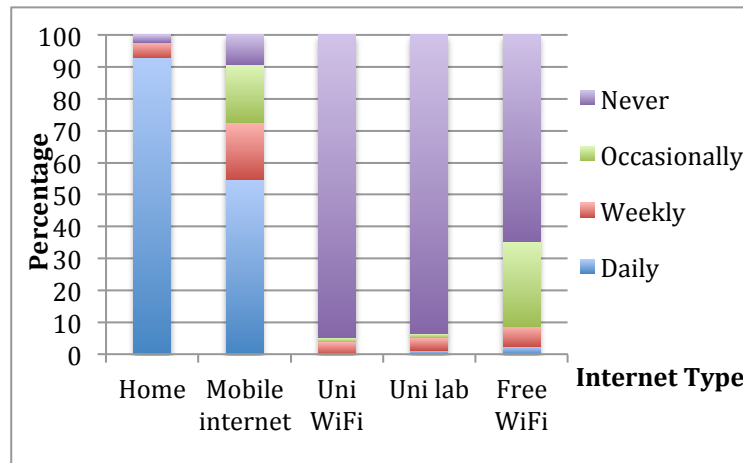
Figure 6.16 OUA PSTs' use of internet type

Attitudes toward ICT

Figure 6.17 shows the results of survey questions about adoption of new technology. It shows that most (50%) OUA pre-service teachers preferred to wait for a while and see others try new technology and then try it themselves. Nearly 32% of them were early adopters and tended to be the first people to check out a new electronic device or gadget. The remaining 18% were conservative and waited to try new technology. These results suggest that OUA pre-service teachers have a less positive attitude to adopting new technology than their teacher educators.
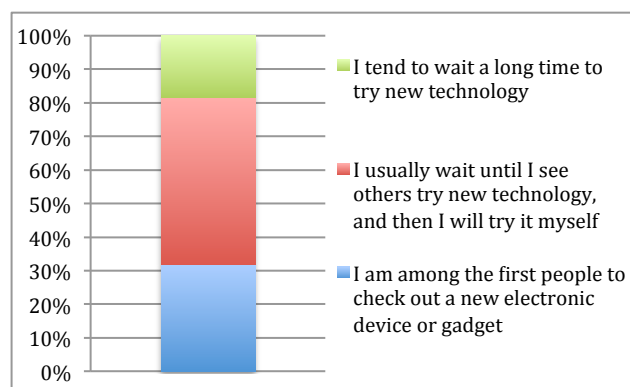
Figure 6.17 OUA PSTs' tendency to adopt ICT

Nearly 92% of OUA pre-service teachers agreed or strongly agreed that they were able to solve technological problems related to their learning (see Figure 6.18). Most of OUA pre-service teachers held a positive attitude towards university support. Ninety percent agreed or strongly agreed that the university offered them online tutorials and

technological instruction. However, 12% still thought negatively about the technological support provided by the university.
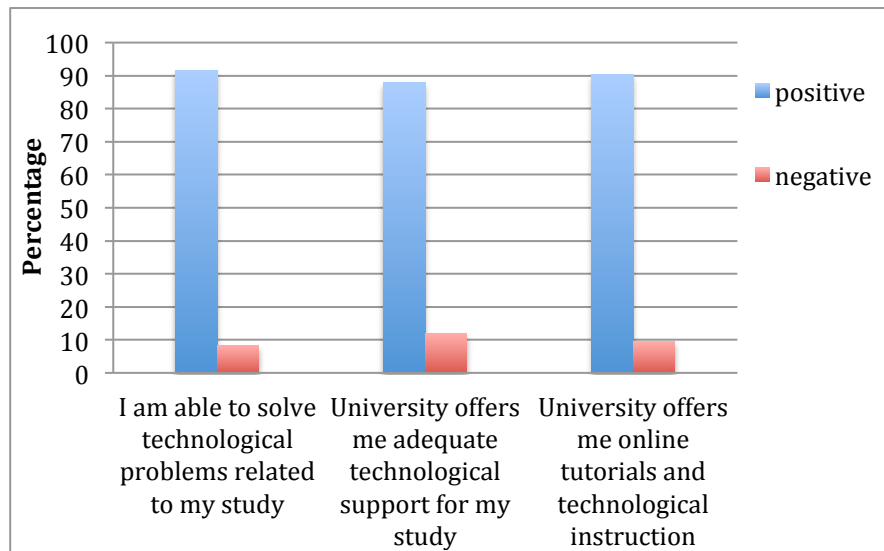
Figure 6.18 OUA PSTs' attitudes to ICT support

OUA qualitative data results

This section presents the findings from the interviews of OUA teacher educators and pre-service teachers about their ICT confidence, ICT use and ICT policy and support.

OUA teacher educators' ICT confidence

Data from the five OUA teacher educators who have been asked question *"How confident are you using ICT in your teaching?"* They were asked to rate their level of confidence. Their responses were different. This is described in more detail below.

Three participants stated that they were very confident in using ICT in their teaching. A typical reason given was, "technology is just another concrete material, just something another tool that can be used" (OTE2). Other participants said that ICT was their hobby; they were comfortable with it and preferred to use technology and thought they could solve problems easily. A typical comment was:

> *I would say I'm very confident, I wouldn't always say I'm capable, but I'm confident in the sense that I am not very scared of technology, so I'm one of the people I will keep playing with it until I figure it out, but I don't think I know everything there is to know and there*

are a lot of the times I still google it or Youtube it, so I'm not really doing anything high in technology but I know how to figure, I know how to solve problem with technology very well, so I feel very confident (OTE4).

One teacher educator participant felt that she was only confident with technologies that she was using. She stated this as the reason why she was not trying other new technology, and commented:

I tend to do with what I'm confident with, and not less with, you know, I need to practice somewhere else first before I try with the students and I don't have a lot of time for that practice if I don't need to (OTE3).

One teacher educator participant felt that she was an average user of ICT in teaching. She felt she would panic if she had problems, but she was willing to learn, "6 out of 10, so medium, I think I'm good to give it a go. If somebody said this is what we are gonna use, I will certainly try it," was her comment (OTE5).

OUA teacher educators' ICT use

In response to the interview question, *"What ICT devices you usually use and why?"* Teacher educators indicated that they used desktops and laptops most often. One of them also used tablets because she found "it was easier to carry around than a laptop, as it was less heavy and could access most things" (OTE1). However, when she did collaborations and lectures, she preferred the laptop because there were some limitations with iPads.

Another teacher educators said "it was really difficult to hook the tablets up into the Curtin system" (OTE3). Two teacher educators mentioned the iPads provided by the university were very limited and not always charged. Two did not use smart phones for their teaching at all, but used them for checking emails or got e-books on them or for some specific teaching purpose like teaching students to use Kahoot on their mobile phones. OUA teacher educators can use laptops at home for teaching. However, one of them pointed out that she used the desktop at the university because the university sometimes upgraded the blackboard system. If something went wrong, it was good to be able to use the desktop at university and get the help.

The results from the interviews showed that some teacher educators tended to be the first people to check out new electronic devices or gadgets. Others tended to wait. One early adopter of technology took this approach because it was efficient and it was easy to keep records and track everything, and she enjoyed being challenged. Another teacher educator preferred to take the technology up quickly because she did not want to wait to see if it was effective. If the new technology or new apps satisfied the needs of her teaching or personal use she would buy them. Teacher educators who did not adopt the new technology gave a variety of reasons. One did not need it, while another preferred to wait and see how the new technology worked and what it cost. As she said "if it is online and free, I will definitely try it" (OTE4).

OUA pre-service teachers' ICT confidence

Three pre-service teachers were asked, *"How confident are you using ICT in your learning and future teaching?"*

Most of the OUA pre-service teachers were confident in using technology for their learning. One of them said, "I enjoy it because I like doing things I am good at and because technology is very creative. I try to think of different ways to incorporate different technologies into classroom learning" (OPST2).

Most of the pre-service teachers interviewed thought they would be comfortable using technology in their future classroom teaching because of their teaching practice experience, if schools had a good technological environment. However, it would be hard for them to integrate technology into school teaching if all the students did not have devices. It would also be difficult to keep abreast of all of the latest technologies. For example, one interviewee said, "I struggle with using Virtual Reality unless I learn how to use it beforehand and then I will feel confident about my ICT skills" (OPST3).

OUA pre-service teachers' ICT use

From the interview questions related to ICT devices they used for learning, The OUA pre-service teachers interviewed said they often use laptops and smart phones for

their study and used laptops, for almost for everything because they were portable and easy to use for reading and writing. They would use smart phones for checking Blackboard or marks, if they did not have their laptops with them, but not for reading or writing assignments because smart phone screens were too small.

With regard to iPads, one of them thought iPads were uncomfortable to be used for writing because an extra wireless keyboard would be needed. They also would not use iPads in their future school teaching because it was not designed for students to type properly. Students might feel excluded if their parents could not afford to buy them one.

One of the OUA pre-service teachers interviewed preferred to wait for a while to see how other people were using new technology and have someone to show her how to use it. She felt that she was not the person to look for the latest technology; having someone demonstrate the technology was a way to save time and to engage with other people. Another pre-service teacher thought that it depended on the technology, as she said, "I will not use technology for the sake of using it. I will use it if it is interesting" (OPST1).

OUA ICT policy and support

Curtin University's School of Education provides OUA pre-service teachers' learning experiences and employs the teacher educators who teach and support their learning. The courses and technical support rely on Curtin, which means the ICT policy and support comes from Curtin. The ICT policy is the same as for Curtin and has been analysed in the case study of Curtin. Because of this relationship, the ICT support experiences of OUA teacher educators and pre-service teachers are presented in the next section.

OUA teacher educators' view on ICT support

All the teacher educators were aware that ICT support was provided by Curtin University and all them thought that the ICT support was very good, helpful and very quick and convenient. Teacher educators reported that they could draw on the main ICT support staff for the whole campus, who dealt with things like the computers, teaching

rooms and projectors and all sort of campus-wide issues. They also had their own ICT support called the Learning Management team in the School of Education to help with the teaching of OUA through phone calls, emails or face-to-face support. The OUA teacher educators had full access to the Curtin ICT service and there was a 24-hour Blackboard contact as well.

There were also criticisms regarding the service and support. Some teacher educators pointed out that the 24 hours service was not that helpful, especially on the weekends or holidays or Christmas time. If there was a problem nobody could help the teacher educators during those times as ICT support was not available. As one teacher educator commented, "I will waste an entire day if I can't get ICT support on weekends. So I would like to see an after-hours phone service provided" (OTE4).

OUA pre-service teachers' view on ICT support

Only one of the OUA pre-service teachers interviewed was aware that there were ICT support provided by the university, but she did not know where to get the support. As she said,

> *I'm sure it is there, but I'm not sure where I need to go and get it. If I have had an IT problem, 95% [of the time] I would go into the physical environment in Curtin and got somebody to fix it* (OPST1).

Other pre-service teachers did not know there was ICT support provided or they did not use the ICT support. For example, one commented, "No, I don't use ICT support. If I encounter of problem of using something, I probably just Google the answer anyway. I don't contact IT support at university" (OPST2).

Overall OUA findings

This part compares teacher educators' and pre-service teachers' employment of and attitudes to ICT, with a particular focus on the congruity of the practices used by the two groups.

From the previous findings, as seen in Figure 6.19, the hardware device that most OUA teacher educators owned was a laptop and a smart phone, followed by a printer, a

scanner, a tablet and a desktop. While, the hardware device that most OUA pre-service teachers owned was a smart phone, followed by a laptop, a printer, a tablet, a scanner and a desktop. Both of OUA teacher educators and pre-service teachers owned various technology devices, but the average ownership of hardware devices as reported by OUA pre-service teachers was less than OUA teacher educators, especially the ownership of a desktop, a printer and a scanner. It indicates that pre-service teachers more prefer to have portable devices such as a laptop rather than a desktop. More teacher educators owned a printer and/or a scanner because they needed to use a printer and scanner for printing out students' assignments when they were working at home.
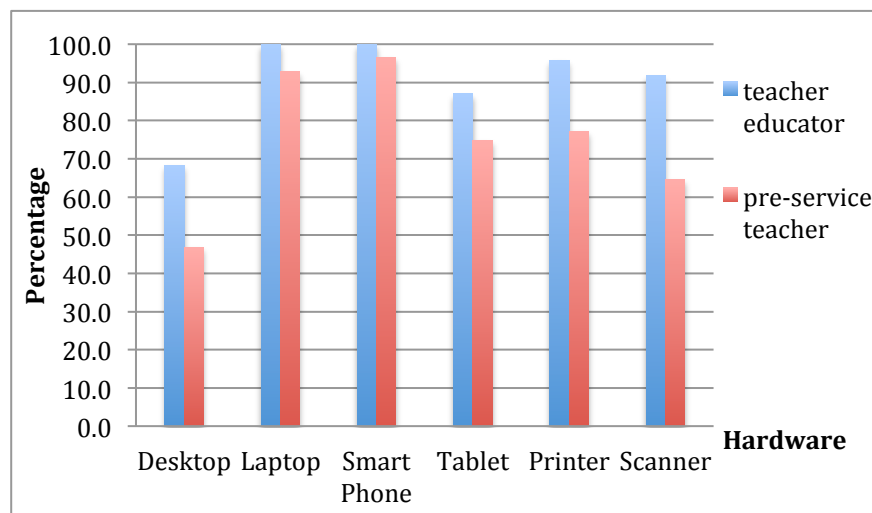
Figure 6.19 OUA TEs' and PSTs' ICT ownership comparison

Both teacher educators and pre-service teachers at OUA indicated some level of competency in all categories of software (see Figure 6.20). Teacher educators had at least competent knowledge and skills of using all types of software, especially the learning management system, email, word processing, internet browsing and slideshows. The pre-service teachers also indicated some level of competency in all categories, especially social networking, word processing, email, internet browsing and the learning management system. Only a small number of OUA teacher educators had the advanced or competent skills in using video editing. Similar to OUA teacher educators, OUA pre-service teachers knew little about video editing, but different from teacher educators, the greatest number of pre-service teachers who have the advanced or competent self-perceived skill with software was in the social networking. This is

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probably because pre-service teachers are a younger generation who use social media much more than teacher educators.
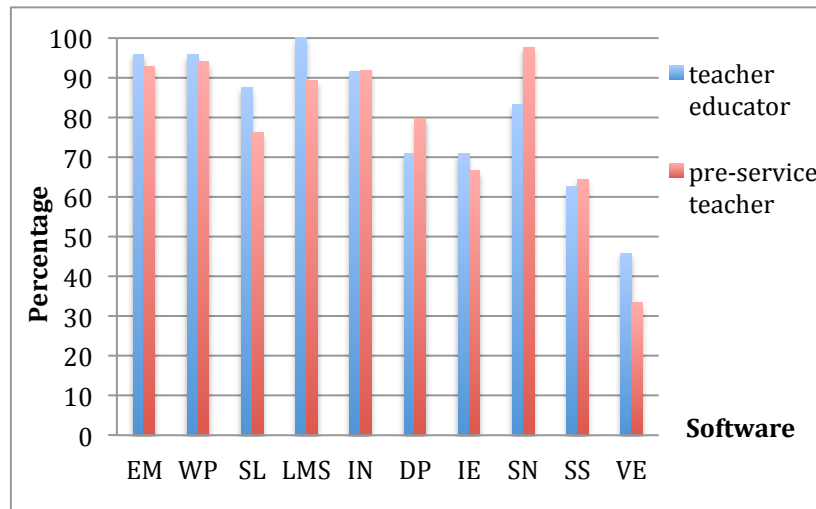
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 6.20 OUA TEs' and PSTs' ICT skills (advanced or competent) comparison

There are contrasts and similarities in the frequency with which teacher educators and pre-service teachers used certain hardware, as can be seen in Figure 6.21. Desktops and laptops were the most frequently used by teacher educators, while tablets, printers, smart phones and scanners were less frequently used. The teacher educators interviewed stated that although a tablet was easier to carry around, but when they did the collaborations and lectures, it had to be the laptop because there were some limitations with the iPads. Some found that it was really difficult to connect to the tablets with the Curtin system. That teacher educators were using laptops more than desktops suggests a preference for the portable device. In contrast, Figure 6.21 reveals that pre-service teachers used laptops and smart phones a great deal more frequently than teacher educators, but desktops, tablets, printers and scanners were less frequently used. Pre-service teachers' high frequency of use of smart phones may be because smart phones are used for checking emails, Blackboard or social media. As the pre-service teachers interviewed said that they would use a smart phone for checking the

Blackboard or finding out an assignment mark if they did not have their laptops with them.
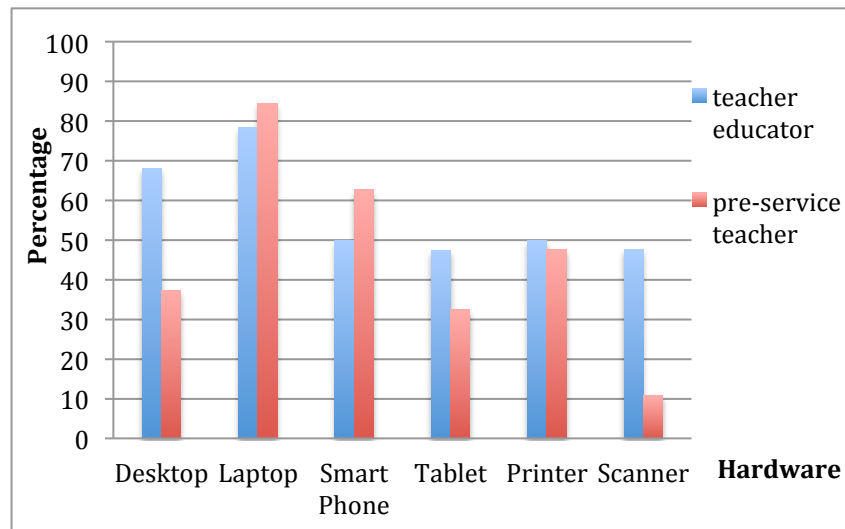
Figure 6.21 OUA TEs' and PSTs' hardware frequency (daily or weekly) of use comparison

For the software use, OUA teacher educators mostly used email, the learning management system, word processing, slideshows and internet browsing but less used social networking, digital photography, image editing and video editing (see Figure 6.22). Similar to OUA teacher educators, OUA pre-service teachers more used internet browsing, the learning management system, word processing and email, less used spreadsheeting, digital photography, image editing and video editing. However, teacher educators used spreadsheeting more than pre-service teachers perhaps because teacher educators prepared charts and figures for their lectures and did research for writing their papers. Pre-service teachers used social networking more than teacher educators because as the younger generation they felt more comfortable of using social networking for their learning.
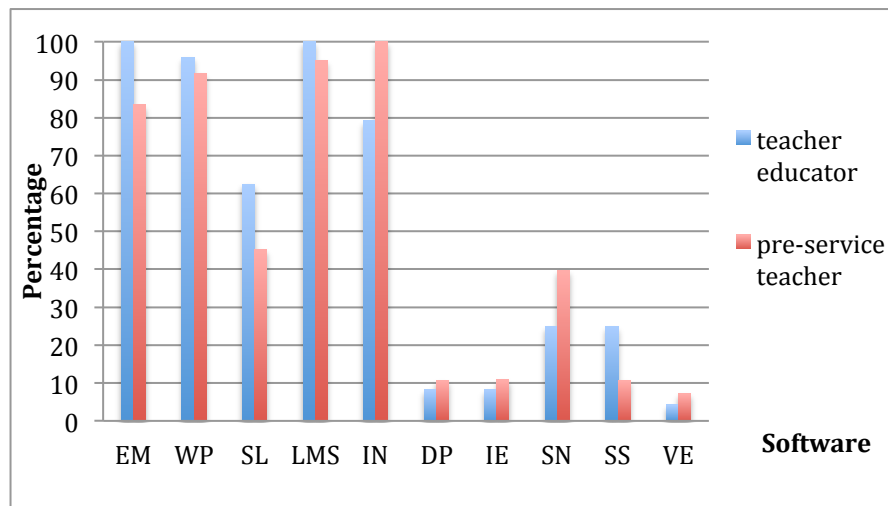
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 6.22 OUA TEs' and PSTs' software frequency (daily or weekly) of use comparison

OUA teacher educators and pre-service teachers showed similar tendencies with regard to the adoption of ICT. Just over half of both groups and interestingly slightly more teacher educators (about 53% and 50% respectively) indicated they preferred to wait for a while to try the new technology rather than being an early adopter (see Figure 6.23). The percentage of those being among the first to check out new technology was also similar for both groups, but with more teacher educators (just under 40%) than pre-service teachers (just over 30%) in this category. Pre-service teachers tended to be more conservative than teacher educators, with almost 20% of them indicating they tended to wait before trying new technology.

The results from the interviews showed that it was because the pre-service teachers felt that they were not the persons to look for the latest technology and waiting was a way to save time and a way to engage with other people. And it also depended on the technology, and they would not use technology just for the sake of using technology. They would use it if it was interesting. The teacher educators tended to be the first people to check out a new electronic device or gadget because they found it was efficient and it was easy to keep records and track everything, and they enjoyed being challenged. They did not want to wait a long time to see if it was effective and if the

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new technology or new apps were satisfy the needs for teaching or personal use they would buy it. There were also teacher educators who would not adopt the new technology because they did not need it or they would wait and see how the new technology goes or read the reviews if the new technology takes money. They would definitely try it if it was online and for free.
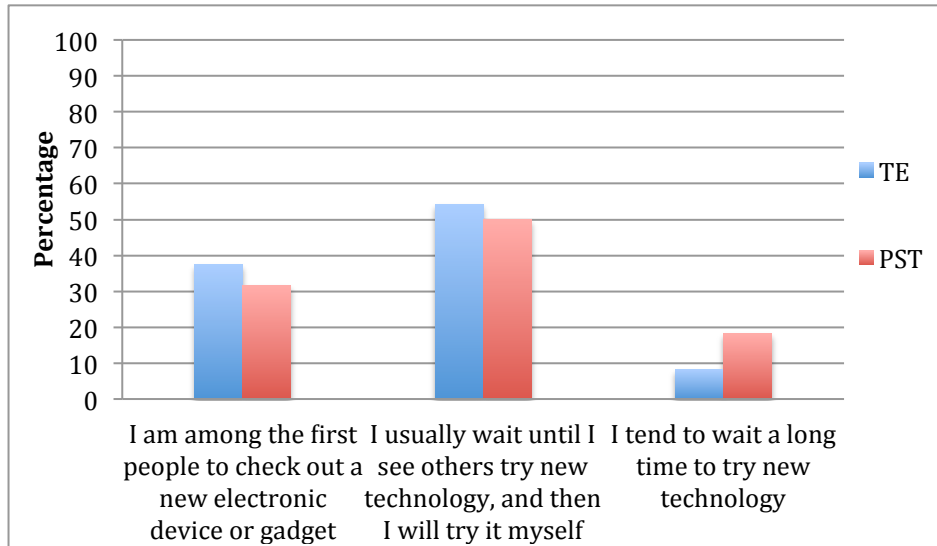
Figure 6.23 OUA TEs' and PSTs' tendency to adopt ICT

A similarly high percentage of OUA teacher educators and pre-service teachers held positive attitudes towards the ICT support provided by Curtin University, OUA's host institution (see Figure 6.24). Ninety percent of respondents from both groups were able to solve technological problems related to their teaching and learning and felt they were offered adequate maintenance and support for technology resources. Attitudes about online tutorials and instruction were similarly high, with those of teacher educators being slightly higher - 95% as compared to 90%.
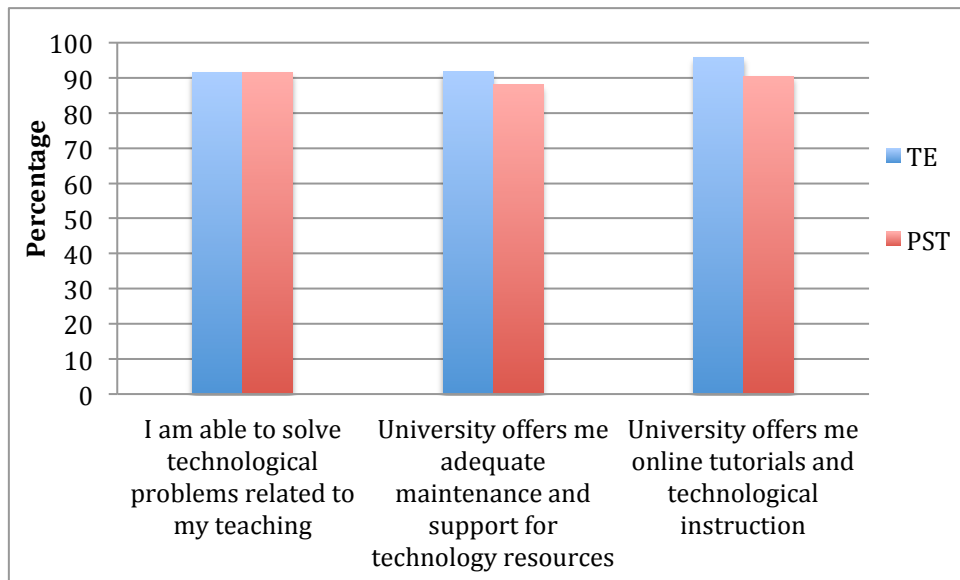
Figure 6.24 OUA TEs' and PSTs' positive attitudes to ICT support

For teacher educators interviewed, they were satisfied with the ICT support that the university provided for them. The main only problem was the 24-hour service was not that helpful, especially on the weekends or holidays. For pre-service teachers interviewed, they did not know there was ICT support provided by the university or they noticed there was, but they did not know where to get the support.

Summary

This chapter has presented the findings of case study of Open Universities Australia which document teacher educators' and pre-service teachers' ICT ownership, skills, use and the institutional ICT policy and support. Some of key insights provided by these findings include: Most OUA teacher educators and pre-service teachers owned laptops and smart phones. However, the average ownership of hardware devices by pre-service teachers was less than teacher educators, especially the ownership of desktops, printers and scanners.

For ICT skills, both OUA teacher educators and pre-service teachers indicated some level of competency, especially in the learning management system, email, word processing and internet browsing. However, only small number of both groups knew little about video editing. Different from teacher educators, pre-service teachers had higher skills in social networking.

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Desktops and laptops were most frequently used by OUA teacher educators, but laptops were more often used than desktops. Pre-service teachers used laptops and smart phones a great deal more frequently than teacher educators. Smart phones were more frequently used because of checking the Blackboard or finding out an assignment mark. For software, most OUA teacher educators frequently used email, the learning management system, word processing, slideshows and internet browsing. Pre-service teachers used social networking more than teacher educators. For the tendencies with regard to the adoption of ICT, both OUA teacher educators and pre-service teachers tended to wait for a while to try the technology rather than being an early adopter. Pre-service teachers were more conservative than teacher educators.

A high percentage of OUA teacher educators and pre-service teachers held positive attitudes toward the ICT support. However, teacher educators were not satisfied with the ICT support on the weekends or holidays. For pre-service teachers, some did not know there was ICT support or did not know where to get the support.

The following chapter provides the cross case analysis results of the three universities.

Chapter Seven: Cross-case analysis

This chapter summarises the core themes and discuses key findings that emerged from the analysis of data in Chapter Four, Five and Six. The summary is mainly based on comparisons between the three universities: ECU, Curtin University and OUA. This part is going to combine the results of teacher educators and pre-service teachers from these three universities to present teacher educators' and pre-service teachers' hardware ownership, self-perceived software skills, and use of digital devices and software in their teaching and learning, with the purpose of indicating the trends of applying ICT in teaching and learning and answering the research questions. The structure of the cross-case analysis and discussion has been displayed in below (see Figure 7.1).
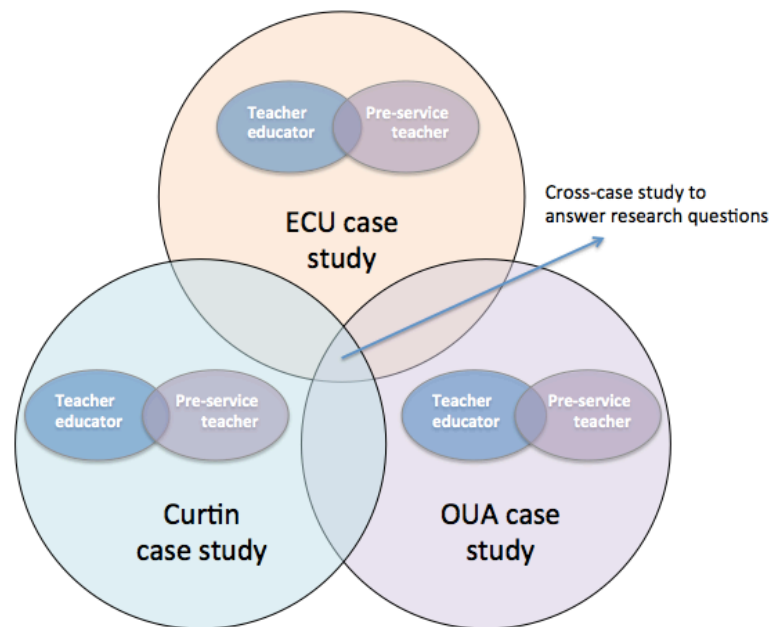
Figure 7.1 Structure of cross-case analysis

Discussion of the combined survey data

This section discusses the combined survey data to indicate teacher educators' and pre-service teachers' ICT ownership, ICT skills and ICT use.

Teacher educators' ICT ownership

In 2016, teacher educators at the three universities all indicated high percentage of ICT ownership, nearly 70% on average owned the hardware devices as listed (see Figure 7.2). However, the hardware devices most owned were different for each of the three universities. The most owned device for ECU teacher educators was a printer, with 96% owning this device. For teacher educators from Curtin and OUA, laptops and smart phones were the most owned, with ownership at 100% for both institutions. The least personally owned device at ECU were laptops, while for Curtin and OUA they were desktops. This could be due to ECU providing teacher educators with laptops, while teacher educators at Curtin had workstations with desktops. For many teacher educators at OUA who provide their own technologies and work away from the physical campus, laptops were a logical choice for them to purchase.

From these results, it is possible to draw the conclusion that the ICT ownership of teacher educators from the three universities was high for most of the devices listed. Interestingly, ECU teacher educators were likely to own more traditional digital device such as desktops, printers and scanners, while Curtin and OUA teacher educators were more likely to have portable devices such as laptops and smart phones.
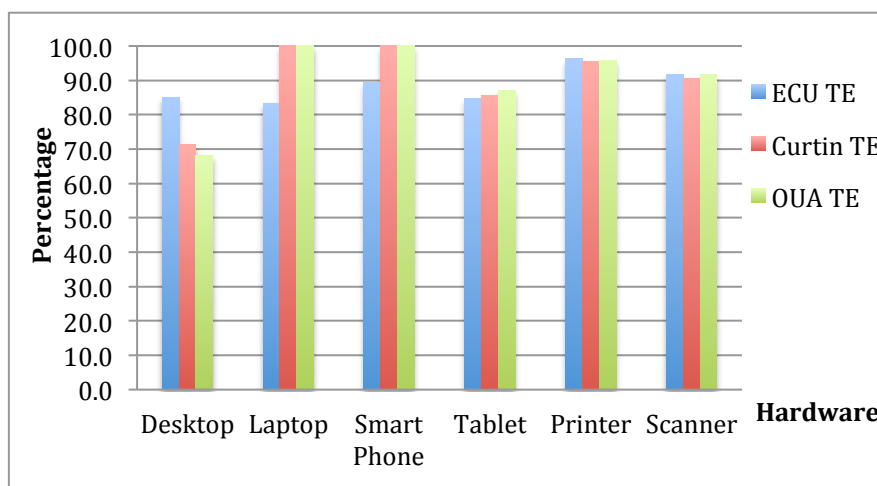
Figure 7.2 TEs' ICT ownership

Teacher educators' ICT skills

Figure 7.3 presents teacher educators' self-perceived ICT skills below at advanced or competent level. A high percentage (between 87% and 100%) of teacher educators from the three universities thought they were either competent or advanced in the use of email, word processing, slideshows, the learning management system and internet browsing.

The percentage for digital photography, image editing, social networking and spreadsheeting was lower (between 61% and 85%), but still significant. Skills in digital photography and image editing were highest among ECU teacher educators, while OUA teacher educators were adept at social networking. Video editing had the lowest percentage of teacher educators with competent or advanced skills across the three institutions; between 42% and 45% respectively for ECU and OUA, and a very low 12% for Curtin. Possible reasons will be discussed below in the software use section (see Figure 7.5). The other software skills that teacher educators perceived were slightly different from three universities.
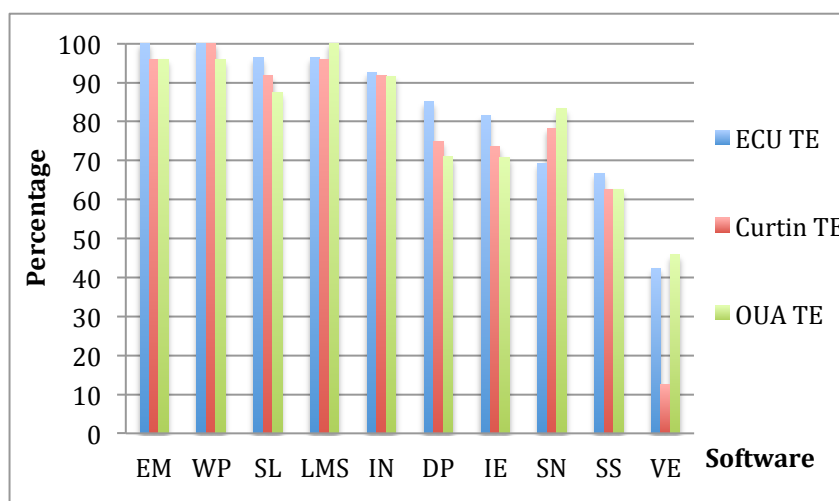
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 7.3 TEs' ICT skills (advanced or competent)

Teacher educators' ICT use

Hardware use

Figure 7.4 shows that the digital device that teacher educators from all three universities used most frequently in their teaching was the laptop and that least frequently used was the scanner. However, the frequency differed between universities with a much higher percentage of teacher educators at ECU using laptops than at the other two universities.

The hardware devices that 50% or over of ECU teacher educators used daily or weekly in teaching were laptops and printers. For Curtin teacher educators it was desktops, laptops and tablets, and for OUA teacher educators laptops, smart phones, printers and scanners (see Figure 7.4). A much higher percentage of teacher educators at Curtin frequently used desktops than at ECU and OUA. The relatively small percentage of teacher educators at OUA using desktops in their teaching may be because they were all teaching online and laptops allow them to work at anytime and anywhere.

The relatively low percentage of teacher educators from the three universities using portable devices such as smart phones and tablets suggests that progress in integrating these devices into their teaching practices was slow, especially at Curtin with regard to

smart phones and at ECU with regard to tablets. Maybe Curtin university's aim of paying more attention to integrating technology in teaching and OUA's online courses will help promote integration.
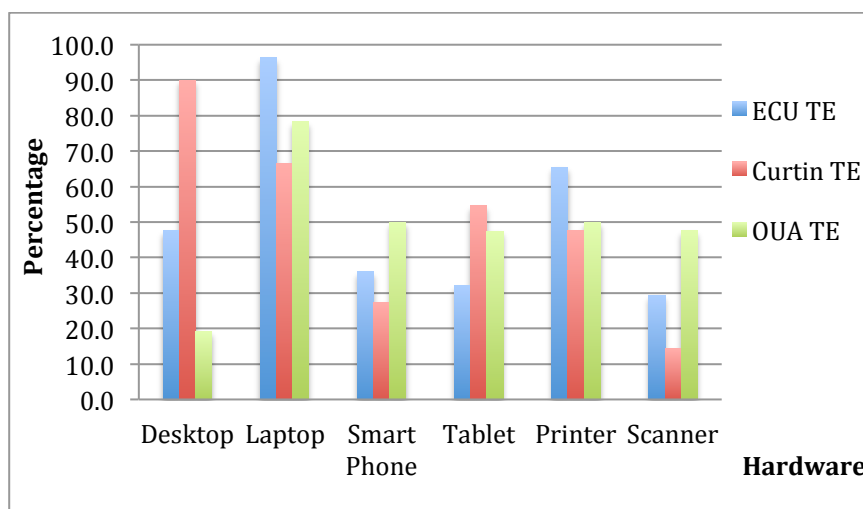
Figure 7.4 TEs' hardware frequency (daily or weekly) of use

Software use

The software that teacher educators at the three universities used most frequently (daily or weekly) in their teaching was email, the learning management system, word processing and internet browsing (see Figure 7.5). The software that over 70% of ECU and Curtin teacher educators used in teaching at least daily or weekly were word processing, slideshows, email, the learning management system and internet browsing. A similar percentage of OUA teacher educators used all of these software, except slideshows, at least daily or weekly in teaching. The relatively low percentage of slideshows use may be a characteristic of online teaching. Many more ECU teacher educators than those from Curtin frequently used slideshows than which possibly suggests that ECU teacher educators are more traditional in their teaching.

The software used by the lowest percentage of teacher educators in all three universities were digital photography, image editing and video editing. Teacher educators from ECU and OUA used video editing more frequently than Curtin. These results were in accord with the teacher educators' software skill level, which may suggest that the more frequent the use of these software, the higher skill teacher educators will have.
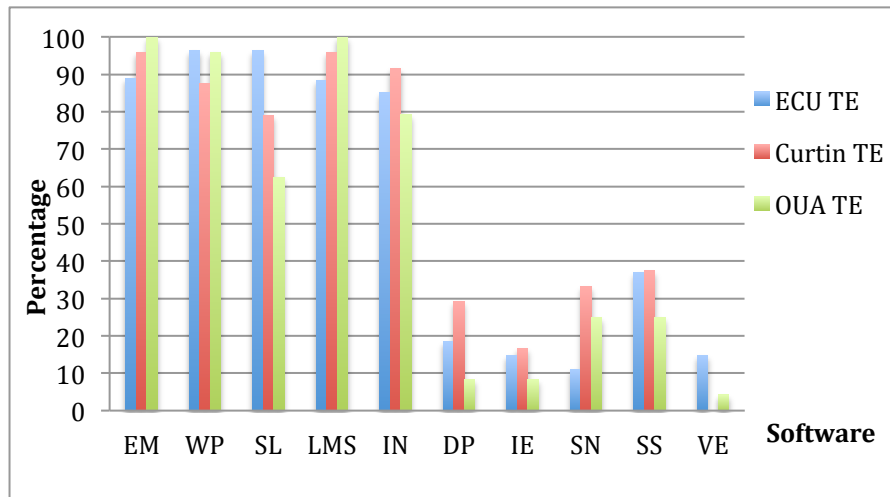
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 7.5 TEs' software frequency (daily or weekly) of use

Internet access

Most of the teacher educators at the three universities were using home internet and mobile internet. One hundred percent of them used home internet at least daily or weekly, and nearly 80% or over used mobile internet (see Figure 7.6). Few teacher educators used the university computer lab, which may suggest that teacher educators tend to bring their own devices or use the devices in their office.

That more teacher educators at ECU frequently used the university wi-fi than at Curtin University and fewer ECU teacher educators used university computer lab is consistent with the fact that teacher educators at ECU more often used laptops while teacher educators at Curtin more often used desktops. Again, because teacher educators at OUA were teaching online, they relied more on home internet and less of them used the university wi-fi.
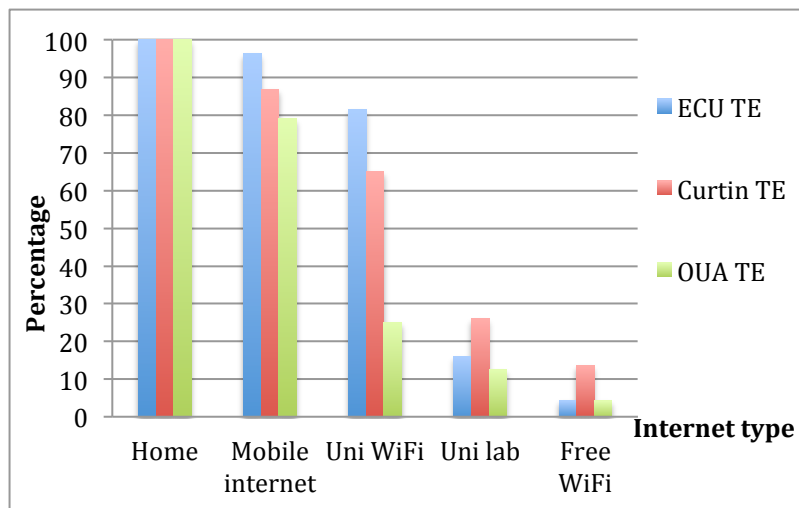
Figure 7.6 TEs' frequency (daily or weekly) use of internet type

Attitudes toward ICT

Over 40% of teacher educators at the three universities tended to wait until they saw others try new technology before trying it themselves and less than 23% tended to wait a long time to try new technology. While these results may suggest that teacher educators are still a little conservative about using new technology, it should be noted that nearly 30% or over of teacher educators were among the first people to check out a new electronic device or gadget (see Figure 7.7), with 38% of OUA teacher educators and 35% of ECU teacher educators being early adopters. OUA teacher educators may be more willing to check out new technology because they teach online, which requires them to keep pace with the new technology. Age may also be a factor as most of them were younger than the teacher educators at the other two universities.
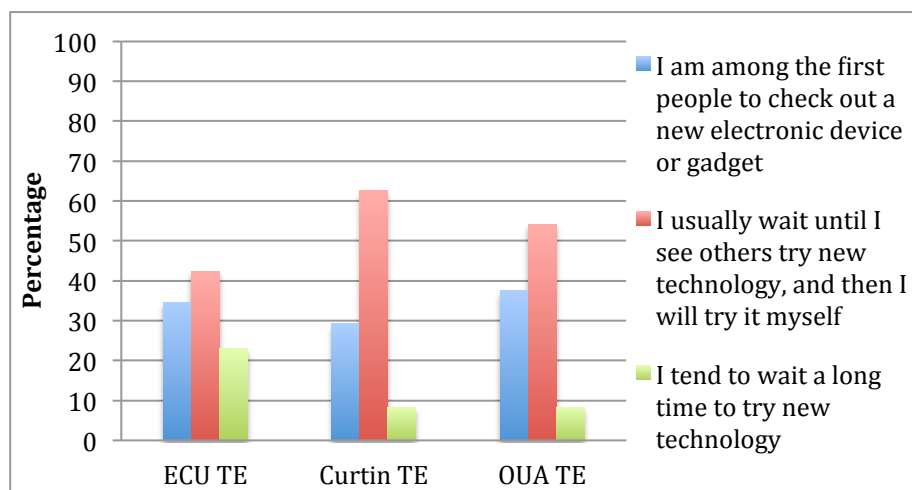
Figure 7.7 TEs' tendency to adopt ICT

Pre-service teachers' ICT ownership

In 2016, pre-service teachers at three universities all indicated high percentage of ICT ownership of smart phones, laptops and printers, with over 70% on average owning these hardware devices (see Figure 7.8). However, the hardware device that most owned were different for the three universities. The most owned device for ECU and OUA pre-service teachers was the smart phone, with 99% and 95% ownership respectively. For Curtin pre-service teachers it was the laptop, which 100% of pre-service teachers owned.

There was a relatively high level of ownership for tablets and scanners as nearly 75% had these devices. The highest percentage of tablet ownership was among OUA pre-service teachers. The least owned device was the same for all three universities, being the desktop, which less than half of them owned. However, the highest percentage of desktop ownership was among more ECU pre-service teachers.

From the results, it is possible to draw the conclusion that the ICT ownership of pre-service teachers from the three universities was high overall and particularly high for smart phones and laptops. Most pre-service teachers possessed a smart phone, which suggests they may have a greater preference for portable devices than their lecturers.
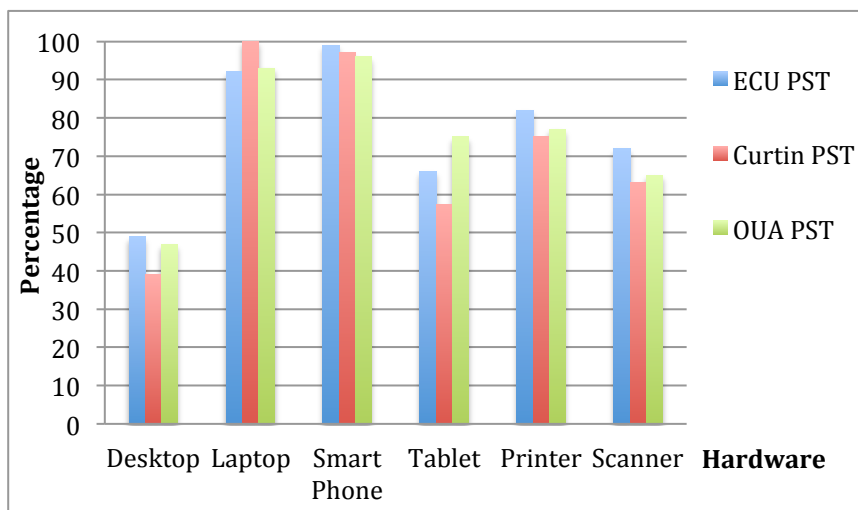
Figure 7.8 PSTs' ICT ownership

Pre-service teachers' ICT skills

A high percentage (between 75% and over 95%) of pre-service teachers from three universities indicated that they were least competent in the following software skills listed in Figure 7.9: social networking, email, word processing, slideshows, the learning management system, internet browsing and digital photography. Social networking, word processing and internet browsing were areas of particular strength with over 90% reporting being at least competent. On the other hand, the percentage for the remaining three software skill was lower, with video editing having the lowest percentage overall.

There were differences between the three universities for each software skill, but these tended to be slight, except for video editing. More pre-service teachers from ECU and Curtin considered themselves skilled with slideshows than those from OUA. This may be because OUA pre-service teachers were learning online and had less classroom presenting experience. However, almost 59% of pre-service teachers from Curtin considered themselves at least competent in video editing, while only 45% and 32% respectively from ECU and OUA considered themselves at least competent.
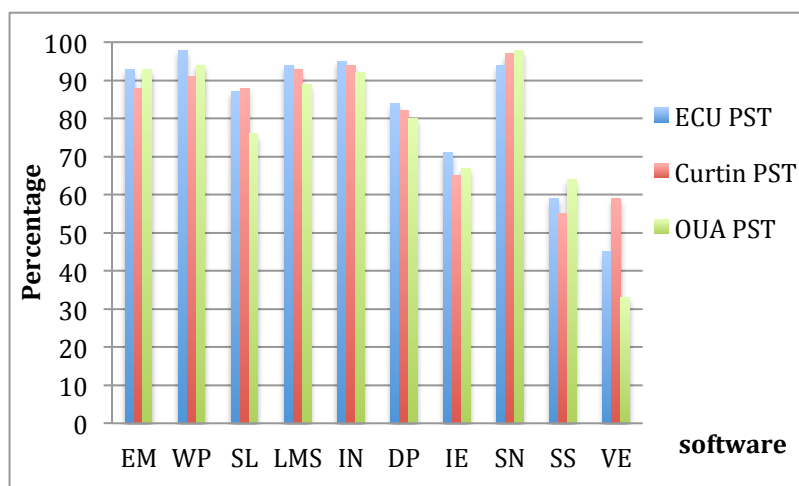
EM – Email WP – Word Processing SL – Slideshows LMS – Learning Management System

IN – Internet Browsing DP – Digital Photography IE – Image Editing SN – Social Networking

SS – Spreadsheeting VE – Video Editing

Figure 7.9 PSTs' ICT skills (advanced or competent)

Pre-service teachers' ICT use

Hardware use

The digital device that most pre-service teachers in the three universities used (daily or weekly) in their learning was a laptop. Almost 100% of pre-service teachers at Curtin used laptops, as compared to almost 90% at ECU and 85% at OUA (see Figure 7.10). The next most frequently used device was the smart phone with the frequency of use ranging from around 55% to less than 65% across the three universities. Desktops, tablets and scanners were the least frequently used with scanner usage the lowest, ranging from 8% (OUA) to 12% (ECU). The hardware devices that over 50% ECU pre-service teachers used in learning on daily or weekly basis were laptops, printers and smart phones. For Curtin and OUA pre-service teachers they were laptops and smart phones.

While over half of the pre-service teachers from the three universities used laptops and smartphones for studying daily or weekly, many did not integrate tablets in their learning practices. The reasons for this are not clear; it may be because integration is considered difficult or in some way disadvantageous.
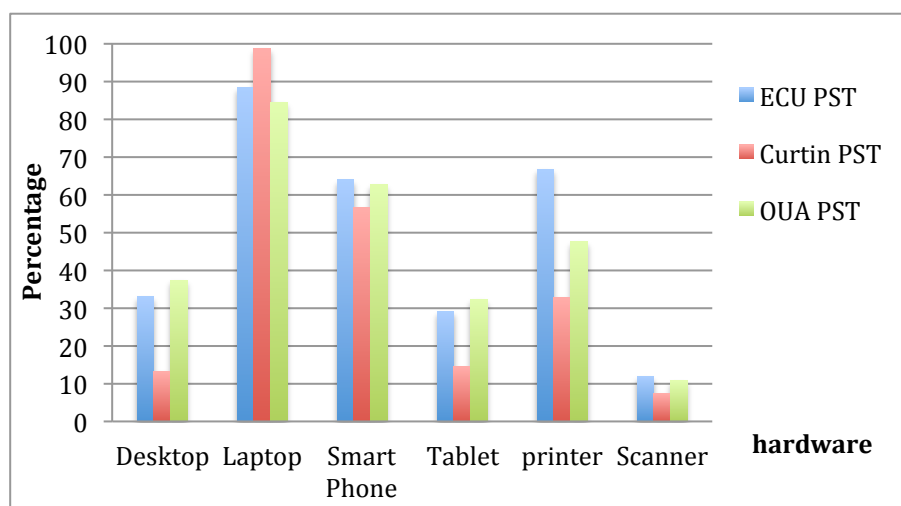
Figure 7.10 PSTs' hardware frequency (daily or weekly) of use

Software use

The software that most pre-service teachers at three universities frequently used (at daily or weekly) in their learning was internet browsing and the learning management system (between 95% and 100%), followed by word processing and email, which were used between 83% and 90% (see Figure 7.11). Curtin pre-service teachers used slideshows more frequently than social networking.

The least frequently used software across the three universities were video editing, spreadsheeting, image editing and digital photography in learning. These results were in accord with the pre-servicers' software skill level and suggest that there may be a link between higher frequency of use and skill level development.
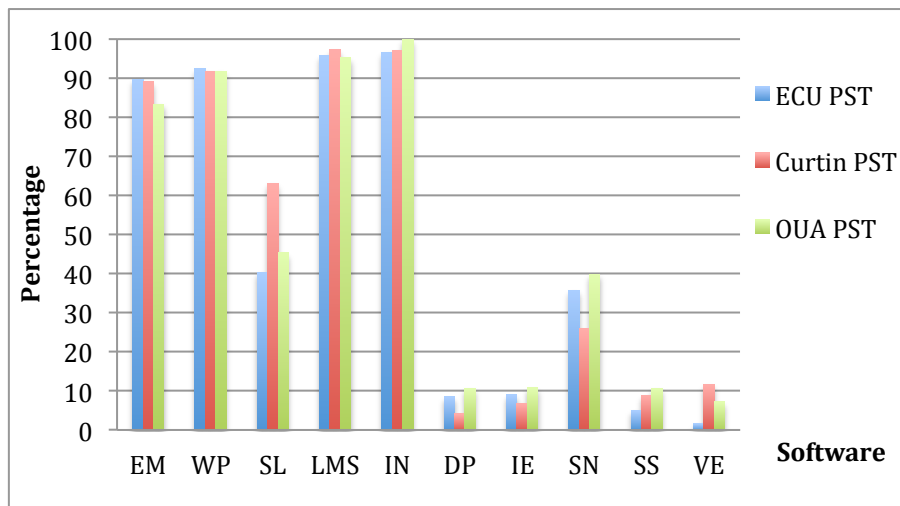
EM – Email   WP – Word Processing   SL – Slideshows   LMS – Learning Management System

IN – Internet Browsing   DP – Digital Photography   IE – Image Editing   SN – Social Networking

SS – Spreadsheeting   VE – Video Editing

Figure 7.11 PSTs' software frequency (daily or weekly) of use

Internet access

As with the teacher educators, most of the pre-service teachers at three universities were using home internet. Over 96% of them used home internet at least daily or weekly (see Figure 7.12).

That more pre-service teachers at Curtin frequently used the university wi-fi than the university computer lab is consistent with the high level of usage of laptops and the lower level of use of desktops by pre-service teachers there. Again, because 98% of pre-service teachers at OUA were learning online, they were more reliant on home internet than the university wi-fi.

Over 70% of the pre-service teachers never or occasionally used the university computer lab, which suggests that pre-service teachers tend to bring their own devices to university. It also indicates the correctness of BYODD policy and may suggest that the universities could consider reducing some of their ICT facilities.
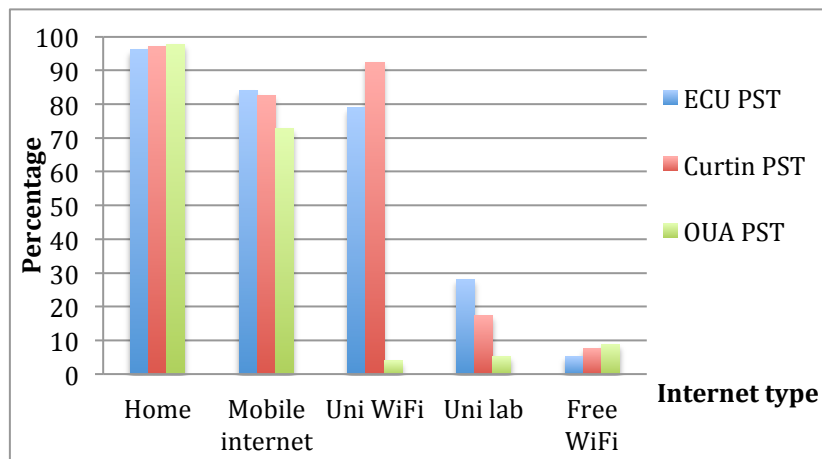
Figure 7.12 PSTs' use of internet type (daily or weekly)

Attitudes towards ICT

A relatively high percentage (between 50% and 70%) of pre-service teachers at the three universities tended to wait until they saw others try new technology, then they would try it themselves, with the highest percentage coming from ECU. More than 13% but less than 32% of them were among the first people to check out a new electronic device or gadget (see Figure 7.13). Interestingly, over 30% OUA pre-service teachers, 18% pre-service teachers at Curtin University were early adopters of new technology. In contrast, only 13% pre-service teachers at ECU were in this category. This suggests that OUA pre-service teachers, like OUA teacher educators, are more willing to check out new technology than their colleagues, perhaps because their online learning requires them to keep pace with new technology.

Less than 19% of pre-service teachers tended to wait a long time to try new technology. It may indicate that a small trend towards early adoption of new technology by pre-service teachers.
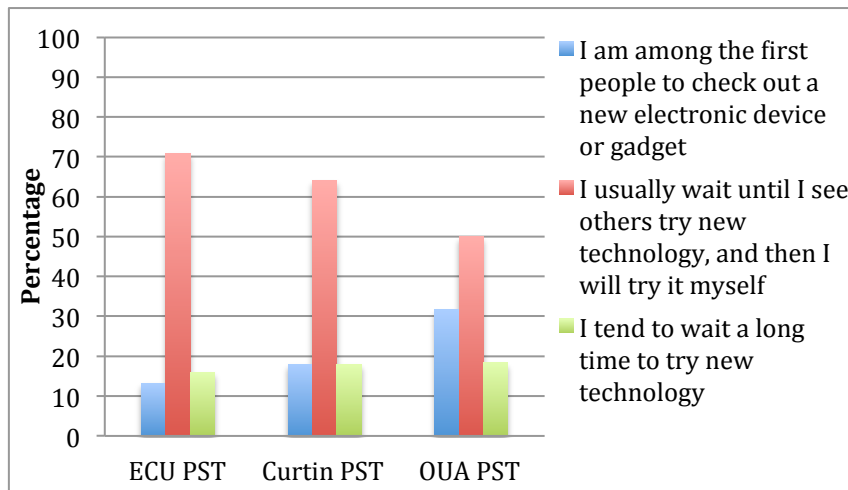
Figure 7.13 PSTs' tendency to adopt of ICT

Issues emerging from the interview data

The combined interview data were transcribed and then analysed for common themes that point to issues raised by teacher educator and pre-service teacher participants when explaining their ICT confidence, ICT use and ICT support. These three issues were identified and categorised according to the research questions. The issues displayed in Table 7.1 and Table 7.2 are those that emerged from teacher educator and pre-service teacher interview data. The issues were then further analysed to identify any additional concerns, and these are described in the individual issue section.

Table 7.1

Issues from the TEs Interview Data

Issue one: ICT confidence	Number of participants (N=15)
Very confident	8
Confident with technologies used	5
Less confident	2
Issue two: ICT use	**Number of participants (N=15)**
Desktop	12
Laptop	9
Smart phone	5
Tablet	7
Projector	9
Others (clicker, USB, electronic writing boards)	4
Issue three: ICT support	**Number of participants (N=15)**
Positive	15
Negative	4
Additional supports (training, classes, workshops)	5

Issue one: teacher educators' ICT confidence

As can be seen from Table, 7.1 the teacher educators' ICT confidence included that very confident (8); confident with technologies used (5); less confident (2). Examples of these views are given below.

Eight teacher educator participants felt very confident in using ICT in their teaching. A typical reason given was they just used technology to assist the teaching and technology was just another tool that can be used. Another reason offered was that ICT was a hobby. Therefore they were comfortable with and preferred to use

technology as they could solve problems easily. Yet another was they felt confident because they were not very scared of technology.

Five teacher educator participants were only confident with technologies that they were using at the time. They did not feel confident with technology that they did not know well and use effectively. Reasons given for why they were not trying other new technology was they needed to practice somewhere else first before they tried with the students. Usually they did not have time for that practice.

Two teacher educator participants felt that they were less confident users of ICT in teaching. They felt incompetent, afraid or panicky when there were ICT problems, for example, if they were trying to show the students something on YouTube but the internet was not working, which was frustrating and embarrassing. That's why they did not feel confident in using ICT and tended to teach without ICT. However, they were still willing to learn.

Issue two: teacher educators' ICT use

The number of teacher educators' who commented about the devices listed were: desktop (12); laptop (9); smart phone (5); tablet (7); Projector (9) and others (4). Examples of these views are given below.

Teacher educators commented on the contexts in which they used desktops or laptops for their classroom teaching. Teacher educators usually used a desktop in the classroom and only used their own laptops just in case of some problems with the desktop, which did not happen often. Some teacher educators who were teaching online, used their laptops at home for teaching. However, one of them pointed out that she would use the desktop at the university because the university sometimes upgraded the Blackboard system. So she used the desktop at university because she could get the help if something went wrong.

Teacher educators gave a number of reasons why they adopted tablets and smart phones in their teaching. One was an early adopter of new technology and liked playing with new devices and would adopt them if they made things easier. The other was

teaching drama, so she used a smart phone for the music and the lights. She also thought that she would use other mobile technology like a tablet if it would make things more efficient.

Teacher educators mentioned they used smart phones to check emails or get e-books or used them for some specific teaching purpose like teaching students to use Kahoot on their mobile phones. They also tried to encourage pre-service teachers to make greater use of smart phones because some schools integrated them into their school teaching.

Tablets were used because they were easier to carry around than laptops. They were also less heavy and most things could be accessed on them, but had too many limitations for collaborations and lectures, for which laptops were better suited. Some of the teacher educators would use their own iPads for presenting their lectures. They were critical of the iPads provided by the university as they were very limited not always charged and needed to be booked before classes.

Teacher educators mentioned the disadvantages of using smart phones and tablets. These devices could be distracting for the students and to the learning process, if not used in the right way. Some teacher educators rarely used them in their classroom teaching because of software issues.

Tablets were problematic to use because it took a lot of time at the beginning of the lesson to make sure that everybody was online and there tended to be connection problems with the wi-fi and the projector. For these reasons, they thought the day of the tablet was past. They did not see the value of having a tablet, as now and smart phones are not that much smaller than the tablets. One of the teacher educator also pointed out that it was hard to read on a smart phone; however, he thought that some of the learning apps might work out okay on a phone. One teacher educator found that it was really difficult to hook the tablets up into the university system.

Issue three: teacher educators' ICT support

As can be seen from Figure 7.1 the teacher educators' views on ICT support varied. Many were positive (15) and some negative (4). The need for additional support was also expressed by a number of interviewees (5). Examples of these views are given below.

Teacher educators held positive attitudes toward the ICT support provided by universities and stressed its helpful nature. Due to the fact that problems were solved quite quickly, the IT staff came to where the teacher educators were working and showed them what to do. Most of the teacher educators interviewed did not expect more support from the university.

Some however, felt negative about institutional ICT support. They felt it was ICT control rather than ICT support. This related to problems with downloading software, which needed administrative approval. Some felt it was problematic when the ICT support was not available online on the weekends or holidays. This was especially an issue with online study and could be solved by the provision of after hours phone support.

A number of teacher educators felt that there should be additional ICT support such as training, classes and workshops provided for them on new developments or how to use devices more effectively. They also expected to have more training in what they can offer their students. However, one teacher educator did not want the compulsory training sessions because he felt he did not need them and he would rather learn what he needs when he needs it.

Table 7.2

Issues from the PSTs Interview Data

Issue one: ICT confidence	Number of participants (N=13)
Very confident	8
Confident with technologies used	3
Less confident	2
Issue two: ICT use	**Number of participants (N=13)**
Desktop	3
Laptop	8
Smart phone	9
Tablet	3
Projector	2
Others (clicker, USB, electronic writing boards, lego robots, Virtual Reality)	4
Issue three: ICT support	**Number of participants (N=13)**
Positive	4
Negative	1
Additional supports (training, classes, workshops)	2
Don't use ICT support	6

Issue one: pre-service teachers' ICT confidence

As can be seen from Table 7.2 the pre-service teachers' ICT confidence included very confident (8); confident with technologies used (3); less confident (2). This is described in more detail below.

Eight pre-service teacher participants felt very confident in using ICT in their learning and future school teaching. A typical reason given was they were growing up with new technology. Another reason offered was that teaching practice would help them to prepare for using technology in the future classroom teaching.

Three pre-service teacher participants were only confident with technologies that they were using at this moment. They felt confident in using devices they already knew how to use, with particular devices like laptops and computers, but not with tablets or smart phones.

Two pre-service teacher participants felt that they were not very confident users of ICT in their learning and future school teaching. They felt scared of using technology as school teachers. They worried about how they would cope with new technology or the technologies that schools used but they were not familiar with. They were also afraid of technology going wrong or not working in the classroom. However, they still wanted to be able to use it because of its benefits.

Issue two: pre-service teachers' ICT use

The pre-service teachers' ICT use included that desktop (3); laptop (8); smart phone (9); tablet (3); Projector (2) and others (4). This is described in more detail below.

Three pre-service teacher participants used desktops and a relatively higher number (8) of pre-service teachers used laptops for their classroom learning. They used laptops for almost everything because it was portable and easy to read and write. They indicated that desktops and laptops were more versatile, with all sorts of different software on them. One pre-service teacher only used laptops, she did have a phone but it was old. Another pre-service teacher had a laptop, a smart phone and a tablet, however she was only using the laptop for learning. Some pre-service teachers tended to use the mobile devices rather than desktops because it's portable, convenient, wireless and capable of being used at university. They were only occasionally using the desktop in the library if they forgot to bring their own laptops. Some pre-service teachers preferred laptops than smart phones or tablets because they preferred the keyboard than the touch screen. However, one respondent did not like to use a laptop because he found the keyboard of a laptop annoying. Some of the pre-service teachers pointed out that because it was easier to read on big screen than an iPad or a smart phone.

Three pre-service teacher participants used tablets and nine applied smart phones in learning. Two pre-service teachers used tablets as alternative to a laptop, because they offered the same functionality, however, they found some limitations of using tablets. At university some software were not available for tablets. Smart phones were considered portable, but because of the small screen of smart phones, which would be difficult to read and write the assignments, pre-service teachers would only use smart phones to check emails, the grades or assessment due day or unit outline if they did not have their laptops with them.

Fewer used tablets, because of the keyboard. Another pre-service teacher thinks it was uncomfortable to write because an extra wireless keyboard would be needed. Tablets and smart phones were much slower than laptops, they did not have much process power, had terrible word processing and could not do as much as laptops. Some pre-service teachers found smart phones were distracting for study because of the notifications popping up. They also would not use iPads for their future school teaching because it was not designed for kids to type properly on and the kids would feel excluded from the class if their parents could not afford one.

Two pre-service teacher participants used projectors in classroom learning. Some (4) were using other ICT devices such as clickers, electronic writing boards, lego robots and Virtual Reality.

Issue three: pre-service teachers' ICT support

As can be seen from Table 7.2 the pre-service teachers' view on ICT support included that positive (4); negative (1); additional supports (2); don't use ICT support (6). This is described in more detail below.

Four pre-service teacher participants held positive attitudes toward ICT support provided by universities. One pre-service teacher considered that the Teaching the Digital World unit was really good and it was good the unit was in the first semester because it showed the pre-service teachers the good websites not only for teaching but also for their own learning.

One pre-service teacher participants felt negative toward the institutional ICT support. He felt it was problematic when it was public holiday.

Two pre-service teacher participants felt that there should be additional ICT supports such as training, classes and workshops provided for them. They expected some workshops and training on how to use technology such as interactive whiteboard before their school practice. Some pre-service teacher interviewed mentioned that the training or workshops would be beneficial for pre-service teachers because they did not really cover that in class, so teaching them how to use specific apps that can be used in the classroom would be helpful. However, some other pre-service teachers found that they did not really need workshop from the university and what the university provide was enough because it was not that hard to learn the technology. They did not expect to spend time on a whole professional development or training unless it was a particular new piece of technology that they did not see before.

Six pre-service teacher participants did not use the ICT support. Some of the pre-service teachers did not use ICT support that much. Some of them did not ask for help but they knew there was ICT support in the library or in the school of Education. However, some pre-service teachers, especially those who were learning online did not know there was ICT support provided or they noticed there was ICT support but did not know where to get it. Usually they tended to solve the problems by themselves.

Summary of the key research findings

This section presents the summary of the key findings of the research. They show that teacher educators at the three universities had high percentage of ICT ownership, especially ownership of printers, scanners, laptops and smart phones. Most of them possessed these digital devices for five or more years. However, there were differences between the universities because of the different ICT policies and environment.

Teacher educators also had relatively high ICT skills in using most of the software, especially email, word processing, slideshows, the learning management system and internet browsing. The lowest ICT skill was in using video editing.

With regard to hardware use, the device that teacher educators used most frequently was a laptop and that used least frequently was a scanner. Because of different ICT settings, teacher educators at different universities had different levels of usage. For example, teacher educators at Curtin made more use of desktops, while teacher educators at ECU used laptops more frequently. As for software, Teacher educators reported a high level of usage of emails, word processing, slideshows and the learning management system, which was consistent with their ICT skills. Their attitudes toward using ICT tended to be relatively conservative. Most of them preferred to wait until they saw others use new technology rather than being the first people to try it.

Pre-service teachers were also found to have a relatively high percentage of ownership of the devices, but not as high as teacher educators. However, they had a high ownership of laptops and smart phones and had possessed smart phones for five or more years.

With regard to pre-service teachers' ICT skills, they had at least a competent knowledge of most software types, except video editing.

The hardware that pre-service teachers used most frequently were laptops and smart phones. Desktops, tablets and scanners were used less frequently. Regarding their software use, emails, word processing, the learning management system, internet browsing, and social networking were most frequently used. Less frequently used software were digital photography, image editing, spreadsheeting and video editing. A more notable point is that pre-service teachers more frequently used social networking than teacher educators. However, pre-service teachers tended to be more conservative in adopting ICT than their lecturers.

Concerning the ICT policies and support, university ICT policies were mainly about guidelines, standards and principles such as how to use mobile devices and how to access the internet. They support the safe use of the university's IT systems and services. The university set up these ICT policies and procedures to ensure users use ICT facilities and services in an appropriate, secure and risk-appropriate manner. However, most of the teacher educators were not aware of ICT policies; even those who

were aware of them were not quite sure what exactly they were. Some teacher educators had noticed the regulations around assessment and what they could or could not do. Some teacher educators understood and appreciated the rules for protecting the university but had problems with these rules because they felt they were restrictive for people who were doing research and creative work.

Most of the teacher educators held positive attitudes about the ICT support provided by universities. They thought ICT support was very helpful and solved problems efficiently. Still some of them felt negative toward it because they felt it was not convenient to download software if they had to get administrative permission. The ICT support was also an issue for online courses because it was not available on the weekends or holidays. Some teacher educators wanted training or workshops for existing and new ICT at their university.

Most pre-service teachers had a positive attitude to the ICT support provided by universities. Some held negative attitudes because there was no support during weekends and public holidays. Some felt that there should be additional training, classes and workshops on how to use technology in the school environment before their practice.

The final chapter provides the answers to research questions and makes conclusion and recommendations for future research.

Chapter Eight: Conclusions

Overview of the Chapter

This study investigated ICT application in teacher education and identified whether there was an incongruity between teacher educators and pre-service teachers in ICT ownership, skills, and application in teaching and learning. This chapter presents the conclusions of the study, and the response to the research questions. The limitations and generalisability of the study are discussed, as well as recommendations for practice, policy and future research.

Response to research questions

To answer the overarching research question, each of the four (subsidiary) research questions will first be discussed.

Subsidiary research question one

What are *Teacher educators' ICT ownership, self-perceived ICT skills, and use of ICT in teaching and learning?*

From the previous analysis of each university, teacher educators in Western Australia had high ownership of all the listed devices. However, the ownership of some devices were different between universities, for example, the desktop, the laptop and the smart phone. There were no big differences for the ownership of the tablets, printers and scanners.

These results showed a large move toward mobile technologies in terms of current ownership and purchasing patterns from the previous research (Cooper & Pagram, 2009b; Pagram & Cooper, 2011, 2012, 2013; Pagram et al., 2008; Pagram et al., 2015). It can safely be assumed that in the future teacher educators will be armed with mobile devices. It also can be seen that the mobile devices have become more affordable and more capable. However, teacher educators' ownership of digital devices were different

between universities and this may reflect universities' ICT environment, policies and support also affect their purchasing patterns. For example, Curtin provides workstations with desktops for teacher educators while ECU provides them laptops, which may have an influence on their personal ICT ownership. For OUA, because they are an online education provider, teacher educators need to be equipped with portable devices for the convenience of teaching.

Teacher educators have average high skills in using most of the software, especially in using email, word processing, slideshows, the learning management system and internet browsing, but not in applying video editing in teaching. Moreover, most of the teacher educators in Western Australia have high skills in using some commonly used software, but not in using those uncommon ones, which indicates that the more frequently a type of software used, the higher the skills will be perceived. For some software such as social media, whether teacher educators applied it in their classroom teaching depends upon the university technology environment. At Universities such as Curtin and OUA, there was more social media used in teaching, and some social media was provided on their website platform for encouraging teacher educators to integrate social media in teaching. In contrast, at ECU, teacher educators were not encouraged to use social media and there were rules and regulations for using social media (*Guidelines for the Responsible Use of Social Media*). Teacher educators had to comply with it. Another reason is the age. As indicated by Companies and Markets.com, (2015), the reason for affecting teachers' ICT competence could be their age. They found that as the age of the teacher increased, the average ICT competence decreased.

For ICT use, teacher educators applied a variety of hardware and software in their teaching, which indicated that they used different means of technology in teaching than before, but still the frequency of using those technologies revealed the preference or the university ICT environment in some degree. For example, teacher educators at ECU more frequently used laptops, however teacher educators at Curtin more frequently used desktops. This appears related to the fact that Curtin provided desktops for teacher educators in the classroom and their workstations, while ECU provided laptops for

teacher educators because ECU has three different campuses and portable devices were more suitable for them. Teacher educators at ECU used printers and scanners more than Curtin, but less used tablets, which may indicate that teacher educators at ECU were less digitalised than Curtin.

Regarding software, all the teacher educators indicated that they commonly used software such as email, word processing, the learning management system and internet browsing, except for slideshows in universities providing online courses such as OUA. Digital photography, image editing, spreadsheeting and video editing were not commonly used by teacher educators, which in some way affected their ICT skills. It was interesting to see that they were less using social media in their teaching, which means that social media still has not been effectively integrated into teaching. It has been found by research conducted by the Department of Education and Training in Western Australia (2006) that there is generational shift in the use of technology, especially social media. However, as age increases, the percentage using social media drops substantially. Australian Communications and Media Authority (ACMA) (2011) and Venkatesh et al. (2012) also pointed out that age has been found to affect teachers' application of ICT.

Most of the teacher educators were using home internet and mobile internet. Few teacher educators used the university computer lab, which may suggest that teacher educators tend to bring their own devices or use the devices in their workstations.

For their ICT attitudes, teacher educators were showing a relatively positive attitude towards integrating technology in teaching, quite a high percentage of them tended to be early adopters of new technology but most of them preferred to wait and see, which is maybe because they were not confident in integrating technology in teaching. As teacher trainers, it is important that teacher educators have positive attitudes to use ICT in teaching because as Wong (2002) indicated in their research, teachers' attitudes towards technology was the key point for the implementation of technology.

Subsidiary research question two

What are pre-service teachers' ICT ownership, self-perceived ICT skills, and use of ICT in their learning?

Pre-service teachers in Western Australia were indicated a relatively high percentage of ICT ownership and they have owned digital devices for a long time. Most of them have possessed hardware devices for five or more years. Same as teacher educators, the hardware devices that pre-service teachers owned were also different between universities, for example, more ECU pre-service teachers owned desktops, printers and scanners than Curtin and OUA, but less of them owned laptops. It revealed that ECU pre-service teachers also tended to have more traditional digital devices such as desktops, printers and scanners, while Curtin and OUA pre-service teachers were more likely to have portable devices such as laptops. However, more pre-service teachers tend to have smart phones than teacher educators.

These results also showed that a significant move toward mobile technologies in terms of current ownership and purchasing patterns. Same as teacher educators, pre-service teachers' purchasing patterns were different from universities, which may also indicate universities' ICT environment such as universities' ICT policies and support could affect pre-service teachers' ownership of digital devices.

Pre-service teachers have average high skills in using most of the software, especially in using email, word processing, slideshows, the learning management system, internet browsing and social networking, but not in applying video editing, imaging editing and spreadsheeting. It indicated that most of the pre-service teachers in Western Australia had high skills in using some commonly used software, but not in using those uncommon ones, which reveals that the more frequently used the higher skills they will perceive. However, slightly different from teacher educators, more pre-service teachers had higher skills in using social media. One reason was about the age, which had been explained in research question one.

As the ICT skills required for Australian graduate teachers, it indicated that some ICT skills such as building animations, using interactive whiteboards, using excel, etc.

were needed (The University of Sydney School of Education and Social Work, 2019). However, pre-service teachers had lower ICT skills in these categories, which means there was still an ICT usage gap between pre-service teachers and school teachers. The unit coordinators could consider about adding courses or trainings to improve these ICT skills.

The digital device that most pre-service teachers in Western Australia frequently used in their learning was a laptop. Less pre-service teachers indicated frequently using desktops, tablets and scanners in their learning. Still many pre-service teachers did not integrate tablets in their learning practices, but over half of the pre-service teachers used laptops and smartphones for studying at least weekly, which may suggest that there are some disadvantage of applying tablets in learning.

The software that most pre-service teachers frequently used in their learning was internet browsing, followed by the learning management system, word processing and email. It may indicate the way of their studying. These pre-service teachers also indicated that they less frequently applied video editing, spreadsheeing, image editing and digital photography in learning. These results were in accord with the pre-service teachers' software skill level, which may suggest that the less frequent the use of these software, the lower skill they have.

Similar to the teacher educators, most pre-service teachers used home internet at least weekly, but less pre-service teachers used the university computer lab, which may suggest that pre-service teachers tend to bring their own devices to universities. It also indicated the correctness of BYODD policy and the universities could consider reduce some of the ICT facilities.

Most pre-service teachers tended to wait until they see others try new technology, then they will try it themselves, and few of them were among the first people to check out a new electronic device or gadget or tended to wait a long time to try new technology. More pre-service teachers than their lecturers tended to wait to try new technology. It may indicate that pre-service teachers are more conservative of using new

technology. Also maybe because they have not perceived the potential and benefits of technology comparing to early technology adopters (P. Rogers, 2000).

Subsidiary research question three

What are the universities' ICT policies and support for teacher educators and pre-service teachers?

The ICT policies that the universities in Western Australia provided are found to be restrict in some degree and may cause inconvenience when teacher educators and pre-service teachers integrate ICT into their teaching and learning. Teacher educators noticed it was rules and regulations around assessment and about uploading or use of inappropriate materials, copyright requirements. Teacher educators understood the ICT policy for protecting the university against security risks and some tried to be flexible with it. However, they still felt it was inconvenient to download software and restrictive for doing research and creative work.

The universities in Western Australia provided helpful and efficient ICT supports for teacher educators and pre-service teachers. They can solve problems quite quickly through phone calls, emails or face-to-face. There was the main ICT support for the whole campus who deal things like the computers and teaching rooms and projectors all these sort of campus wild issues. They also had their own ICT support or the Learning Management team in the School of Education to help with the teaching on campus. The universities also provided training such as how to use Blackboard and Turnitin for new teacher educators and some informal training if teacher educators have problems. Courses such as Teaching the Digital World unit was considered to be good and it was good the unit was in the first semester because it showed the pre-service teachers the good websites not only for learning but also for their future teaching.

However, some negative sides had been pointed out by teacher educators and pre-service teachers. For example, some teacher educators felt it was ICT control instead of ICT support. It was problematic with downloading software or programmes because they needed to get the administrative permission first. The other problem was

that the ICT support was not available on the weekends or holidays. If there was a problem nobody could help the teacher educators and pre-service teachers with that. So, the after-hours service was needed.

Apart from that, additional ICT supports such as training, classes and workshops were needed as well. Teacher educators were expected to have some more training in what they can offer their students. Pre-service teachers were expected to do some workshops and training on how to use technology such as interactive whiteboard before their school practice or teaching them how to use specific apps that can be used in the classroom. This is important because lack of ICT experience and training in pre-service learning could result in unsuccessful implementation of ICT in their future school teaching (Goktas et al., 2009; Sang et al., 2010). However, some teacher educators and pre-service teachers would not like the university to have the compulsory training sessions because the teacher educators probably won't need them and they would rather learn when they need it and the pre-service teachers felt it was not that hard to learn the technology. They did not expect to spend time on a whole professional development or training unless it was a particular new piece of technology.

There were also quite a high number of pre-service teachers who did not use ICT support because they did not know it existed or did not know where to get it or they tended to solve the problems by themselves.

Universities' ICT policies and support would also have effect on teacher educators and pre-service teachers using certain hardware or software, for example, it would affect teacher educators' integration of social media which influences their skills in using social media as indicated in research question one. Therefore, effective adoption and integration of ICT into teaching and learning depends on the availability and accessibility of ICT resources. If teachers cannot access the ICT resources, they will not use them (Buabeng-Andoh, 2012).

Subsidiary research question four

Are there any synergies and differences in terms of ICT ownership, self-perceived ICT skills and use between teacher educators and pre-service teachers?

Both teacher educators and pre-service teachers had quite high ownership of laptops and smart phones. However, teacher educators had higher ownership of desktops, tablets, printers and scanners, which maybe because of the price, pre-service teachers can only afford these devices they often used for studies.

For ICT skills, both teacher educators and pre-service teachers had moderately high level of using all the listed software except video editing. Generally, teacher educators had higher level than pre-service teachers except social media. It may be because with the increased age, the level of using social media decreased.

For the hardware use, both teacher educators and pre-service teachers frequently used laptops and smart phones. However, teacher educators also used desktops and tablets more often in teaching while pre-service teachers frequently applied laptops and smart phones in learning. It indicated that pre-service teachers preferred to use portable devices more than teacher educators. For software use, both teacher educators and pre-service teachers more frequently used emails, word processing, the learning management system and internet browsing, but less frequently using other software such as video editing. It indicated that the various software had not been fully applied in teaching and learning, which suggests that teacher educators could change their way of teaching and more involve different software into teaching practice. Both teacher educators and pre-service teachers tended to be conservative in trying new technology but pre-service teachers were more conservative. It may be because of the price of the new technology. It suggests universities to provide new devices or software and teacher educators should also get prepared to use new technology and to encourage pre-service teachers to try. As Dunn & Ridgway (1991), MacDonald (2008) and Wild (1996) found that lack of encouragement of pre-service teachers to use ICT by teacher educators in teacher training had been considered as a reason of pre-service teachers' unwillingness to integrate ICT in their future classroom teaching.

Overarching Research Question

This part addresses the overarching research question: *How do teacher educators and pre-service teachers use ICT in teaching and learning within the context of the support provided by the institutions?*

From the previous analysis of each subsidiary question, it can be concluded that both teacher educators and pre-service teachers had a moderately high ownership of ICT devices, especially of laptops and smart phones, which suggests a move toward mobile technologies. However, more teacher educators possessed desktops, tablets, printers and scanners than pre-service teachers. Both of them had high ICT skills in most commonly used software. They had lower level of skills in less commonly used software such as video editing. This indicated that the more frequently they used the software, the higher skills they would perceive. Age was another factor to impact the ICT skills such as in social media.

For software, both groups often used emails, word processing, the learning management system and internet browsing. However, different ICT policies and environment could affect their way of purchasing patterns and their way of using technology. If the university has more strict ICT policy, it may limit teacher educators' and pre-service teachers' capacity to download software. If the university provides workstations with desktops for teacher educators, they will more often use desktops. Also, the ICT support could affect teacher educators and pre-service teachers use of technology. For example, teacher educators and pre-service teachers used tablets less frequently because it was hard to connect to the internet and to download some of the apps.

Nikolopoulou and Gialamas (2013) found that factors such as lack of support were the main reasons why technology had not been effectively integrated into education. Al-Awidi and Aldhafeeri (2017) also indicated that barriers related to technical support leads to lack of teacher preparedness. While research has found some teachers are discouraged from using ICT because of a fear of equipment failure, lack of maintenance and service (British Educational Communications and Technology Agency, 2004;

Tondeur et al., 2012). Other research has pointed out that even when more effort is applied to technical support problems, this did not lead to more effective technology integration. This may be because teachers' beliefs and values have been observed to limit their students' technology uses (Ertmer & Ottenbreit-Leftwich, 2012). While this previous research was in the context of school education and the current research (at university level) also indicates that support is an ongoing concern for educators of all levels.

Limitations and generalisability

It is important to note, that there are two limitations of the study. The first limitation is the data collection instruments. The data collected by using self-reported survey and interview methods. A possible limitation for the methods could be a subjective nature of the data.

The second limitation is the sample size. The original intent of the study was to conduct 15 interviews in total with teacher educators and 15 with pre-service teachers. Due to the limited time and the characteristics of online courses, it was not easy to make contact with pre-service teachers at OUA because they were students outside Perth. The researcher was only able to recruit three pre-service teacher participants from OUA and these three interviews were conducted via telephone instead of face-to-face. Consequently only 13 pre-service teachers were interviewed. More importantly, the sample for interview data was a small proportion of those surveyed, which was just an indication of the views of the teacher educators and pre-service teachers. Future research with more participants may help improve the quality of the data.

Recommendations for Practice, Policy and Future Research

This part gives recommendations relating to how teacher educators and pre-service teachers could better implement ICT in their practice, how universities could improve their ICT policies to better support and facilitate ICT use and what should be considered for future research.

Practice

From this study, it has been found that teacher educators and pre-service teachers had relatively high ownership of ICT devices. However, their use of some devices such as smart phones and tablets in teaching and learning were low. It was because of the limitations of the devices, which were their size, problems of distracting others, limited tablets provided at university, connecting to the internet and restricting in downloading. This suggests that university should consider providing more tablets for classroom teaching and learning and optimise ways of connecting to the internet.

For teacher educators, they could find some ways of better implementing smart phones and tablets into teaching and learning. Basically, pre-service teachers used laptops more frequently than desktops or other devices, which suggests that the universities could decrease the number of desktops at the computer lab. Teacher educators and pre-service teachers reported quite high level of skills in using emails, word processing, slideshows, the learning management system and internet browsing, but lower skill levels in using other software such as video editing. This suggests that teacher educators and pre-service teachers need opportunities to develop and improve advanced technology skills. One of the ways to improve their ICT skills is to use the technology more frequently and find out different ways of using technology in teaching and learning.

Most teacher educators and pre-service teachers were conservative in using technology, especially pre-service teachers. They tended to wait and see rather than being early adopters. They pointed out that this was because they were not confident to try new technology or they wanted others to show them how to use in order to save time. It suggests that teacher educators and pre-service teachers should have more practice in using new technology to increase their level of confidence. The more ICT experience showed more positive attitudes, the more positive attitudes teacher educators and pre-service teachers have, the more confident they are (Teo, 2009; Hammond et al., 2011; Kreijns et al., 2013; Smeets, 2005; So et al., 2012; Kreijns et al., 2013). So teacher educators and pre-service teachers should use ICT more frequently to improve

their ICT skills and confidence. It is important for teacher educators and pre-service teachers to change their attitudes towards implementing ICT into teaching and learning, especially teacher educators, because their attitudes will affect pre-service teachers and affect the school students. Therefore, teacher educators should act as role models in the successful application of technology (Liu, 2016; Ping et al., 2018).

Some teacher educators and pre-service teachers also pointed out that it was problematic when the ICT support was not available on the weekends or holidays, especially for the online courses. Universities could consider of providing the after-hour service to help. Also, additional ICT supports such as training, classes or workshops are required by some of the teacher educators and pre-service teachers. Universities could set up some flexible training or workshops in using some new technology and how to use the technology more effectively in classroom. Some pre-service teachers suggested classes in the use of specific apps or introducing technology such as the interactive whiteboard used in school environment before their practice. It would be beneficial for pre-service teachers if the unit coordinators could take this point into account.

Policy

As discussed above, pre-service teachers more frequently used laptops rather than desktops. It suggests the correctness of the BYODD policy. However, some teacher educators and pre-service teachers pointed out that it was problematic to connect the digital devices to the internet and download some software without the administrative permission. Universities could think of updating the ICT policy system for the convenience of use. For example, they could set up a meeting between the ICT support department and the teacher educators to see the problems and solutions. Find the best way to apply ICT in teaching and learning rather than conducting ICT policy with no consideration of the practice.

Future Research

As mentioned in the limitations of the study section, the researcher recommends that future research of this kind be taken over an extended time period.

While this study only focused on how teacher educators and pre-service teachers use ICT in teaching and learning. It is recommended that future research should investigate the gap (if any) that exists between the ICT used in preparing teachers to teach and that needed in their roles in school education. Also the difference between ICT environments and applications in universities and that in schools should be investigated.

Overall conclusions

The main aim of this research was to find out how teacher educators and pre-service teachers used ICT in teaching and learning within the context of the support provided by the institutions. To achieve this, teacher educators' and pre-service teachers' ICT ownership, self-perceived skills, and use and the universities' ICT policies and support were investigated.

The findings of this study demonstrate a notable high level of ownership, skills and usage of ICT by teacher educators and pre-service teachers. However, a proportion of teacher educators and pre-service teachers are still not well prepared in implementing ICT in teaching and learning. Some improvements are needed in the level of institutional ICT support. The findings of this study also suggest a need for more practice in using ICT to enhance teacher educators' and pre-service teachers' ICT confidence.

Further research is needed to find out the gap in ICT application between teacher education and school education. This could benefit both levels of education and may point to beneficial changes in ICT policy and curriculum

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APPENDICES

APPENDIX 1: Consent form

<div align="center">

Consent Form

</div>

• I have been provided with a letter explaining the research project and I understand the letter.

• I have been given the opportunity to ask questions and all my questions have been answered satisfactorily.

• I understand the information I give will be kept confidential, recordings are for research purposes only and will be erased after 5 years.

• I understand that I will not be identified in any published report, thesis, or presentation of the results of this research.

• I understand that I can withdraw from the research at any time before submission, without any penalty and relation influence with my university.

• I freely agree to participate in this project.

Name (printed): _____

Signature: _____   Date:_____

APPENDIX 2: Information letter

Information Letter

Dear Lecturer (student),

Thank you for your willingness to answer this survey which focuses on your ICT ownership and self-perceived skills along with perceptions of ICT use in teaching (learning). The results from this research may be aggregated and reported in a thesis, journal article or conference presentation. The primary goal of the study is to better understand lecturers' experiences with, and modes of use, of computers.

Your answers are confidential and neither the researchers nor the university will be able to identify you. Furthermore, participation is voluntary. Your decision to participate or not will not effect your current or future relations with Edith Cowan University. If you decide to participate you are free not to answer any question or withdraw at any time.

We appreciate your time and participation. At the end of this survey, you will be invited to take part in an interview if you are interested.

This research has been approved by the Edith Cowan University Human Research Ethics Committee. If you have any questions or concerns you may ring Huifen Jin (6304 6728) or Dr Jeremy Pagram (6304 6331) or if you wish to speak to an independent person please contact:

Research Ethics Officer

Edith Cowan University

270 Joondalup Drive

Joondalup WA 6027

Phone: (08) 6304 2170

Email: research.ethics@ecu.edu.au

APPENDIX 3: Teacher educator's survey

Lecturer's ICT Ownership, Skills and Use Survey

Instructions

1. This survey should take you about 10 to 15 minutes to answer the questions but take as long as you need.

2. Some items require you to TICK an alternative/alternatives while others provide the opportunity for you to write brief responses.

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1. What is your gender?   **2. What is your age?** ____
   Male __   Female __

3. What is your highest educational qualification?
   Post Graduate Certificate/Diploma __   Master's degree __
   Doctorate __   Undergraduate Degree __

4. How many years experience do you have working in higher education?
   0-3 __   4-7 __   8-15 __   16-23 __   24-30 __   30+ __

5. What program(s) do you teach into at present? (you can tick multiple items)
   Early childhood __   Primary __   Secondary __
   Grad Dip __   Grad Certificate/Master __   PhD __

6. Do you coordinate any units at ECU?
   Yes __   No __

7. In what subject area do you teach the most?

Art	Music	Drama	Dance
Media	Catholic Education	Home Economics	Maths
Science	Health and Physical Education	Humanities and Social Sciences	Computing
English	Languages other than English	Design and Technology	Do not apply

8. Which of the following devices have you used in your classes this year (tick as many as apply)?
   Desktop computer __   Laptop __   Tablet (Windows, iPad, or Android) __
   Scanner __   Printer __   Smart Phone __   Projector __

9. For each item that YOU OWN, please indicate how long you have owned it.

	Don't own	Less than 1 year	1-2 years	2-3 years	3-4 years	More than 5 years
(a) Desktop computer …………………................						
(b) Laptop …………………………………............						
(c) Tablet (iPad, Android, Windows) …….............						
(d) Scanner …………………………...................						
(e) Printer …………………………………........						
(f) Smart phone ……………………….….......						

10. For each device YOU USE, please indicate what operating systems you use (tick as many as apply)?

Mac OS __	Windows __	Android __	iOS (iPad & iPhone) __
Linux __	Other __	Don't know __	

11. For each item please indicate the frequency you have used it IN YOUR TEACHING this year.

	Don't use in teaching	Occasionally	Weekly	Daily
(a) Desktop computer ………………...........				
(b) Laptop …………………………………				
(c) Tablet (iPad, Android, Windows) …..				
(d) Scanner ………………………………...				
(e) Printer …………………………………				
(f) Smart phone ……………………….....				

12. For each statement, please indicate the frequency…

	Never	Rarely	Often	Always
I use technology during class to make connections to the learning material or deepen learning with additional materials (e.g. by presenting audio or video examples or demonstrations of learning concepts)				
I use technology during class to maintain students' attention (e.g. break up lectures)				
I have adequate technology skills for unit instruction				
My students use technology for creative or critical thinking tasks in class				
My students use online collaboration tools to communicate/collaborate with the lecturer or other students in or outside class				
My students use technology devices to enhance learning during class				

13. Which tools or resources do you use IN YOUR TEACHING more or less?

	Never	Seldom	Often	Always
Polling tools (e.g. clickers, SMS-based tools)				
Published electronic resources (e.g. assignments, tutorials, quizzes)				
Search tools to find references or other information online for class work				
Academic validation software (i.e. Turnitin)				
Software to make videos or multimedia resources				
Innovative computer interfaces (e.g. voice, touchscreen, gesture-based devices, VR)				
Social media involved as a teaching and learning tool				
Lecture capture (e.g. record lectures for later use or review)				
Simulations or educational games				
Free, web-based content to supplement unit-related materials (e.g. YouTube, Khan Academy, TED talk, iTunes U, etc.)				
E-books or e-textbooks				
E-portfolios				
Online collaboration tools to communicate or collaborate				
Learning management system (e.g. Blackboard)				

14. During semester how frequently do you use the following IN YOUR TEACHING?

	Never	Occasionally	Weekly	Daily
(a) Word processing ……………………………....				
(b) Slideshows (PowerPoint, Keynote) …….…....				
(c) Spreadsheets (Microsoft Excel) ……………...				
(d) Internet browsing (Firefox, Safari) …………..				
(e) Digital photography …………………………......				
(f) Image editing ……………………………....				
(g) Video editing ……………………………....				
(h) Social media (Facebook) ………...............				
(i) Email ……………………………….…..……				
(j) Course management software (Blackboard) ….				
(k) Cloud computing (Google docs) …………..…				

15. Rate yourself on what you can do on computers. For each application TICK the option that describes the *highest level* of skills that you possess.

Word processing (e.g. Microsoft Word)	I can't do much	Print a document, change fonts, spell check, insert a footer and page numbers	Insert images, create tables, change page setup, change margins	Use columns and sections, set up styles, use templates and add-ins
Slideshows (e.g. Powerpoint, Keynote, etc)	I can't do much	Create a slideshow, insert images, change fonts and layout	Navigate during a presentation, add animation and transitions, insert hyperlinks	Edit the master slide, include sound, print handouts, add navigation buttons
Spreadsheets (e.g. Microsoft Excel)	I can't do much	Enter data, use sort, create charts (graphs) and modify them	Insert some calculations, format cells, insert and delete rows and columns	Use complex formulae, use absolute and relative cell referencing
File management	I can't do much	Save files in a folder, create and name folders, navigate between folders, copy, delete and rename files	Recognize different file types, navigate between drives and directories, access a network, use Help files	Zip and unzip files, install software, do complex searches for files, create short-cuts, use control panels
Internet browsing (e.g. Internet Explorer, Firefox, Safari, etc)	I can't do much	Navigate to know web sites, create Favourites, do basic searchers	Save images and text, use Advanced search tools, organize Favourites	Do complex searches, download and install plugins, use different browsers, alter browser preferences
Digital photography	I can't do much	Take photos or video, and transfer them to a computer	View images/video on the camera, adjust camera settings such as flash and close-up	Adjust camera menu options such as resolution and shutter speed
Image editing	I can't do much	Draw pictures and do simple editing such as crop, delete, colour, draw and add text	Change image size, file format and clearness	Do complex image editing using special effects, and layers
Video editing	I can't do much	Edit video on a computer such as join, split, delete and insert	Use software to add transitions, import and edit sound tracks, add titles and subtitles	Use advanced software to apply complex editing and special effects
Social networking (e.g. Facebook, Twitter, etc)	I can't do much	Edit my profile and chat with friends	Post photographs, play games, and join groups	Share files, create and manage groups, edit privacy settings
Email	I can't do much	Send and access emails, add to and access the Address book	Store messages in folders, find Sent messages, manage the Address book	Add and edit 'Signatures', and add attachments
Course management software (e.g. Blackboard)	I can't do much	Find and read course materials online	Download files and participate in online discussions	Retrieve my assignments

16. For each statement, please indicate the frequency…

	Never	Seldom	Often	Always
I use technology during class to make connections to the learning material or deepen learning with additional materials (e.g. by presenting audio or video examples or demonstrations of learning concepts)				
I use technology during class to maintain students' attention (e.g. break up lectures)				
I have adequate technology skills for unit instruction				
My students use technology for creative or critical thinking tasks in class				
My students use online collaboration tools to communicate/collaborate with the lecturer or other students in or outside class				
My students use technology devices to enhance learning during class				

17. During semester indicate the frequency you use the following types of Internet access.

	Never	Occasionally	Weekly	Daily
(a) Home internet …………………………				
(b) Mobile Internet (3, 4G) ……………				
(c) University computer lab ………….....				
(d) University wireless ….........................				
(e) Free Wi-Fi (McDonalds) ……...……..				

18. To what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree
(a) Technology helps students make connections between units …………………………………..				
(b) Technology use in class develops relevant skills that are useful to students beyond the university ……				
(c) Technology helps students understand basic concepts ………………………………………..				
(d) Technology makes students' learning experiences more authentic (closer to real life) …………………..…				
(e) Technology aids students' achievement of unit objectives …………………………………………				
(f) Technology enriches students' learning experiences ……………………………………				

19. During semester how often do you…

	Never	Occasionally	Weekly	Daily
Access your university email account				
Upload learning materials				
Create online learning materials				
Assess students' work electronically				

20. Institutional support for ICT use

	Strongly disagree	Disagree	Agree	Strongly agree
I am able to solve technological problems related to my teaching				
University offers me adequate maintenance and support for technology resources				
University offers me workshops related to ICT training				
University offers me online tutorials and technological instruction				

21. Which one of these statements describes you best?
    (a) I am among the first people to check out a new electronic device or gadget.
    (b) I usually wait until I see others try new technology, and then I will try it myself.
    (c) I tend to wait a long time to try new technology.

This is the end of the survey. Thank you for your responses.

Optional

I am willing to be contacted and to participate in an interview.

University email address:

APPENDIX 4: Pre-service teacher's survey

Student's ICT Ownership, Skills and Use Survey

Instructions

1. This survey should take you about 10 to 15 minutes to answer the questions but take as long as you need.

2. Some items require you to TICK an alternative/alternatives while others provide the opportunity for you to write brief responses.

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1. What is your gender?
Male __   Female __

2. What is your age? ____

3. How many years of full-time study (or equivalent) at university have you completed?

_____ (e.g. o.5/1/1.5…)

4. Are you currently a full-time or part-time student?
Full-time __   Part-time __

5. Are you mostly an 'on campus' (attend classes) or 'off campus' (online/distance) student?
All on campus __   Some on campus/some off campus __   All off campus __

6. Which course are you studying in?
Bachelor of Education __   Graduate Diploma of Education __   Other __

7. What type of teacher are you preparing to become?
Early childhood __   Primary __   Secondary __   Other __

8. (SECONDARY ONLY) What is your teaching major?

Art	Music	Drama	Dance	Media
Catholic Education	Home Economics	Maths	Science	English
Languages other than English	Health and Physical Education	Humanities and Social Sciences	Computing	Design and Technology

9. For each item that YOU OWN, please indicate how long you have owned it.

	Don't own	Less than 1 year	1-2 years	2-3 years	3-4 years	More than 5 years
(a) Desktop computer						
(b) Laptop						
(c) Tablet (iPad, Android, Windows) ...						
(d) Scanner						
(e) Printer						
(f) Smart phone						

10. For each device YOU USE, please indicate what operating system(s) you use (tick as many as apply)?

Mac OS __   Windows __   Android __   iOS (iPad & iPhone) __

Linux __   Other __   Don't know __

11. For each item please indicate the frequency YOU HAVE USED it IN YOUR STUDIES this year.

	Don't use in study	Occasionally	Weekly	Daily
(a) Desktop computer				
(b) Laptop				
(c) Tablet (iPad, Android, Windows) ...				
(d) Scanner				
(e) Printer				
(f) Smart phone				

12. Which of the following devices have YOUR LECTURERS used in your classes this year (tick as many as apply)?

Desktop computer __   Laptop __   Tablet (Windows, iPad, or Android) __

Scanner __   Printer __   Smart phone __   Projector __

13. Which tools or resources DO YOU WISH YOUR LECTURERS use more or less?

	Never	Seldom	Often	Always
Polling tools (e.g. clickers, SMS-based tools)				
Published electronic resources (e.g. assignments, tutorials, quizzes)				
Search tools to find references or other information online for class work				
Academic validation software (i.e. Turnitin)				
Software to make videos or multimedia resources				
Innovative computer interfaces (e.g. voice, touchscreen, gesture-based devices, VR)				
Social media involved as a teaching and learning tool				
Lecture capture (e.g. record lectures for later use or review)				
Simulations or educational games				
Free, web-based content to supplement unit-related materials (e.g. YouTube, Khan Academy, TED talk, iTunes U, etc.)				
E-books or e-textbooks				
E-portfolios				
Online collaboration tools to communicate or collaborate				
Learning management system (e.g. Blackboard)				

14. For each statement, please indicate the frequency…

	Never	Seldom	Often	Always
My lecturers use technology during class to make connections to the learning material or deepen learning with additional materials (e.g. by presenting audio or video examples or demonstrations of learning concepts)				
My lecturers use technology during class to maintain my attention (e.g. break up lectures)				
My lecturers have adequate technology skills for unit instruction				
I use technology for creative or critical thinking tasks in class				
I use online collaboration tools to communicate/collaborate with the lecturer or other students in or outside class				
I use my own technology devices to enhance learning during class				

15. Rate yourself on what you can do on computers. For each application TICK the option that describes the *highest level* of skills that you possess.

Word processing (e.g. Microsoft Word)	I can't do much	Print a document, change fonts, spell check, insert a footer and page numbers	Insert images, create tables, change page setup, change margins	Use columns and sections, set up styles, use templates and add-ins
Slideshows (e.g. Powerpoint, Keynote, etc)	I can't do much	Create a slideshow, insert images, change fonts and layout	Navigate during a presentation, add animation and transitions, insert hyperlinks	Edit the master slide, include sound, print handouts, add navigation buttons
Spreadsheets (e.g. Microsoft Excel)	I can't do much	Enter data, use sort, create charts (graphs) and modify them	Insert some calculations, format cells, insert and delete rows and columns	Use complex formulae, use absolute and relative cell referencing
File management	I can't do much	Save files in a folder, create and name folders, navigate between folders, copy, delete and rename files	Recognize different file types, navigate between drives and directories, access a network, use Help files	Zip and unzip files, install software, do complex searches for files, create short-cuts, use control panels
Internet browsing (e.g. Internet Explorer, Firefox, Safari, etc)	I can't do much	Navigate to know web sites, create Favourites, do basic searchers	Save images and text, use Advanced search tools, organize Favourites	Do complex searches, download and install plugins, use different browsers, alter browser preferences
Digital photography	I can't do much	Take photos or video, and transfer them to a computer	View images/video on the camera, adjust camera settings such as flash and close-up	Adjust camera menu options such as resolution and shutter speed
Image editing	I can't do much	Draw pictures and do simple editing such as crop, delete, colour, draw and add text	Change image size, file format and clearness	Do complex image editing using special effects, and layers
Video editing	I can't do much	Edit video on a computer such as join, split, delete and insert	Use software to add transitions, import and edit sound tracks, add titles and subtitles	Use advanced software to apply complex editing and special effects
Social networking (e.g. Facebook, Twitter, etc)	I can't do much	Edit my profile and chat with friends	Post photographs, play games, and join groups	Share files, create and manage groups, edit privacy settings
Email	I can't do much	Send and access emails, add to and access the Address book	Store messages in folders, find Sent messages, manage the Address book	Add and edit 'Signatures', and add attachments
Course management software (e.g. Blackboard)	I can't do much	Find and read course materials online	Download files and participate in online discussions	Submit my assignments

16. During semester indicate the frequency you use the following IN YOUR STUDIES.

	Never	Occasionally	Weekly	Daily
(a) Word processing				
(b) Slideshows (PowerPoint, Keynote)				
(c) Spreadsheets (Microsoft Excel)				
(d) Internet browsing (Firefox, Safari)				
(e) Digital photography				
(f) Image editing				
(g) Video editing				
(h) Social networking (Facebook)				
(i) Email				
(j) Course management software (Blackboard)				
(k) Cloud computing (Google docs)				

17. During semester indicate the frequency you use the following types of Internet access.

	Never	Occasionally	Weekly	Daily
(a) Home internet				
(b) Mobile Internet (3, 4G)				
(c) University computer lab				
(d) University wireless				
(e) Free Wi-Fi (McDonalds)				

18. To what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree
(a) Technology helps me make connections between units				
(b) Technology use in class develops relevant skills that are useful to me beyond the university				
(c) Technology helps me understand basic concepts				
(d) Technology makes learning experiences more authentic (closer to real life)				
(e) Technology aids my achievement of unit objectives				
(f) Technology enriches my learning experiences				

19. Institutional support for ICT use

	Strongly disagree	Disagree	Agree	Strongly agree
I am able to solve technological problems related to my study				
University offers me adequate maintenance and support for technology resources				
University offers me workshops related to ICT training				
University offers me online tutorials and technological instruction				

20. Which one of these statements describes you best?
   (a) I am among the first people to check out a new electronic device or gadget.
   (b) I usually wait until I see others try new technology, and then I will try it myself.
   (c) I tend to wait a long time to try new technology.

This is the end of the survey. Thank you for your responses.

Optional (Removed before transcription)

If you wish to be entered into the prize draw for a $50 voucher for the iTunes or Google Play Store (your choice), please write down your student email address below.

☐ I am willing to be contacted and to participate in an interview.

University email address:

APPENDIX 5: Semi-structured interview guide 1

For teacher educator:

Section 1. ICT use

1. What ICT devices you usually use/prefer to use? Why?

2. How you use technologies in your class?

3. Do you ask students to submit assignments electronically?

4. When you mark electronic assignments do you mark on screen (computer & iPad) or on paper?

5. What things would you like to do using technology that you cannot do now?

6. How do you feel when students use their devices in your class without invitation?

7. How do you feel about using tablets and smart phones for teaching and learning?

8. Are there any other factors that encourage or impede your use of technology at university?

Section 2. ICT confidence

9. How confident are you using ICT in your teaching?

Section 3. Attitudes to ICT

10. Are you an early adopter of new technology or you tend to wait for a bit of time to use? Why?

11. How useful do you think it will be for a future teacher to use ICT?

12. How critical do you believe ICT is to your teaching?

Section 4. ICT policy & support

13. Are you aware of any (ECU / Curtin) ICT policies?

14. What do you know about the current institutional ICT policies?

15. Are you aware of any ICT support?

16. What do you know about the current institutional ICT support? Could you tell your experience with your ICT support.

17. What additional support would you like the university to provide?

APPENDIX 6: Semi-structured interview guide 2

For pre-service teacher:

Section 1. ICT use

1. What ICT devices you usually use/prefer to use? Why?

2. Describe how you use technologies?

3. Do you submit your assignments electronically?

4. Do you prefer your assignments been marked electronically or on paper?

5. What things would you like to do using technology that you cannot do now?

6. How do feel when students use their devices in the class without invitation?

7. How do you feel about using tablets and smart phones for teaching and learning?

8. Are there any other factors that encourage or impede your use of technology at university?

Section 2. ICT confidence

9. How confident are you using ICT in your learning? As you are becoming a teacher.

10. How confident do you think you will be in your future teaching using technology?

Section 3. Attitudes to ICT

11. Are you an early adopter of new technology or you tend to wait for a bit of time to use? Why?

12. How useful do you think it will be for a future teacher to use ICT?

13. Can you describe a scenario in which you would use ICT in your future teaching?

Section 4. ICT support

14. Are you aware of any (ECU / Curtin) ICT support?

15. What do you know about the current institutional ICT support? Tell us your experience with your ICT support?

16. How do you think this support has impacted your training to be a teacher? / Is there any special kind of support you have found extra useful?

17. What things could the university do to help you with technology that you cannot do now?