Trinity College Dublin, The University of Dublin

Pre-Service Teachers and their Experiences of Technology: A Mixed Methods Study

A thesis written in fulfilment of the requirements for the degree of Doctor in Philosophy (PhD)

2018

Alison Egan

Declaration & Online Access

I declare that this thesis has not been submitted as an exercise for a degree at this or any other university and it is entirely my own work. I agree to deposit this thesis in the University's open access institutional repository or allow the Library to do so on my behalf, subject to Irish Copyright Legislation and Trinity College Library conditions of use and acknowledgement.

Name: Alison Egan

Signed:

May 2018

Summary

The research study was conducted to explore pre-service teachers' use of technology, in a personal and professional capacity. It sought to establish if participants were millennials, by virtue of their uses of those technologies and proceeded to identify any factors that aided or impeded technological use on school placement. The literature reviewed pre-service teacher education in Ireland and provided a context for the research. The domains of technology and education were then explored, and it was established that Ireland has had an inconsistent approach to technology integration in the classroom. The literature then moved to review the practice of use of technology, in personal and professional capacities, by teachers, and pre-service teachers. Finally, the intrinsic and extrinsic factors that can impede the use of technology in a school placement classroom were discussed. The final section explored the theoretical framework that underpinned the research study, including TAM, TRA, TPB, and discussed the psychological concepts of self-efficacy and technological self-efficacy, and their application to the current research.

The research was conducted based on a pragmatic epistemological paradigm, and utilised mixed methods to generate data to address the research questions. These research questions were as follows:

- Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the net generation or millennial learners?
- What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes?
- What barriers, if any, do pre-service teachers perceive as impacting on their use of technology in the classroom?
- Does pre-service teacher's technological self-efficacy correlate positively with their use of technology while on school placement?
- Do pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM

variables (facilitating conditions and subjective norms), act as a positive predictor of their use of technology while on school placement?

The methods used to address these research questions included surveys and interviews, administered in a sequential explanatory design over three years, with each of two cohorts of pre-service teachers. The first survey was administered when the pre-service teachers entered their Bachelor in Education course, in first year, and then subsequent surveys were administered after school placement in second and third years. A sub-sample of survey respondents were invited to interview in the third year of the research study. Cohort one (C1) had 80 participants and cohort two (C2) had 104 participants. Of these, fourteen (n=14) respondents completed semi-structured interviews. Statistical and thematic analysis was conducted on the survey and interview data.

The results of the research demonstrated a complex and multi-faceted interplay of components that impacted on use of technology by the pre-service teacher participants. The research participants were frequent, and confident, users of a number of personal technologies. However, physical, social and cultural factors impeded technology use in the classroom. These factors included extrinsic barriers such as technology not being available and lack of technical support in the school. Intrinsic barriers experienced included participants own lack of competence using technology. Other contextual factors were germane for the pre-service teacher participants and included the influence of the mentor teacher, the college-based preparation course and the social norms experienced while on school placement. The implications of the results for general educational policies are discussed, where school environmental factors should be considered in future *Action Plans for Education*. The implications of the study for pre-service teacher education include recommendations for a cohesive approach to school placement, and suggestions include creation of partner schools and CPD for members of the placement triad. Finally, how the research study adds to the growing body of literature on technology and pre-service teachers is discussed, and the limitations of the research presented.

Acknowledgements

This thesis is dedicated to Dad who left us far too soon – requiescat in pace.

I would like to thank Dr. Keith Johnston, my thesis supervisor, for his support and encouragement over the past six years. His insightful and perceptive words of wisdom were invaluable, as each chapter progressed. A particular word of appreciation for introducing me to Leonard Cohen in the Mahalia Jackson Theatre, New Orleans during a SITE conference – an exceptional event.

I am very grateful to the CRITE research group, especially Ann FitzGibbon, Elizabeth Oldham, Aibhin Bray, Brendan Tangney, Ciaran Bauer, Richard Millwood and Claire Smith. These critical friends reviewed chapters, conducted research seminars, shared desks (and teabags) and provided constructive feedback when needed. It is a real privilege to continue to work with this research group, as it has been for the past six years.

To my colleagues and friends in MIE, especially Dr. Anne O'Gara, whose support and words of encouragement came at pivotal junctures. A special word of thanks to Martin Lynch and Patrick Geary whose friendship, practical advice and counsel helped at every stage of the process. Also, to Anne McMorrough and Jennifer O'Sullivan who listened, cajoled, aided (& abetted) me along the way. Of course, without the student research participants, this project could not have happened, and their contribution to the research is recognised and appreciated.

Other PhD friends provided virtual assistance at all times of the day and night – Stella, Colin and Gerry, it has been entertaining. A special note of appreciation for my best pals Anto, Eva, Trina and the 'mossies', finally, my 'homework' is finished.

I am grateful for the support of my immediate family, especially Mum, Kar & Bar and my nephews, Hugh & Matthew, who provided welcome distraction. Of course, without Alan, my husband, this would not have happened – now married life can begin.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACM	Access, Competence and Motivation Model
ATCU	Attitude to Computer Use Model
BECTA	British Educational Communications and Technology Agency
BI	Behavioural intention
CPD	Continuing Professional Development
C- TAM - TPB	Combined TAM and TPB model
CAS	Computer Attitude Scale
CESI	Computers in Education Society Ireland
CRITE	Centre for Research in IT in Education, University of Dublin, Trinity College
DCMNR	Department of Communications, Marine & Natural Resources
DES	Department of Education and Skills
DNAS	Digital Native Assessment Scale
EdTech	Educational Technology
EU	European Union
FC	Facilitating Conditions
HEA	Higher Education Authority
IBM	International Business Machines
ICT	Information and Communications Technology
INTO	Irish National Teacher's Organisation
IWB	Interactive Whiteboard
LMS	Learning Management System
MBA	Master's in Business Administration
NCCA	National Council for Curriculum and Assessment
NCTE	National Centre for Technology in Education
NDP	National Development Plan
NT	National Teacher
OECD	Organisation for Economic Co-Operation and Development
PEU	Perceived Ease of Use
PST	Pre-Service Teacher
PU	Perceived Usefulness
SN	Subjective Norm
SPSS	Statistical Package for the Social Sciences
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTF	Task Technology Fit Model
UTAUT	Unified Theory of Acceptance and Use of Technology Model
VLE	Virtual Learning Environment

List of Appendices

Chapter One Introduction

This chapter provides an introduction to the research study. It will explain the rationale and background to the research. The focus of the research is to examine pre-service teachers' use of technology in their personal and professional lives. It will discuss the disconnect that occurs when their frequent personal use of technology is not matched in a professional environment. The research thesis uses the term pre-service teacher, in lieu of student teacher, trainee teacher and student. A short précis of the forthcoming chapters is provided here.

Background and Context to Research Study

Irish pre-service teachers' use of technology on a personal basis, or in the classroom, has long been an area of interest of the researcher (Egan & FitzGibbon, 2010). This previous research identified a gap in the literature on personal and professional usage of technology by Irish pre-service teachers. This prompted further enquiry as to how pre-service teachers' attitudes to technology were formed, and how these attitudes impacted on actual use of technology in the classroom, especially during school placement blocks.

Cuban (1986, 1993, 2001a, 2001b) and Papert (1987a, 1987b) have long advocated that having technology in a classroom does not ensure use of that technology. Yet, the pre-service teachers in the current research were the millennials (Dede, 2005) who were using technology every day on a personal basis, why were they not bringing this familiarity with technology into the classroom? This is not a uniquely Irish phenomenon, reviews of pre-service teachers' use of technology in other countries have reported similar results (Albion, 2011; Ottenbreit-Leftwich et al., 2012; Redmond & Albion, 2002; Thinyane, 2010). A techno-centric focus to technology integration has long been the approach of various Irish governmental policies. As far back as the 1980s, the benefit of technology and education was mooted in Ireland (DES, 1980). However, Ireland has had an inconsistent approach to technology integration (DES, 1997), and various initiatives and projects over the years have had limited effect on changing the way technology is used in a classroom context. Hence, the focus of the research study emerged and the findings would have implications for future policy, practice and research.

Research questions.

The research questions were guided by the overarching theme of why if pre-service teachers were using technology in their everyday lives, this was not translating to similar frequent use of technology in their professional lives. This theme provided the focus of the research, which was guided by five research questions. These were:

- Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the net generation or millennial learners (Cuban, Kirkpatrick, & Peck, 2001; Dede, 2000; Tapscott, 1998)?
- What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes (Cosgrove, Zastrutzki, & Shiel, 2005; Shiel, Sofroniou, & Cosgrove, 2006)?
- What barriers, if any, do pre-service teachers perceive as impacting on their use of technology in the classroom (Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012)?

- Does pre-service teacher's technological self-efficacy correlate positively with their use of technology while on school placement (Albion, 2007; Bandura, 1977)?
- Do pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM variables (facilitating conditions and subjective norms), act as a positive predictor of their use of technology while on school placement (Davis, 1989; Teo, Lee, & Chai, 2007; Venkatesh & Davis, 2000)?

Research Location

The locus of the research was the researcher's institution, one of many colleges of education in Ireland. However, the researcher was not a member of the academic teaching staff, but rather worked in an administrative support function, in the institution. The researcher had no teaching contact with the pre-service teacher participants during their time in college. The researcher also used a variety of techniques to negate demand characteristics that may have been experienced by the pre-service teacher participants. These are discussed in chapter three.

Methodology

The research study was conducted within a pragmatic epistemological paradigm and utilised a mixed methods approach. The methods used included surveys and interviews, administered in a sequential explanatory design over three years, with each of two cohorts of pre-service teachers. The first survey occurred when the pre-service teachers entered their Bachelor in Education course, in first year, and then subsequent surveys happened after school placement in second and third year. A sub-sample of survey respondents were then invited to interview in the third year of the research study. Cohort one (C1) had 80 participants and cohort two (C2) had 104 participants. Of these, fourteen (n=14) respondents completed semi-structured interviews. Sample attrition became a feature of the research, as the research was of three year's duration, and this is discussed in chapter four. Parametric and non-parametric statistical analysis was conducted on the survey data, using SPSS. Thematic analysis was conducted on the interview data, and the researcher used nVivo to aid this analysis. The results of this pragmatic mixed methods sequential explanatory research design are illustrated in chapters four and five.

Structure of Thesis

This thesis is presented in seven chapters. This first chapter provides a brief introduction to the study and provides a context to the work. The second chapter outlines the relevant literature that informed the research. This chapter is divided into five main sections. These are the context of teacher education and technology integration in Ireland, pre-service teachers and their personal uses of technology, professional uses of technology, barriers experienced using technology and finally, a review of the psychological concept of self-efficacy and how this has been applied to use of technology. Finally, a theoretical framework for the current study is presented, and discussed in light of the psychological literature that informed the TAM model. The third chapter provides a review of the chosen methodology (mixed methods) and considers how a pragmatic epistemological approach was employed during the course of the research study. This third chapter also provides justification for the analytical methods chosen. Chapters four and five present the findings of the research study. The results are presented by research question, with analysis of the results presented sequentially. Chapter six examines the main findings of the research and discussed where these have added to current literature on pre-service teachers' use of technology and factors that influenced this use. Finally, chapter seven concludes the thesis, and considers the research contribution to the practice of teacher education, and the implications for governmental technology integration policies. This final chapter delineates the limitations of the current work and provides suggestions for future research.

Chapter Two Literature Review

This chapter outlines the literature that forms the basis of various themes explored in the study and provides the foundation for the research methods chosen. The first section of this chapter provides a context for the research. This section focuses on pre-service education and technology policy in Ireland. This section proceeds to contextualise the domain of technology in education and outline the impact of Irish government policies on technology in education, up to and including the current *Digital Strategy for Schools* (DES, 2015). Having reviewed the educational technology policies over the past 40 years in Ireland, the predominant theme is one of techno centrism (sic.) – where there has been a "tendency to given centrality to the technical object" (Papert, 1987a, p. 2) and a distinct lack of detail on how to implement technology in the classroom. This techno-centric theme persists to the current day with continued focus on provision of hardware and access to broadband as key objectives of the *Digital Strategy for Schools* (2015), with a lesser focus on the pedagogy of technology. However, the more recent *Action Plan for Education, 2016- 2019* demonstrates some awareness that technological pedagogies are also required, in future education initiatives.

The second substantive section reviews literature on practice and use of technology by pre-service teachers, with a particular focus on their professional use of technology, during school placement. Use of technology is explored within the broader domains of personal and professional use. Factors that influence successful technology integration in the classroom are then investigated. The third section reviews intrinsic factors that influence technology integration in the classroom, in particular the psychological concepts of self- efficacy and attitude. The application of these concepts to the technological domain with pre-service teachers is then discussed. The final section of the literature examines the theoretical framework and psychological tools used to measure attitude and self-efficacy. Explanation of how these psychological constructs have been applied to the technological domain is then outlined.

While there is extensive literature on in-service teachers' attitudes and use of technology, there are few examples of pre-service teachers' use and attitudes to technology in the classroom, in an Irish context. Each section is designed to justify the research questions central to the study.

Pre- Service Teacher Education in Ireland

This section will give an overview of the history of pre-service teacher education in Ireland. It will review various government policy documents that were influential during that time, including the Green and White Papers, and then outline the enactment of the Education Act, 1998. It will discuss the role of the Higher Education Authority and how the establishment of the Teaching Council of Ireland heralded a time of change for pre-service teacher education generally, in the past decade.

Formal training of primary school teachers (herein after referred to as pre-service teachers) was first established in Ireland with the publication of the Stanley Letter (DES, 1831). This letter outlined formal procedures to govern education in Ireland and established a model school in Dublin (now the location of the Department of Education, Marlborough Street, Dublin) that would train teachers. Eventually, teacher training model schools were established throughout the country and the new Irish State (1922) inherited five of these model schools (Travers et al., 2004). These became colleges of education in the 1960s (Coolahan, 1981) where trainee teachers qualified with a 'national teacher' (NT) title, upon completion of a two-year course. However, this was not a university qualification and after much lobbying from the Irish National Teacher Organisation (INTO, a primary school teacher union), the Government requested that the universities agree to award degrees to primary teachers. Thus, a formal Bachelor of Education degree was established in 1974,

> within a short period in the 1970s, the teaching profession became an all graduate one, with a mixture of concurrent and consecutive initial teacher education programmes on offer, and all new categories of teachers having degree status (Travers et al., 2004, p. 8).

While much progress had been made on formalising the role of pre-service teacher education, during the 1980s some policy problems (Coolahan, 2004) had occurred. For example, Carysfort College (one of the largest teacher education colleges in the State at that time) was closed due to a declining birth rate. Further, a more generalised lack of government action in regard to education had been noted by Coolahan (2004).

The Organisation for Economic Co-operation and Development (OECD) (1991) undertook a review of Irish Education in 1991. Whilst acknowledging the positive aspects of the Irish education system, the OECD report outlined key areas of improvement required, especially in teacher education. The OECD stated that teaching should be viewed as a career, where "good quality initial teacher education, followed by a structured form of induction and greatly expanded in-service teacher education" (OECD, 1991, p. 17) was recommended. These recommendations went on to form the basis of the *Green Paper,* published by the Irish Government, the following year (1992).

Green & White Papers

Pre-service teacher education in Ireland was given formal mention in the *Green Paper* (DES, 1992) where "a well-trained and committed teaching force is essential in maintaining and enhancing the quality of education" (pp. 163-164). In 1995, the *Charting our Educational Future* - *White Paper* (DES, 1995), again confirmed the importance of "the teaching career as a continuum involving initial teacher education, induction processes and in-career development opportunities" (p. 128). This *White Paper* consolidated the role of universities in providing linkages with the Colleges of Education and stressed an emphasis on combining academic study with the study of educational theory and practice, alongside the subject requirements of the primary school curriculum. The Department (of Education) also advised the development of a post-graduate diploma (Higher Diploma) for those wishing to enter the teaching profession, but whose primary degree was in another discipline. The effect of these two papers was to establish, formally, the criteria for qualification as a primary school teacher in Ireland. With these publications, a structured model of teacher education now applied to every teacher (whether primary or post-primary) in Ireland. The *Green & White Papers* also provided the basis for various sections in the Education Act, 1998, which was to follow, three years later.

The Teaching Council

The Education Act 1998 transposed many of the recommendations of the *White Paper* into legislation. A key feature of the Education Act, 1998 was the creation and establishment of The Teaching Council by statute (The Teaching Council Act, 2001). This gave statutory provision to the newly formed Teaching Council's ability to review and accredit the programmes of teacher education and training provided by institutions of higher education and training in the State (Teaching Council Act 2001, s. 38.1.a).

Coolahan (2001, 2004) in his general review of pre-service teacher education in Ireland, echoed the findings of both the *White Paper* (DES, 1995) and the earlier *OECD Report* (OECD, 1991) which argued that the length and structure of the programmes available should be reviewed. The *Kellaghan Report* (2002) also addressed course modules in pre-service teacher education and was critical of their lack of integration. With particular reference to the foundation courses (psychology of education, history of education, philosophy of education) Kellaghan (2002) argued that when concepts and theories of education were learned out of context, they were then only retrieved and applied when a practical problem occurred. Both *Coolahan* and *Kelleghans'* recommendations were key influencers when the Teaching Council commenced their reviews of initial teacher education in the various colleges of education in 2009.

The Teaching Council undertook these, statutorily provisioned, reviews of pre-service teacher education courses between 2009 and 2011 and examined the courses on offer in Ireland (Teaching Council, 2010). There were five state funded Colleges of

Education at that time, which offered programmes of primary teacher education leading to a Bachelor of Education degree. These colleges also offered Graduate Diplomas in Education (known as PG. Dip sic.), for those that already held an undergraduate degree, in another discipline. The Teaching Council reviews were based on the over-arching principle that,

> the accelerating pace of societal and legislative change and educational reform, coupled with the increasingly complex and demanding role of teachers, necessitate a thorough and fresh look at teacher education. This is essential to ensure tomorrow's teachers are competent to meet the challenges they face and are life-long learners, continually adapting over the course of their careers to enable them to support their student's learning (Teaching Council, 2010, p. 7).

As a result of the Teaching Council's reviews, they developed a document called *Initial Teacher Education: Criteria and Guidelines for Programme Providers* (Teaching Council, 2011) which outlined new criteria for pre-service teacher education courses in Ireland. As a result of these guidelines, teacher education programmes in the colleges of education, underwent substantial revision and re-configuration between 2011 and 2012. One of the major changes that resulted from the Teaching Council review was the extension of the Bachelor of Education programme from three years to four years' duration, which came into effect for all new entrants to colleges, from September 2012. Furthermore, the Postgraduate Diploma was extended from eighteen months to two years, which came into effect from September 2014. This was now known as a Professional Masters in Education (PME). These changes meant that a primary school teacher would have either have spent four years as an undergraduate, and graduate with an honours degree in education; or spent six years in college and graduate with a master's degree in education, before they commenced their teaching career. The Teaching Council reviews thereby ensured a uniform approach to teacher education, across all colleges of education, and this was significant progress.

The Teaching Council guidelines (2011) provided clarity on the required content for these newly configured degree courses. They advised that pre-service teacher education courses should concentrate on three main areas – foundation studies; professional studies and school placement (Teaching Council, 2011, p. 13) and outlined the names of sixteen subjects that should be covered under these headings. However, interpretation of the nature and duration of these sixteen topics was at the discretion of each College of Education, when reconfiguring their individual programmes of study. A particular focus on literacy, numeracy, ICT and inclusion were suggested (Teaching Council, 2011, p. 15) but the duration and operation of these modules, in the various colleges differed greatly, depending on the hours attributed to them, and where they would fit into a curriculum focussed timetable. The Teaching Council had mentioned the importance of technology in education in 2011, whereas heretofore ICT had not held such prominence.

Higher Education Authority

The Higher Education Authority (HEA) was established by statute (HEA Act, 1971) for "effective governance and regulation of higher education institutions and the higher education system" (HEA website, n.d). Funded by the Department of Education the HEA, as an agency of government, has statutory powers to carry out its functions. One of its primary responsibilities was to review the operation of higher education institutions and as such, a strategy group to write a future vision for these educational institutions, was commissioned in 2010. The report of that strategy group is discussed subsequently. This strategy document, combined with the reviews by the Teaching Council, heralded a time of change in Irish higher education.

National Strategy for Higher Education to 2030.

The *National Strategy for Higher Education to 2030* (Hunt, 2011) outlined a vision for the future of higher education in Ireland, up to 2030. Commonly referred to as the *Hunt Report,* the strategy document was commissioned by the Higher Education Authority, under the auspices of the Department of Education. There were four main areas of focus. These included greater diversity in higher education, increased research capacity of higher education institutions, general funding policies and a number of structural changes required for educational institutions. One concern raised by authors of the *Hunt Report* was an awareness that the future education landscape would require "new pedagogies and new delivery channels and that flexibility of provision" (p. 54) would be a requirement. However, a lack of teaching and learning skills amongst those teaching in higher education was identified by the authors. Hence, a separate government funded agency was established to address this.

National Forum for Teaching & Learning at Third Level, 2012.

The National Forum for Teaching and Learning at Third Level (National Forum website, n.d.) was announced in 2012. The role of the National Forum was to "enhance the teaching and learning for all students in higher education" and they have funded various projects in higher education institutions since. One key area of focus has been "building digital capacity" of those teaching in higher education, and two Digital Roadmaps (National Forum website, 2014, 2015) have been published in this regard. These roadmaps were announced with associated funding opportunities for all higher educational institutions and have been successful in supporting a number of digital initiatives, nationally, over the past five years.

Summary

This section has provided a short history of pre-service teacher education in Ireland and discussed the relevance of the *Green* and *White* papers, and their impact on pre-service teacher education. The section also discussed the role of the Higher Education Authority and the establishment of the National Forum for Teaching and Learning. The role of the HEA and National Forum, and their agenda to increase the digital capacity of teaching staff in HEA funded institutions was noted, as being particularly relevant in the current research. An overview of the implications of the *Education Act (1998),* and subsequent formation of the Teaching Council, and its influence on pre-service teacher education was also outlined. This section then considered how the establishment of the Teaching Council, the publication of the Hunt Report and subsequent reviews of teacher education colleges heralded a time of change, in pre-service teacher education in Ireland.

The next section will review the various government documents, initiatives and policies that have been influential on technology integration in Irish classrooms. It also provides a critique of various governments' views on technology integration that persist to the present day.

Technology in Irish Education

This section will outline the history of governmental policy initiatives, and related documents, that have influenced how technology has been used in the Irish classroom since the 1970s. While there have been many projects and programmes designed to improve both teachers and students' access to technology, progress has been slow, with a singular techno-centric approach. Various commentators' analyses of policy development on technology in education are also included in this section. Bruce (1993) argued that most policy development in relation to technology in education has tended to be 'innovation focused',

> which tends in practice to highlight improvement in conditions…. for whatever area, the innovation addresses and problems are presented as remaining obstacles to overcome (p.3).

Bruce (1993) conceded that the real change happens at a social system level of policy implementation, and "the discussion of technologies is too often isolated from an understanding of the settings in which the technologies are used" (p. 4). Selwyn (2011a) and others (Zhao, Pugh, Sheldon, & Byers, 2002) have critiqued the nature of governmental policy discourse on the role of technology in education and referred to the "technotopian" (p. 12) views of governments' approaches to technology integration in classrooms. Often seen as a universal belief in the ability of technology to improve education, Selwyn (2011) outlined the critical role of the school, where the context of where technology implementation happens was key to the success (or otherwise) of that technological intervention. Schools were subject to "a series of complex interactions and negotiations with the social, economic, political and cultural contexts into which they emerge" (Selwyn, 2011, p. 41). How this has influenced use of technology in Irish schools over the past few decades is now described, and this innovation focused (Bruce, 1993; Papert, 1987a) stance reviewed.

The Seventies & Eighties

Initial discussions around use of technology in education go as far back as the 1970's and one of the key outcomes of that decade was the establishment of CESI (Computers in Education Society of Ireland). One of its original members, Elizabeth Oldham (Oldham, 1998), remembers a time of microcomputers; a focus on programming languages and much hope that "programming could be a route to problem-solving for all, or at least, for very many, students". CESI's role, at that time, was focused on "the promotion of IT in education in a manner that is consistent with best principles and highest standards in education". McGarr (2009) referred to this era as the early technophile stage where early adopters in Irish education were influential in their use of ICT, and he mentioned the formation of CESI whose members were those "motivated by a curiosity about new technology" (p. 1097).

Based on the results of a teacher survey conducted by Breathnach (1984, p. 18) teachers, at that time, were concerned with their own computer literacy. For example, CESI had lobbied to introduce computer studies as an optional module on the Leaving Certificate curriculum. However, only teachers with a qualification to teach the subject were allowed offer it, and there was no set syllabus provided. As this course was not part of the Leaving Certificate examination, Breathnach (1984) was critical that,

> the criteria for monitoring are unclear, and the distinctions made are gross, effectively between pass and fail; furthermore, the certificates awarded are separate from the Leaving Certificate proper, and therefore of dubious status (p.14).

During this time Kelly (1985) commented on a long history of inconsistency between the term "computers in education" and the curriculum subject of "computer studies" (p. 156). Kelly clarified that the term 'computers in education' meant both the use of the computer as an administrative resource by the teacher; and as an "educational tool or resource, to aid or sometimes even replace the teacher in the classroom" (p. 156). This variance of the terminology relating to the use of computers as a pedagogic aid rather than as a technological tool has been the subject of debate since (Albion, Jamieson-Proctor, & Finger, 2010; Bruce, 1993; Koehler & Mishra, 2009; Papert, 1987a) and persists to the present day.

The Nineties

During the 1990s a plethora of technology related policy announcements were released by the Irish government. Following publication of the *Green Paper* (DES, 1992) on *Education for a Changing World*, as outlined earlier, Irish government policy was concerned with "keeping abreast of the potential created by new technologies for the process of teaching and learning" and outlined that "the use of the new information technologies is likely to become a more familiar feature of classroom life in the future" (p. 134), yet no specific implementation strategy was detailed. As outlined earlier the Green and White papers formed the basis of the Education Act 1998. However, there was no specific mention of ICT or technology in the Education Act*,* 1998 where one section suggested teachers should "be aware of accelerating changes in their environment" and that in-service training would therefore, be required (Walsh, 2011, p. 63). As Walsh (2011) commented "often policy documents are aspirational and can remain little more than the good intentions of short-lived governments if not translated into action" (p. 64); a critique of the lack of specifics to address implementation.

Indeed, the INTO (1996) report on *Issues and Recommendations for Information Technology in Irish Primary Education* acknowledged that while the pace of change in schools was quickening as the new millennium approached, government policy was not keeping pace. Critically there was no national policy in relation to the development of ICT in primary education, the INTO criticised the lack of a funding strategy at national level to allow support and training for primary school teachers, as well as to equip schools with the hardware required. Referring to the pilot project of the *Primary Project – Computers in Irish Primary Schools* (DES, 1987), that had identified fundamental problems around lack of access in primary schools, the INTO remarked on a lack of activity by the Department of Education, in the "intervening twelve years and there is no evidence to suggest that the Department has any plans to begin addressing them now" (p. 24). They (INTO) reported they were aware of the many primary school teachers who were "understandably apprehensive about how to incorporate it (ICT sic.) into their teaching methods" (p.i). Their report (INTO, 1996) outlined three fundamental principles:

- That every child and teacher had the right of access to the curriculum through information technology at school;
- That teachers had the right of access for IT training at both pre and in-service levels of education and finally,
- That information technology should be integrated into the primary curriculum as a cross-curricular resource (p. v).

They further recommended that, in relation to pre-service teacher education, an "overall comprehensive pre-service programme in IT should be established in consultation with the Colleges of Education and the INTO" (p. 25) and that this programme should focus on the use of IT as a training tool, rather than just focus on the hardware. Referred to as the "keyboarding phase" by McGarr (2009) the focus had begun to shift towards 'how' teachers were using the technology, rather than 'what' technology was available to teachers, in the classroom. Yet, this was twenty years ago, and progress has been slow since.

Schools IT 2000 – A Policy Framework for the New Millennium

Providing €51 million in funding, *Schools IT 2000 – A Policy Framework for the New Millennium* sought to increase the integration of ICTs in primary and post-primary level schools. Ireland, according to the introduction to *Schools IT 2000 – A Policy Framework* *for the New Millennium* "lags significantly behind" (DES, 1997, p. 1) its European partners in the integration of information and communication technology in the classroom. In light of this, the announcement of *Schools IT 2000* was seen as a positive first step to "computerise the nation's schools" (Judge, 2002, p. 3). It outlined a range of initiatives targeted at integration of ICT into Irish schools (H2 Learning, 2015) and sought to,

> place our pupils and teachers at the cutting edge of international innovation and development in education and help to secure important skills necessary to our future economic well-being (DES, 1997, p. 1).

Schools IT 2000 (DES, 1997) had three overarching themes – namely

- Technology Integration Initiative (provision of technology),
- Teaching Skills Initiative (provision of training on skills and pedagogy to use ICT) and
- Schools Support Initiative (provision of a Scoilnet website and School Integration Project).

One of the main objectives of the technology provision objective was to ensure every student in an Irish classroom,

> should have opportunities to achieve computer literacy and to equip themselves for participation in the information society; support is given to teachers to develop and renew professional skills, which will enable them to utilise ICTs as part of the learning environment of the school (DES, 1997, pp. 2-3).

Schools IT 2000 also funded the National Centre for Technology in Education (NCTE) which saw the rollout of a dialup broadband connection to "most schools" (p. 1270) and was effective in raising the profile of computer literacy training requirements for teachers. At that time, Freeman, Holmes, and Tangney (2001) believed "that ICTs within the classroom are still confined to the 'early adopter' category and severe challenges are in store in any attempt to spread the use of ICTs into the 'late majority'" (p. 1271), a concern that is still somewhat valid sixteen years later. However, a report of the National Policy Advisory and Development Committee (NCTE, 2002) on the Impact of Schools IT 2000, detailed the achievements arising from the initiative and concluded that "it had been successful in increasing the number of computers in Irish schools, and in significantly increasing internet access for teachers and pupils" (p. 1). Yet investment by government in IT in schools was still an issue, and the NCTE (2002) said "significant and sustained investment" (p. 9) was still required.

Mulkeen (2003) argued that while the *Schools IT 2000* strategy had put equipment in schools; had given schools access to the internet (limited to dial up internet of one hour per day) and had trained 70% of all teachers on a 'short course' in basic ICT skills, actual use of ICT in schools was still lacking. A reason suggested was "an absence of clear guidelines or regulations about how ICT was to be used, as a result of which the way in which ICT was used was decided locally within each school" (p. 280). Mulkeen (2003) also discovered that despite the large numbers of teachers attending the 'short courses', these continuing professional development courses were not "sufficient to bring teachers to a level of skill where they were confident enough to use ICT in the classroom" (p. 283). As such, provision of IT equipment by government was not enough, and he suggested that the "process of integration of ICT may depend on factors related to thinking and beliefs within each individual school" (p. 291). More recently, Marshall and Anderson (2008) queried the policy direction for embedding "digital technology in education" (p. 436) and cited an evaluation of *Schools IT 2000*, where there remained a demand for more training; more funds and more equipment. This was a persistent theme (Marshall & Anderson, 2008, p. 464) that focused on a techno-centric approach to technology integration rather than a focus on how the technology should be used. However, Mc Garr (2009) reminded us, that by the end of the decade, the *Schools IT 2000* project had begun to lose momentum.

Blueprint for the Future of ICT in Irish Education

A second policy document *A Blueprint for the Future of ICT in Irish Education* (DES, 2001) also set out to address integration of ICT in teaching and learning; enhance teacher professional development and develop educational software and multimedia resources for use by teachers. Given the formation of the National Centre for Technology in Education (NCTE) and its role in the implementation of government policy, a *NCTE Census on ICT Infrastructure: Statistical Report* (2006) established that while improvements in the availability of computing resources in the schools were evident, much remained to be achieved.

The *NCTE Census* (Sheil & O'Flaherty, 2006) also argued that while Ireland had spent money on infrastructure and had improved it, other countries had also improved their infrastructure in the same period, leading the report authors to conclude that "Ireland continues to lag behind the OECD average on key indicators of infrastructure" (p. 68). Given that both the *Blueprint* (2001) and *NCTE Census* (2006) were written by government-funded departments, their lack of criticality on progress relating to basic infrastructure was expected. The key infrastructural issue that persisted in Irish schools was a lack of access to broadband and the report referred to the provision of broadband by the Department of Communications which was announced the previous year, (DCMNR, 2005) outlined "a grant to arrange networking and connection to broadband for each school" (p. 68). Yet, ten years later lack of broadband in the Irish classroom was still a bone of contention for the INTO, amongst others, especially in rural locations,

> the non-specific commitment for primary schools falls far short of the 100mb high speed broadband provided to post primary schools in recent years…it gives schools no idea of what might be provided and when (INTO, 2015, p. 16).

Towards 2016

In 2006, the Government put education and technology back on the agenda with the publication of *Towards 2016* (Department of an Taoiseach, 2006). Section 17, dedicated to education and training, reflected a growing awareness of the need to embed key skills, including ICT, and to develop technology subjects at all levels of education where "all children will have the opportunity to become ICT literate by completion of second level" (p. 31), however, there was scant mention of primary students. Later that year, the NCCA (National Council for Curriculum and Assessment) published the *ICT Framework: A Structured Approach to ICT in Curriculum and Assessment* (Assessment, 2006) and included their proposals for the integration of ICT into the classroom providing a "structured approach to using ICT in curriculum and assessment" (p. 5) as a guide for teachers. This *ICT Framework* provided a comprehensive overview of ICT skills that learners would need and was more explicit in terms of objectives and particulars of the variety of skills a student might require in the 21st century. While useful as a guide for teachers, implementation was at the behest of each local school where,

> use of the ICT Framework, including provision of appropriate learning opportunities, will vary from school to school depending on a range of school factors including access to ICT equipment and resources, teacher competence and confidence in using ICT (p. 8).

This framework, again, acknowledged the lack of a comprehensive national approach, but did mention the role that teacher competence and confidence had on use of ICT by that teacher in the classroom.

National Development Plan, 2007

The focus of an OECD PISA report on *Assessment of Mathematics, Reading Literacy, Science and Cross-Curricular Problem Solving* (2003) and the results for Irish students, as reviewed by Shiel et al. (2006), saw a reduction in literacy and numeracy levels. Thus, given the lower rankings than previous years, the Irish government began to focus on improvement of these literacy and numeracy skills. Thus, in 2007 the *National Development Plan* (2007) outlined a series of projects in which education was a key priority for Ireland:

> Key areas requiring further attention relate to school and classroom planning, assessment for learning, promoting active teaching and learning approaches, nurturing higher order thinking skills, embedding ICT skills across the subjects, and supporting engagement with parents (p. 199).

An investment of €252million was announced for schools over the period of the *National Development Plan* and sought to develop an e-learning culture in schools and ensure ICT usage was embedded into everyday teaching. In addition, schools were promised a national broadband network. The *National Development Plan* (2007) created a strategy group to advise government on key ICT priorities over the next five years. The impetus of this strategy group was to prioritise what was required for ICT integration, with a focus on infrastructure, hardware/software, professional development, digital content and technical support/research. The strategy group were complimentary that €252million would be spent on ICT in education, noting that such investment demonstrated "a realisation that policy and investment is lacking" (p. 468) heretofore. The ICT strategy group published their report *Investing Effectively in ICT for Schools* (DES, 2008a) in 2008 and issued recommendations for how the money announced in the *National Development Plan* should be spent,

> the enthusiasm for and commitment of our teachers to ICT integration is manifest – there is now a need to provide them with the appropriate ICT facilities and supports to facilitate greater ICT integration in learning and teaching (DES, 2008a, p. 7).

However, in light of the global economic downturn that was happening at that time, spending such a large amount on ICT integration, was put firmly on the back burner due to governmental budgetary constraints.

Inspectorate Report, 2008

Despite the lack of a core national policy on ICT integration in schools, and availability of funding generally, the *Inspectorate Report on use of ICT* in schools was released (DES, 2008a). While the *Inspectorate Report* (2008) demonstrated that much had been achieved in the rollout of ICT to schools, considerable challenges remained. This report was critical of the lack of support and maintenance of computers in schools and also criticised the funding provided, where "schools generally spend considerably more on ICT than the sums made available through the grants scheme" (p. vii). They mentioned instances of how technology was being used and described peripherals such as printers, scanners and digital cameras, still a techno-centric focus on hardware, rather than what teachers were doing with technology in the classroom. The *Inspectorate Report* also mentioned the presence of Interactive Whiteboards (IWBs) in schools but did not report on how they were being used. The *Inspectorate Report* was also critical of pre-service teacher education finding,

> there needs to be an increased emphasis on the application of ICT in teaching and learning in teacher education at pre-service, induction and continuing professional development stages. It is recommended that teacher education departments in third-level colleges should provide student teachers with the skills necessary to effectively use ICT in teaching and foster in them a culture of using ICT in their work (p. xxi).

Of course, while the recommendations of the *Inspectorate Report* in relation to technology were commendable, they were not specific as to how these recommendations should be implemented and given the advisory nature of the Inspectorate generally, the recommendations were not enforceable.

Smart Schools=Smart Economy, 2009

Mc Garr (2009) had noted the "absence of on-going investment has also had an effect on the integration of ICT in schools" (p. 1106). Yet, the Tánaiste had announced that €150 million (DES, 2010) be made available to spend on equipping schools with ICT equipment, due to a recommendation of the advisory group's *Smart Schools= Smart Economy Report* (DES, 2009). This was designed to aid "Ireland's national recovery which will be rooted in further developing our outstanding education system" (p. 5) and the advisory group stressed the need for "an urgent strategic initiative" (p. 6) to ensure that Ireland kept pace with global technological developments. The implementation plan, recommended by the advisory group, began in 2009 where each school would have ICT in the classroom; teacher professional development; local ICT planning and a budget available and enhanced broadband. All interested parties lauded this plan, while they awaited receipt of the funds to disperse locally as they required. While the proposed funding went some way to providing hardware (computers, peripherals, etc.), the Irish government had still not addressed lack of equipment, lack of broadband and lack of money in schools, to implement the recommendations of the advisory group. Of course, this initiative was then superseded by economic issues that were occurring in Ireland at the time, and the initiative was put on hold.

National Broadband Plan, 2012

The *National Broadband Plan – Delivering a Connected Society* (DCMNR, 2012) was announced in 2012, and its primary aim was to ensure "all citizens and businesses have access to high speed broadband no matter where they live or work" (p. 2). It was also designed to ensure 780 post primary schools had access to 100mb broadband, however, there was no specific mention of such access in primary schools. Subsequent governments and education ministers had promised resolution of the broadband connectivity issue, for example the Department of Education and Skills (2013) announced their involvement in the 'broadband for every school' initiative. Yet, primary schools were still not connected to 100Mbps broadband, as promised (DCMNR, 2012; HEAnet, 2012) and this first level barrier (Ertmer, 1999) to effective use of technology, persisted in both primary and post-primary schools. As recently as July 2014, the promise was still unfulfilled, but there were some improvements, with an additional 105 schools connected to 100Mbps broadband that year (Kennedy, 2014).

In the *Digital Strategy for Schools* (DES, 2015) continued funding of the broadband rollout, especially to primary schools, was defined as a top-level objective. Acknowledging the lack of broadband in rural areas, the associated press release announced that the *Digital Strategy* in conjunction with the *National Broadband Plan* (DCMNR, 2012) would ensure "access to cost-effective, high speed connectivity to rural primary schools that cannot access reliable broadband" (DES, 2015). The funding and procurement was to commence at the end of 2015 and has, to date, had limited impact.

ICT Census, 2013

The 2013 *ICT Census in Schools Report* (Cosgrove et al., 2013) was published in August 2014. This *Census* was designed to inform the *Digital Strategy for Schools* publication, where an online survey was sent to all school principals (primary and post-primary) in Ireland. The main objective of the *Census* was to gather data on various themes including the impact of ICT on teaching, learning and assessment; the current ICT infrastructural base across schools; access to ICT equipment (availability, number of machines; number of working machines); obstacles to ICT integration (and how they could be overcome); current practice around how ICT was used in the school and pupils' access to ICT outside school. This *Census* also informed the government on the specific needs and requirements of schools around the country. The last *Census* had occurred in 2005 (Sheil & O'Flaherty, 2006), so this one was generally welcomed by the teaching community.

Four main themes emerged from the data collected. These were ICT infrastructure; learning, teaching & assessment using ICT; teacher professional learning and research and policy & leadership (p. 37). As expected, ICT infrastructure and Internet connectivity were on-going concerns for the principals surveyed. Equally, access to computers (and other devices) remained a concern. Despite evidence in the *Census* that schools and teachers were well resourced in terms of lesson preparation (using ICTs) it became evident that students were not so well resourced. The *Census* suggested a reduction in the ratio of students to computing devices, with an overall aim of achieving one to one computing (p. 38). The *Census* also suggested that the *Strategy* should address the issue of ageing machines and maintenance of these machines, where "school principals rate ageing computers as the most serious obstacle to using ICTs to support teaching and learning, while their counterparts in primary schools rate it as the third most serious obstacle" (p. 38). Equally, lack of technical support was a major concern for all those surveyed, suggesting that "without this, schools are highly unlikely to successfully integrate ICTs into teaching, learning and assessment on an on-going and sustained basis" (p. 39). Teachers' skills and confidence using ICTs was also identified as an issue, where "teachers' confidence levels in using ICTs in teaching and learning may also be a problem" and such low confidence levels would "discourage teachers from trying out new ideas in the classroom", akin to technological self-efficacy, which is discussed later in this chapter.

Digital Strategy for Schools, 2015

Finally, in October 2015, the Minister for Education and Skills launched the *Digital Strategy for Schools 2015 – 2020* (DES, 2015). The associated press release announced the "largest ever investment in digital technology in schools" (p. 6) and promised €210million in funding to allow schools invest in technology, to continue the broadband for every school rollout (in conjunction with the *National Broadband Plan*), to integrate digital skills in the curriculum and assessment, to develop opportunities to take an in-depth digital technology course at Leaving Certificate and other specific recommendations (DES, 2015). Investing in technology in the schools was one of the primary objectives of the *Strategy* with a continued focus on equipment purchase for schools. However, despite the announcement of funding, the primary teacher's union (INTO) argued that the *Strategy* document was lacking. The INTO general secretary said that "without substantial detail and specific commitment, the strategy was not fit for purpose" (p. 16), and the INTO were also critical of the lack of provision of technical support for schools. However, implementation of the *Strategy* was to be led by the Department's ICT Policy Unit, and they were to report regularly on their progress to the Minister for Education.

The *Strategy* was also mindful of the role of pre-service teacher education, and suggested "ICT is embedded in the planning, design and delivery of all teacher education courses" (p. 33) and the Department (of Education) should "cooperate with initial teacher education providers to ensure that pre-service teachers acquire the skills, knowledge and confidence to use digital technologies to support learning and teaching" (p. 33). However, little detail as to what the content of these courses should contain, nor their duration, was provided.

Action Plan for Education, 2016 - 2019

In September 2016, the Department announced an *Action Plan for Education, 2016 – 2019* (DES, 2016), a new strategy document that outlined the Department's vision to provide the best education and training system in Europe, for Ireland. Within this *Action*

Plan there was specific reference to the previous year's *Strategy* document. The first goal of the *Action Plan* was to "increase the use of ICT in teaching, learning and assessment" (p. 13) and this change was to commence with "rollout of broadband to primary schools; continuing professional development for teachers and lecturers, and increased technology enhanced learning and blended learning opportunities" (p. 16). The Department outlined they would publish quarterly reports on the *Action Plan's* progress, and these have been forthcoming.

Summary

The previous section has provided a historical overview of various technology in education initiatives, in Irish classrooms, over the past near fifty years. From the early technophile era in the 70s and 80s, where those teachers that had an interest in technology began using it in an educational setting, to the more recent initiatives focused on acquisition of technology for classrooms. However, despite these initiatives funding, support, training and connectivity problems still persist in Ireland. Indeed, Selwyn (2013) would contend there has been "a strong family resemblance the world over" (p. 65) where most international educational technology policies have included an initial focus on introducing computer equipment, subsequent internet connectivity and then go on to establish system wide programmes of training and development for teachers, followed by policies "seeking to address issues of pedagogic practice" (p. 65). The lack of clear guidance for schools on technology integration, prevalent in the Irish policy documents, is not dissimilar. A recent article by Mc Donagh and Mc Garr (2015) used the term "technology somnambulism" (a phrase coined by Winner (1986)) to describe the nature of ICT integration in Irish schools. Whether the *Digital Strategy for Schools,* or *Action Plans for Education* will be successful in shifting the focus from acquisition of hardware (Papert, 1987a), to the pedagogical use of technology in the classroom remains open to question but will be closely monitored over the duration of these strategy documents. However, early indications are positive where the Department of Education has recently announced the introduction of the *Digital Learning Framework for Schools* (DES, 2017a) to 30 pilot primary schools around the country, and associated *Digital Learning Planning Guidelines* (DES, 2017b) that are also available to the schools involved.

Having outlined the pre-service teacher education and technology policy contexts within which this research study operated, the next section will query the practice of technology use by students and qualified teachers alike. It will establish how frequent personal use of technology has not translated into professional use in a school placement classroom and describe the various barriers that impede successful technology integration in schools.

Personal Use of Technology

In this section, the author analyses the literature which addresses the types of technologies pre-service teachers use in their personal lives. It will outline the concepts of digital natives; millennials and other terms used to describe the pre-service teacher participants in the study and illustrate these terms' application to the current study. The main focus of this section is to query whether those that use technology every day in a personal capacity can truly be regarded as millennials in their use of technology, rather than just by virtue of when they were born. This section will also consider whether the term digital native is universally applicable and explain the reality of personal use of technology by the pre-service teacher participants.

Millennials' Use of Technology

Many phrases abound to describe the generation of pre-service teachers at the core of this study. According to Tapscott (1998; 1999) students today were "the first to grow up with this new medium (technology) and are defined by their relationship to it (technology)" (p.6). One definition was based on their age profile, where 'millennial students' (Dede, 2000) were defined "as those born after 1982" (p. 8). Prensky (2001), who was responsible for the phrase 'digital natives', described "our students today as native speakers of the digital language of computers, video games and the internet" (p.1). Other definitions included "Net-Gen-ers … who were born in or after 1982 and tend to gravitate towards group activity; believe it is cool to be smart and are fascinated by new technologies" (Oblinger, 2004) or Veen and Vrukking's (2006) definition of homo zappiens as "those children born with a computer mouse in their hands" (p.9). Jones, Ramanau, Cross, and Healing (2010) described a UK university's net generation campus:

> One student walks across campus listening to an iPod, another is engrossed in text messaging on her phone. During class they're

> googling, IMing (sic) and playing games – often at the same time. They are more likely to use the library as a gathering place than a resource – this is the Net Generation (p. 723).

Problematic Terminology

The concept of millennials, and how these students use technology in their personal lives, has been considered by other authors (Helsper & Eynon, 2010; Kennedy, Judd, Dalgarno, & Waycott, 2010; Kolikant, 2010; Thinyane, 2010) and has received some criticism, in the literature. Kennedy et al. (2010) identified four types of technology users present in their university population:

> Power users (14%) are those that use a wide range of technologies and use them significantly more frequently than all other users; ordinary users (27%) are regular users of standard web and mobile technologies; irregular users (14%) are similar to ordinary users but engage in most of the technology-based activities less frequently (p.337).

Of particular interest in Kennedy et al's (2010) study was that the "basic users (45%) were characterized (sic.) by infrequent use of new and emerging technologies and less than weekly or monthly use of standard web technologies". Critical of the concept of digital nativeness, FitzGibbon, Girvan, Oldham, and Mc Loughlin (2010) realised there was much variation in personal use of technology, by their participants. While there was a high frequency of use of "mobile phones, email and online booking, 22% of the first-year students surveyed, had never used online banking" (p. 2463). Eynon and Malmberg (2011) examined how young people tended to use the internet and of particular interest were the "peripheral group (31%) whose members perceived themselves as less skilled at using the internet and (were) less likely to have home internet access" (p. 590). Margaryan, Littlejohn, and Vojt (2011, p. 437) compared 160 social work and engineering students at the University of Glasgow and concluded that "students may not understand the nature and potentialities of technologies, either because they use them in limited ways, or not at all". As Thomas (2011) put it,

> many so called digital natives are no more intensive users of digital media than many so called digital immigrants, they are by no means as technologically proficient as is often assumed…much of young people's use of technology is mundane rather than spectacular…characterized by relatively routine forms of communication and information retrieval (p.x).

As discussed by Plowman, Stevenson, Stephen, and McPake (2012), ownership of technology from a young age did not guarantee use and in this study "the children demonstrated some timidity in trying out technologies on their own" (p. 13). Hence, Thompson (2013) suggested that these natives' use of technology "might be more limited than what popular press suggests" (p. 20).

Indeed, recent literature has begun to shy away from the term nativeness [sic.] and questioned the whole concept of millennials' abilities using technology, at all. Sieber (2009), in a study with medical students (N = 846), was critical that, despite having completed their European Computer Driving Licence (ECDL), his students were still lacking basic ICT skills. In his work "many [students] do not understand the full range of functionality and tools offered by applications" (p. 225), using the example of students being unable to create a table of contents in MS Word. In more recent work, O'Byrne (2014) assessed students technological skills using blogs. In their study students could upload multi-media content but were reluctant to share and create the blogs they had made. Therefore, they were not fulfilling Prenskys' criteria for nativeness using technology. Recent literature has focused on misuse of the terminology surrounding digital natives, millennials and net-generation. As noted in the literature, this term being applied to anyone born after 1980 was problematic. In a seminal article by Akcayir (2016), who administered Teo's (2013) digital native assessment scale, their results concluded,

> that being a digital native is not an innate talent, but as a result of acquired skills that can be developed over time. If an individual uses technology

> and has access to it, with growing experience this person's standing as a digital native will be enhanced over time (p. 439).

They contended that age should not be the only determinant of ability to use technology, where if you spent enough time learning about the affordances of a particular technology then you would eventually use it "natively, even if born long after 1980" (p. 439). Thus, whether the students in the current study were digital natives by virtue of their age, or comfort with technology, was brought into focus. Sorgo (2017) cautioned that "personal ownership of smartphones, mobile computers and desktop computers has no direct effect on information literacy" (p. 764) where use of the term digital native was a poor predictor of information literacy (N= 299). Therefore, as a result of this problematic term, measurement of the use of personal technologies by these types of students is now explored, and the application of these measurement models to the current research analysed.

Measurement of Personal Use

Measurement of personal use of technology has been addressed in the literature. Teo (2013b) developed the digital native assessment scale (DNAS) as a measurement of how these "digital natives interact and learn with technology" (p. 52). Using a large sample of 1018 secondary school students, they were asked to rate their levels of agreement with four main areas of "nativeness (*sic*); growing up with technology; comfortable with multitasking; reliant on graphics for communication and thrive(ing) on instant gratification and rewards" (p. 54). This DNAS scale made a useful contribution to the debate on digital natives and moved the focus away from age towards reliance and comfort levels with technology. Gu, Zhu, and Guo (2013) considered that a combination of statements used in the Task Technology Fit model (Dishaw & Strong, 1999), including the social influence statements of Thompson and Mishra (2007) and personal factor statements of Venkatesh, Morris, Davis, and Davis (2003) combined, were a useful measurement of whether their students and teachers were digital natives or digital immigrants. More recently, Teo and Noyes (2014) reported that intention to use technology by students was not just dependent on their age profile, but also on their previous experiences of using technology. Statements drawn from these models were used in the use elements of the surveys administered to the pre-service teachers in the current research.

Summary

This section has summarised the concept of digital natives (Prensky, 2001) and discussed the associate problems with that terminology, evident in more recent literature. While the terms millennial and digital native were popular when this research study commenced, over the course of the study, this terminology had lost favour in the literature, and was not considered a reflective portrayal of the way students used technology in their personal lives. This will be considered further in the findings and discussion chapters. This section also examined various measurement models used to calculate and define personal use of technology. These were considered briefly and statements from these were used in the personal use section of one of the methodological instruments, discussed in chapter three shortly.

The next section will summarise the literature on professional use of technology, and how the pre-service teachers in this study were using technologies available to them in a school placement classroom. It will also describe measurement models used to measure professional use of technology and outline how these models apply to the current research.

Professional Use of Technology

In this section, a review of how pre-service and other teachers use technology in the classroom is analysed and whether the context of the classroom had any impact on their use of technology, as evidenced in the literature. This section will also critique the role of school placement, the college preparation course and other influences on a pre-service teacher and depict how these impact on decisions to use technology in a classroom. Professional use of technology was particularly relevant in the current study, and this section also examines whether pre-service and in-service teachers tend to use technology in different ways.

There have been few comparisons of pre-service and in-service teachers' use of technology (Waycott, Bennett, Kennedy, Dalgarno, & Gray, 2010) in the literature. Waycott et al's (2010) research demonstrated that pre-service teachers used technology in five distinct ways, namely for personal entertainment, social communication, general everyday use (such as storing data or looking at train timetables), for professional work and to support their course requirements, such as typing up documents or downloading content from a virtual learning environment. Of most interest in this study was the initial finding that "some participants expressed a preference to separate the contexts in which they used particular technologies" (Waycott et. al. 2010, p.1206).

Teachers' Use of Technology

In-service teachers use of technology in the classroom has been the subject of debate in the literature as far back as the 1980s, when Cuban (2001a) lamented,

> without attention to workplace conditions in which teachers labor (sic.) and without respect for the expertise they bring to the task, there is little hope that new technologies will have more than a minimal impact on teaching and learning (p. 197).

Generally, the literature has remarked that teachers use technology in limited (Mama & Hennessy, 2013; van Braak, 2001), transmissionist (Sheil & O'Flaherty, 2006) or traditional ways (Teo, Ching Sing & Chwee Beng, 2008). In terms of limited use of technology in the classroom by in-service teachers, van Braak (2001) surveyed 233 teachers' willingness to adopt technology in their own teaching. Their use of computer mediated communication remained "limited" (p. 53) and teachers reported that the links between use of technology and how a teacher would use such technology in practice would need to be made clear to them. Equally Barak's (2006) research indicated that while the teachers acknowledged "the potential of advanced technologies to raise interest in learning and to enrich the ways pupils can actively learn" (p. 135), they were also aware that use of technology did not solve basic educational problems. Buettner (2006) queried teachers' hesitations to integrate technology into their teaching, despite having completed a specific training course (called 2BITS) on how to integrate technology. While they were not specific as to how "pedagogically competent use of ICT by teachers" (p. 268) was measured, their research did highlight the need for teachers to be trained on how to use the technology in the classroom specifically. Haydn and Barton (2007) concluded that despite an increasing pressure on teachers to "upskill on ICT, many government interventions are found not to be useful" (p. 365). They remarked that "previous bad experiences with ICT training; often feeling overloaded with information which they don't have time to consider, given the overall demands of their time" (p. 366) were seen as reasons why in-service teachers had not used technology in the classroom. Another reason for this lack of use of technologies in the classroom, was reported by Verdegem and De Marez (2011), where "technological innovations often fail because too much attention is still given to (technical) product related features, without taking into account the most important parameters of user acceptance" (p. 411). Similar to the Irish literature on technological innovation (Johnston, 2014) where a techno centric focus had not taken user acceptance of technology into account.

Confidence and positive attitudes about using technology (Yilmaz & Bayraktar, 2014; Zhao et al., 2002) have also played a large part in the decision process to use technology by teachers. More specific factors that influenced a teacher to use technology were identified by Baek, Jung, and Kim (2008). These included peer pressure to use technology, keeping the students' attention, using the affordances of technology, giving themselves a break in the classroom, for class preparation and using the enhanced functions of technology (p. 232). Yet, Morris (2010) noted "the vast majority of teachers are both enthusiastic and confident in using ICT to support teaching and learning" (p. 4010) but, "despite this engagement, newer technologies are reportedly under employed" (p. 4011). For example, commenting on teachers use of blogging, Lai and Chen (2011) learned that teachers were motivated by a variety of influences such as beliefs about personal innovativeness, perceived ease of use and enjoyment in helping others. Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer (2010) queried the reasons why those teachers that use technology in the classroom, do so. Their results grouped the reasons for technology use into two distinct categories, namely addressing professional and student needs, but these were based on "the underlying value belief of promoting student learning" (p. 1321) and will be explored in the section on technology acceptance and behavioural intention.

Examples of technologies teachers did use in the classroom included Interactive Whiteboards (IWBs) (Nikleia, 2008; Slay, Siebörger, & Hodgkinson-Williams, 2008), Learning Management Systems (LMS) (De Smet, Bourgonjon, De Wever, Schellens, & Valcke, 2012) and mobile phones (Thomas, O'Bannon, & Britt, 2014). Nikleia (2008) remarked that teachers used IWBs in "ways that are restricted and traditional, more like high tech chalkboards, than educational tools" (p. 681). Slay et al. (2008) re-iterated this point and found lack of "ICT literacy displayed by teachers and learners and the cost of technology" (p. 1321) as limiting the use of this IWB technology. De Smet et al. (2012) questioned adoption of an LMS by teachers and suggested that teachers should be supported in their use of technology as they found this support valuable and inspirational. However, a recent example in the US reflects the current reality of technology use in a classroom. In an exploration of teachers' perceptions of mobile phone use by Thomas et al. (2014), results "indicated that teachers are using the same old tools (clock, alarm timer, calculator, internet for research) …avoiding the newer technologies like educational apps, podcasts/vodcasts and QR codes" (p. 386). As such they were still using mobile technology in traditional ways. However, such limited and traditional uses of technology in the classroom are also influenced by external factors and in the next section the impact of school context on technology use is explored.

School Policies

Often a school's policy towards use of ICT will affect teachers' use of technology in that school. Tondeur, van Keer, van Braak, and Valcke (2008) surveyed principals and teachers and discovered "school related policies, such as an ICT plan, ICT support and ICT training had a significant effect on class use of ICT" (p. 212). Yet, lack of policy at a national level also had an effect and Tondeur et al. (2008) commented that despite governmental encouragement, use of technology was still not compulsory in the classroom. The provision of professional development opportunities had also influenced the decision to use technology in the classroom but "feedback and assistance" (Watts, 2009 p. 4211) is required when participating teachers go to implement what they have learned, in their own classroom. Often, that assistance was in the form of an ICT champion who promoted use of technology in the school and ensured on-going support for those trained teachers (Stuart, Mills, & Remus, 2009). The presence of these champions “who were ICT competent with reasonably high levels of ICT knowledge and experience” (Stuart, Mills, & Remus, p. 739) generally led to higher use of ICT in that school. However, Donnelly, Mc Garr, and O’Reilly (2011) queried whether second-level science teachers could be persuaded to use more technology in their classrooms. They suggested before a school introduced an ICT policy, discussion with the “educational stakeholders” (p. 1482) about strategies they used in a classroom, should be considered. Pynoo et al. (2012) considered that positive attitude (about technology), perceived usefulness (of the technology) and the norms in the school (around use of technology) were the strongest indicators of technological adoption in a school. This persistence of a school’s influence on use of technology in that school had been noted by Selwyn and Bulfin (2015) where highly regulated school environments and blocked websites, have impeded integration in the classroom. Thus, the school factor cannot then be underestimated for in-service teachers’ use of technology – and this school factor has also been shown to have an influence on pre-service teachers’ decisions to use technology in their school placement classroom. This will be discussed in the next section.

Pre-service Teachers and their College Preparation Course

A focus on traditional uses of technology and the question of how these pre-service teachers are trained to use technology arises, more generally, in the literature (Angeli, 2005; Haydn & Barton, 2007; Weber et al., 2004; Yeung, Taylor, Hui, Lam-Chiang, & Low, 2012). Other research into professional uses of technology by pre-service teachers demonstrated that basic technologies were still playing a large part in a pre-service teacher’s classroom, with a continued reliance on the internet, display software and a transmissionist approach to teaching (Egan, FitzGibbon, Girvan, & Oldham, 2012; Egan, FitzGibbon, & Oldham, 2013; Egan, FitzGibbon, Oldham, & Johnston, 2014).

However, pre-service teachers often are at the behest of the technology available in a school placement classroom, and other factors affected their willingness to use technology in the classroom. Sime and Priestley (2005) had queried pre-service teachers' experiences of technology use and their participants were specifically asked for their reported perceptions of what hindered or helped the use of ICT in schools they had visited on placement. Having reviewed what effective technology use in schools was, they considered "physical (dedicated ICT space), human (teachers attitude to using technology) and cultural (school attitude and promotion of ICT use among teachers) factors" (p. 140) were integral to such integration. Of interest was one participant's comment "that ICT will never be encouraged by someone who is not comfortable in using it themselves" (p. 138), noted in relation to the influential role of the mentor teacher, in their research.

Equally, the approach a college takes to teaching pre-service teachers how to use technology, has an impact on their subsequent use. Weber et al. (2004) queried whether teacher education programmes around the world were "preparing future workers with the knowledge, skills and dispositions essential for employment in this era of technology" (p.1524) and acknowledged that the associated problems of "pace of technological innovations, the high costs associated with purchasing IT equipment, the inconsistency of faculty professional development in IT and finally, the moderate rate at which teacher education colleges are integrating IT into their curricula"(p. 1525) were relevant. As suggested by Angeli (2005) "if student teachers are not well trained to develop a clear and appropriate pedagogical rationale for incorporating computer technologies in their classrooms, then technology will never affect the teaching and learning process" (p. 394). Indeed, Barton and Haydn (2006) advised against a strategy of information overload where "rather than insisting that trainees become proficient across a broad range of new technology applications, it may be more effective to focus on the provision of a smaller range of high-quality, powerful and convincing examples of the use of ICT in subject teaching that have an impact on trainees' attitudes to the development of ICT capability" (p. 267). Moreover, as the pace of technological change increases, skills learned in college will often be obsolete in a few years' time, leading Barton and Haydn (2006) to suggest that instilling student teachers with a positive view of ICT would be more useful in the longer term. Kay (2006) reviewed the strategies used to incorporate technology into pre-service teacher education and advocated that "modelling how to use technology; practising technology in the field; and integrating technology in all courses" (p. 383) were the most pertinent requirements. Hammond et al. (2009) questioned why some pre-service teachers made very good use of ICT and found "support for, and modelling of, ICT use in the classroom were key issues in developing this very good use of ICT" (p. 59). Further, Yeung, Taylor, et al. (2012) concluded that forcing mandatory use of ICT may not be useful, where it was more productive to enhance pre-service teachers' technology competencies, so they had confidence to use technology in a future classroom. Sadaf, Newby, and Ertmer (2012b) also argued that "perceived difficulty in lesson integration may have a negative influence on their (pre-service teachers) intention to use such technologies" (p. 944) and, as such, pre-service teachers should be shown how to integrate technology into a lesson, rather than just shown the actual technology itself. These findings are mirrored in the literature on technological self-efficacy explored later in this chapter.

Criticism of pre-service teacher education courses had been noted in the literature, and a European report by the OECD (Enochsson and Rizza, 2009) detailed there were "few teacher training programmes that target the teaching or development of 21st century skills" (p. 21). Similar to an OECD (2009) report, Hur, Cullen, and Brush (2010) established five essential characteristics necessary for pre-service teachers' ICT education and advised inclusion of "concrete experiences, promote reflection, assist in application, create communities of learners and develop a TPACK (Mishra & Koehler, 2006) approach" (p. 176). Chai, Ling Koh, Tsai, and Lee Wee Tan (2011) advocated that teacher education should move away from the traditional transmissionist approach, where "many educators advocate the need for belief change [of teacher educators] for constructivist-oriented teaching to emerge" (p. 4). A further OECD publication by Rizza (2011) reviewed the quantity and quality of pre-service teacher education ICT courses and remarked that there were few similarities in the number of hours delivered, or the type of courses undertaken, across various European countries. Lane (2011), in Australia, acknowledged that pre-service education was "lacking in the area of use and integration of new technologies" (p. 452). In a further review of the Australian Teaching Teachers for the Future (TTF) project, which was intended to empower staff to integrate and use technology effectively, lack of effective technology integration by teacher educators/lecturers began to emerge (Campbell, 2012; Campbell et al., 2012). Issues such as lack of access to technology and equipment, lack of a common vision and understanding of how ICT could be integrated and finally, lack of technical knowledge by faculty persisted, despite the reported success of this TTF project. Tondeur et al. (2012) were critical of pre-service teacher education courses and remarked that a gap still existed between what pre-service teachers see in college and actual use of technology in classrooms, while out on school placement. Tondeur et al. (2012) argued that teacher training institutions should be acting as agents of change and were lacking in this regard. In the New Media Horizon report for Schools, Johnson et al. (2014) suggested that a 'fast trend – 1 to 2 years' away was rethinking the role of teachers and they suggested that "integrating ICT into teacher education and low digital competence" (p. 24) were solvable challenges. To do this they outlined how teacher education programmes needed to integrate technology in a way that was not superficial but was meaningful and the authors suggested that digital learning should permeate teacher education at all levels but were quite vague as to the specifics of how this would happen.

In an Irish context, the Department of Education (DES, 2008b) stressed that "a lack of appropriate training for teachers acted as a major barrier to the effective use of ICT in schools" (p. 186). Equally in the *Digital Strategy for Schools* (Butler, Leahy, Shiel, & Cosgrove, 2015) a theme two objective was to "ensure that ICT is embedded in the planning, design and delivery of all teacher education courses" (p. 6) but the specifics and rollout of a plan of action are as yet, undefined, as outlined earlier.

Role models of technology integration.

Outside of a dedicated ICT class in their college preparation course, pre-service teachers learn about effective teaching by modelling what they see during their college courses (Shulman, 1986). Haydn and Barton (2007) outlined factors that influence how pre-service teachers viewed technology, where a role model was key:

> We would not expect trainees to attempt to cope with say classroom management without an opportunity to discuss/observe so why should we expect trainees to be able to use ICT without this opportunity? (p. 266)

Hur et al. (2010) further contended that "teacher educators should be role models of appropriate technology use" (p. 179) and model good technological practices for pre-service teacher education students.

Yet, a lack of use of technology by teacher educators has been discussed in the literature. Specifically, Ellis, Hughes, Weyers, and Riding (2009) outlined that a distinct lack of use of technology was apparent, and what technology was employed was used mostly to "create efficiencies" (p. 116) rather than to enable learning. When trying to encourage faculty to use technology, Friel et al. (2009) remarked that this was often a slow process due to factors such as "fear of failure, disinterest or aversion to change" (p. 301). A reliance on a traditional transmissionist approach by teacher educators was also criticised by Chai and Lim (2011) who stated that "many educators advocate the need for belief change for constructivist-oriented teaching to emerge" (p. 4) but still used traditional methodologies. More recently, Vanderlinde, Aesaert, and van Braak (2014) have queried whether teacher education programmes around the world are managing to prepare future teachers with adequate knowledge, skills and attitudes (about using technology). The pre-service teacher education colleges themselves were integrating IT into their "curricula at a moderate rate" (p. 1525), and, as such, they were not providing enhanced models of technology use to their students. This remains an area of discussion in current literature (Alt, 2018; Gebre, Saroyan, & Bracewell, 2014, Instefjord, 2017; Tondeur, 2016) but suggestions such as training for the teacher educators, as a first step towards removing their anxieties and negative attitudes using technology, have been offered (Gibson et al., 2014) as a method of increasing positive role modelling in pre-service teacher education.

School Placement Reality

This section will outline the formal structure of the school placement block, referred to throughout this study, where pre-service teachers observe and practice teaching in a school environment, each year during their college preparation course. The pre-service teachers are then observed conducting a lesson, by school placement supervisors, whose role is to support and assess a pre-service teacher on that lesson, in their school placement location. The relevance of school placement to the current work is now discussed.

What is school placement?

School placement, also known as field placement, practicum, teaching practice and fieldwork, was a key component of the research. Huberman (1989) described the professional life cycle of teachers and his "model of teacher development" (p. 32) is applicable to the current research, where the pre-service teacher participants were in the first phase of their teaching life cycle. During this first phase, a pre-service teacher's main concern was "survivability and discovery" (p. 34), where survival in a school environment and their own discovery about how a classroom operated, were relevant. Placement in a co-operating school for an extended duration, as part of a pre-service teacher's college preparation course, was part of that discovery, for the research participants.

Based on a model of cognitive apprenticeship (Brown, Collins, & Duguid, 1989) the school placement process was designed to "support learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity" (p. 39), that domain being the classroom. To ensure this apprenticeship model was successful, Darling-Hammond (1987) and Darling-Hammond and Snyder (2000) outlined the importance of placement as being an authentic assessment of teaching. Continued research by Darling-Hammond (2006) outlined three critical components of teacher education programmes where,

> coherence and integration among courses and between course work and clinical work in schools, extensive and intensely supervised clinical work integrated with course work using pedagogies that link theory and practice, and closer, proactive relationships with schools that serve diverse learners effectively and develop and model good teaching (p. 300)

were recommended. Indeed, recent research has advocated making placement the "core of the teachers' professional preparation" (Ball & Forzani, 2009, p. 497).

In an Irish context, *Learning to Teach* (DES, 2006) evaluated how teaching practice was conducted in Irish classrooms. This inspectorate report was complimentary that "purposeful learning occurred in the majority of classrooms" (p. 35), when pre-service teachers were on placement, and that "teaching practice was well organised by the colleges" (p. 36) of education. Dolan (2007) and others had advocated that teaching practice should adopt a combination of a behaviourist and competency approaches in the future, where "teacher education is indeed at a crossroads" (p. 5) in relation to how placement was conducted. This crossroads came shortly thereafter, when the Teaching Council commenced their review of initial teacher education providers, in 2009. As outlined earlier, the Teaching Council (2011) had advised an "extended period of placement" (p. 14) which was of relevance in the current research. This extended period should, as recommended by Hoffman et al. (2015),

> draw on cooperating teachers as a resource in making programs more powerful. However, programs must engage directly with cooperating teachers around coaching practices aligned with program goals and a vision for teaching. (p. 110).

Therefore, school placement and the experience pre-service teachers had in a school placement classroom, were relevant in the current work.

Influence of school placement.

Pre-service teachers experience influential people, while on school placement, the most notable of these being their school placement supervisor. As school placement was an examination of these participants' teaching skills, they were generally in a position of vulnerability within a placement triad. As discussed by Bain (1991), management of the personal relationships with members of these teaching triads was key. The teaching triad included typically, a "student teacher; co-operating teacher and university supervisors" (p. 4). Bullough (2005a, 2005b) referred to the vulnerability of pre-service teachers on placement where some decided they would adopt an approach that would ensure they were "immune to the possibility of failing" (p. 23), where often this sense of vulnerability results in a decision by the pre-service teacher to "limit their aims and to preserve their senses of self" (p. 24). Thus, as Darling-Hammond (2006) surmised, "no amount of course-work can, by itself, counteract the powerful experiential lessons that shape what teachers actually do" (p. 308), where the school placement experience shaped pre-service teachers' beliefs about what it was to be a good teacher. Indeed, in a recent Irish example, Hall et al. (2012) discussed how pre-service teachers conducted themselves in a school placement classroom. Despite being a small sample (n=6), her results demonstrated that participants "frequently mentioned how they would *not* ask for help and felt the need to conceal their inadequacies rather than seek assistance from teachers" (p. 107). Ultimately, to ensure pre-service teachers did well on placement, Halls' "student teachers invest[ed] in a dominant and traditional version[s] of teaching and learning" (p. 109) and tended to focus on classroom management and discipline, rather than try any new methods in this environment. As noted by Ní Chróinín and O'Sullivan (2014) "the highly monitored and high stakes (grades) nature of teaching practice meant that it was too risky an environment to experiment or test out ideas" (p. 450).

As far back as Sime and Priestley (2005), pre-service teachers reported their perceptions of what hindered or helped the use of ICT in schools they had visited on school placement. They considered dedicated IT space, their supervisory teacher's attitude to technology and the school culture (about using ICT) as key factors in their decisions to use technology in the classroom, while on school placement. Indeed, while out on school placement, use of ICT in the classroom can be dependent on watching a supervising classroom teachers' use of technology in the classroom (Hammond et al., 2009; Hammond, Reynolds, & Ingram, 2011; Haydn & Barton, 2007, p. 266). Hammond et al. (2009) interviewed 40 pre-service teachers and observed their use of technology while on school placement. Their research established that a good mentor while on teaching practice, and the school having a positive attitude towards using ICT in the classroom, were motivational factors that influenced the pre-service teachers' use of technology while on placement. Yet, access to ICT remained a problem for those interviewed, where they often had to "book class sets of laptops or computer rooms in advance" (p. 68). Chen (2010) undertook an analysis of the decisions by pre-service teachers to use technology and they commented on the social and contextual factors a student faced when out on school placement. These included a curriculum that needed to be covered, the school schedules and the culture of teaching in that school. Furthermore, if supportive conditions were not in place out in schools, pre-service teachers would revert to traditional teaching methods and tended not to use technology (Ell, 2017; Hammond et al., 2011; Trevethan, 2017). These studies came from a variety of US, Asian and European countries – all with similar experiences of the problems pre-service teachers faced when attempting to use technology in the school placement classroom and were focused on contextual factors and supportive conditions being present. The next section will outline what measurement tools were used to measure what technologies were used on school placement.

Measurement of Use of Technology

A variety of use of technology measurement scales have queried what technology respondents are using, and frequency of use of the tools mentioned. In the current research, an EU report on the use of technology by schools across Europe was used as the basis for the list of technologies presented in the second and third surveys (surveys II & III) for each cohort (EU Commission, 2013). The findings of this EU report were of interest to the current work, as one of their conclusions was that,

> despite having access and positive attitudes towards implementing ICT into their teaching and learning, teachers often find this difficult and require on-going support – not only technical but also pedagogical (p. 156).

Other use measurement scales relied on for the current work included Frank's (2002) instrument which measured how technology was used in elementary schools, in particular. The actual statements about use, utilised in these surveys are explained further, in chapter three and the relevant methods section therein.

Summary

In this section, a review of how pre-service and in-service teachers used technology in the classroom was provided. In-service teachers tended to use technology in traditional and transmissionist ways, primarily to gain attention and prepare for lessons in advance themselves, at home. However, in-service teachers were mindful of their schools' policies towards use of technology in the classroom, and as such, they tended to conform to these policies. Such traditional uses of technologies were also relevant for pre-service teachers where teacher educators were modelling this transmissionist, traditional use, during pre-service teacher education courses. Next, the confines of a school placement classroom were discussed, and that pre-service teachers were in 'survival' mode during that time. Hence, it was not the time to use technology if they perceived that technology might fail them, when they were being examined. The literature was reflective of the constraints of school placement, and the impact and influence of this environment cannot be ignored.

The next section will analyse the factors that impede use of technology in a classroom environment and delineate differences between extrinsic and intrinsic barriers to using technology. This section will then provide a review of the theoretical models, prevalent in the literature, used to measure intrinsic barriers to technology integration.

Technology Integration Factors

This section will examine barriers that impede use of technology in a classroom. It will outline the differences between internal and external barriers to use of technology. It will then explore the literature on specific internal barriers to technology integration, including beliefs and attitudes. It will then analyse how attitudes have been measured in previous literature, and demonstrate the application of these measurement models, to the current work.

The reasons for lack of use of technology by pre-service teachers has been an area of discussion in the literature, for some time. Schunk and Ertmer (1999) established two main factors that impeded effective use of technology in the classroom; namely first order (extrinsic) and second order (intrinsic) barriers. Indeed, Ertmer (1999) and others (Goktas, Gedik, & Baydas, 2013; Kopcha, 2012; Kurt & Ciftci, 2012; van Braak, 2001; Weber et al., 2004; Wood, Mueller, Willoughby, Specht, & Deyoung, 2005) have continued to identify additional barriers to technology integration in the classroom, and exploration of these forms the basis of this section.

Despite displaying confidence and enthusiasm for new technologies, authors have continued to query why teachers, generally, still have not used technology in their classrooms (Bauer & Kenton, 2005; Morris, 2010; Verdegem & De Marez, 2011). Common themes have emerged in the literature, including external factors such as school policy, lack of computer hardware and lack of support and internal factors including teachers' pedagogical beliefs and their own technological self-efficacy (Drent & Meelissen, 2008; Hew & Brush, 2007; Ottenbreit-Leftwich et al., 2010; Wood et al., 2005). Previous bad experiences when using technology, feeling overwhelmed by technology and being time poor have also been identified as factors that have impeded teachers' use of technology in the classroom (Albion, 2000; Conole, de Laat, Dillon, &

Darby, 2008; Mumtaz, 2000; Russell, Bebell, O'Dwyer, & O'Connor, 2003). Donnelly et al. (2011) questioned how can teachers be motivated to use more technology in the classroom when the "contented traditionalist would not easily transition to becoming a selective adopter, to a creative adopter" (p. 1480)? Furthermore, recent literature has questioned the merits of technology integration at all in education where "we have islands of success in an ocean of failure where there is little evidence to support the proposition that ICT and/or educational technology improve pedagogy or learning outcomes" (Butler, 2015b, p. 3). Thus, the debate continues but technology integration persists and factors that impede its integration are now discussed.

First Order Barriers

First order barriers to technology integration were external to the teacher and were often cited in earlier literature on use of technology in the classroom. First order barriers include access to technology, technical skills needed to operate technology and local support when problems arose using technology. These, however, have no effect on a teacher's fundamental pedagogical belief about the practice of teaching (Ertmer, 1999, 2005). Primarily concerned with creating efficiencies by using technology, acquiring skills needed to use technology and the presence of technology in the classroom, first order barriers were similar to the categories offered by the SAMR Model (Puentedura, 2010). Substitution (S) and augmentation (A) were first level uses of technology and were concerned with enhancement of a lesson and offered no functional improvement or change to the content of that lesson. In the SAMR model technology integration meant technology was used as a replacement for something, only.

Yet, Ertmer et al. (2012), reported recently that "first order barriers have long since been removed in schools" (p.434). Their study was conducted in the US, and while their statement may be true there, it is not universal. In Ireland, first order barriers to technology integration in the classroom still exist as outlined in the recent *Census* (Cosgrove et al., 2013), where only 54% of classrooms had a working computer, and even less had access to a working laptop (41%). Students' access to technology has also been criticised by authors of the *Digital Strategy*, where one of the key objectives of that *Strategy* (Butler et al., 2015) was to allow grants for equipment purchase and to improve broadband connectivity for primary schools (p. 41). Thus, two first order barriers still persist in an Irish context. First order barriers, such as these, were still prevalent in other countries too, including China (Sang, Valcke, Braak, & Tondeur, 2010), Taiwan (Liu, Li, & Carlsson, 2010), Greece (Kopcha, 2012), Turkey (Goktas et al., 2013), Australia (Prestridge, 2012) and Malaysia (Umar & Hussin, 2014). While first order barriers to technology integration still existed in an Irish context, second order barriers were also shown to have an effect on the motivation to use technology in a classroom. These second order barriers are explored in the next section.

Second Order Barriers

The research on second order barriers has focused on two main thematic concerns: these were teachers' beliefs about using technology (self-efficacy, teacher's pedagogical beliefs) and a variety of school factors (context, environment and influence of peers). The intrinsic factors are explored in this section are of particular relevance to the current research.

A report of the British Educational Communications and Technology Agency (BECTA, 2004) identified that "a very significant determinant of teachers' levels of engagement in ICT is their level of confidence in using technology" (p. 3) and that "there is a close relationship between levels of confidence and many other issues which themselves can be considered as barriers to ICT" (p. 3). They cited access to technology, training and technical support as examples of these. Equally second order barriers, such as social norms in the school, affected whether technology was used by a pre-service teacher, and these were often harder to overcome than first order barriers, according to the research (Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2013; Ertmer et al., 2012).

> If pre and in-service teachers are to become effective users of technology, they will need practical strategies for dealing with the different types of barriers they will face (Ertmer, 1999, p. 1).

Critical that "little research has been done to explain the gap between teachers' beliefs and classroom uses of technology" (p. 25) Ertmer's (2005) later work queried how "teachers' beliefs about technology are formed" (p. 30), where their beliefs were based on personal experiences with technology, vicarious experiences (peer-influence) and socio-cultural influences (of colleagues in a school environment). Yet, Ertmer (2005) was critical that high-level technology use was still low in schools, and she suggested,

> introducing teachers to technology that can support their most immediate needs, and this, at the very least, should increase teachers' confidence for using technology so that, over time, higher level uses become more plausible (p. 36).

As such, second order barriers, including computer self-efficacy and personal beliefs and attitudes about using technology in the classroom (Ertmer, 2005) were an area of interest, for the current research. Recently, Ertmer and Ottenbreit-Leftwich (2013) outlined a concrete suggestion as to how these barriers to technology integration could be overcome in the future.

> We suggest that the best way to achieve technology integration is by shifting our focus from promoting technology integration, per se, to promoting technology enabled learning, aimed at preparing students for their 21st century careers (p. 181).

Teachers' Beliefs and Intrinsic Factors

The focus of this section is a review of the literature concerning beliefs about using technology in the classroom. Pre-service teacher beliefs were defined by Kagan (1992) as "assumptions about students, learning, classrooms, and the subject matter to be taught" (p. 66) and she suggested "pre-service teachers use these beliefs as filters through which they view and interpret the teaching performances of others" (p. 68). Mumtaz (2000) had outlined that teachers' pedagogical beliefs had a large role to play in their decisions to use technology in the classroom. They suggested for successful implementation of ICT in the classroom, three factors needed to change. These were "the teacher, the school and policy makers" (p. 319). Doering, Hughes, and Huffman (2003) queried whether pre-service teachers were actually "thinking with technology" (p.342) and administered a technology integration model survey. While a small study, the participants' responses "to technology integration and use in schools were full of scepticism" (p. 348). The pre-service teachers initially saw technology as a way of delivering information and offered traditional transmissionist type examples of how technology was used in school. However, on completion of their technology course, their view of technology use in the classroom was broader, and "they could identify numerous technology integration ideas" (p. 350) for their future classrooms.

Ertmer (2005) queried the relationship between teachers' pedagogical beliefs and their technology practices in the classroom and discovered very few pre-service teachers had seen technology used while they were in school (during their own education), so were unlikely to have a preconceived idea about how technology should be used. The pre-service teachers' discussions centred on the premise that "change in beliefs follows rather than precedes practice, and that by helping teachers adopt new practices that are successful, the associated beliefs will also change" (p. 34). Yet, this study identified a lacuna in the literature where "few researchers have examined the relationship between teachers' pedagogical beliefs and their classroom use of technology" (p. 36). Further work by Plomp, Pelgrum, and Law (2007), on pedagogical practices in various European countries and the use of technology by teachers therein, had established that "while the use of ICT in education is increasing, for the majority of teachers, this (ICT) is still a tool that is used in the margins of the educational process" (p. 85).

Early work by Teo et al. (2007) sought to establish a link between the concept of pre-service teachers' attitudes and beliefs about teaching with technology, as research in this area was "limited and inconsistent" (p. 165). The impact of a pre-service teacher's belief system cannot be underestimated, and Teo, Ching Sing, et al. (2008) then began a period of extensive research into the beliefs pre-service teachers had about using technology. His research has continued to explore intention to use technology by administration of the Technology Acceptance Model (TAM) to various cohorts of in-service, pre-service and other types of teachers in Singapore (Teo 2009a; Teo, 2009b, 2010, 2011, 2012; Teo & Noyes, 2011, 2012). Teo's central thesis (Teo, Chai, Hung, & Lee, 2008) was based on the exploration of the relationship between teachers' beliefs about technology and their subsequent use of technology in the classroom. His research established that "if teachers practice constructivist teaching, they are likely to use technology in a constructivist manner whereas if teachers believe in more traditional teaching, there is a strong likelihood that technology will be used in a traditional way" (p. 170). Yet he was aware that beliefs were difficult to change, as they had been formed over many years of pre-service teachers' experiences in their classrooms, during their own education. Hermans, Tondeur, van Braak, and Valcke (2008) had questioned the impact of primary teachers' beliefs on the classroom use of computers, with a large sample (n= 525). Their study "shed light on the mediating role of primary teachers' educational beliefs in the resistance and receptiveness of primary school teachers to integrate computers in their classroom practice" (p. 1506). Indeed, those with traditional beliefs about teaching had a negative impact on use of technology in the classroom, whereas those with a more constructive and positive attitude had a more positive predisposition towards computer use in their classrooms (Hermans et al., 2008).

Mueller, Wood, Willoughby, Ross, and Specht (2008) queried the personal characteristics of teachers that integrated technology in their classrooms. The participants in this study came from both primary (n=185) and secondary (n= 204) schools. Results indicated that beliefs about computers were a key motivator to use technology in a school or classroom setting. Hammond et al. (2011) drew attention to the factors that influence how and why student teachers use ICT and found ICT use was seen as emerging from a mix of factors, namely "student teachers access to ICT, their feelings of self-efficacy when using ICT and their belief that ICT had a positive impact on learning" (p. 191). Prestridge (2012) (n = 48) explored teacher beliefs that influence the ways ICT are used in the classroom and the findings re-iterated previous literature on teacher beliefs about using technology.

> Beliefs…can be idealistic and desirable, however, when the reality of the classroom is encountered, beliefs may not inform practice...further research is needed to examine actualised practices that stem from stated beliefs, and at what point in practice do beliefs transform (p. 458).

Traditional, transmissionist beliefs about technology, and their influence on the intrinsic motivation to use technology in the classroom, remains an ongoing area of research in the literature (Funkhouser & Mouza, 2013; Koc, 2013). The link between intrinsic barriers, such as attitude and self-efficacy, to successful technology integration in the classroom and whether these have an effect on pre-service teachers' use of technology are outlined and discussed in the next section.

Attitudes

The research conducted by Teo and his colleagues (Teo, 2010; Teo, Ching Sing, et al., 2008) over the past ten years was influential in the current work. The focus of this section is to look at the formation of attitudes to technology and how attitudes can have an effect on subsequent behaviour with technology in a classroom. An outline of the psychological construct of attitude is given, the various components of attitude formation are discussed, and then a review of teacher attitudes to technology, provided.

Psychological construct of attitude.

The psychological literature defined attitudes as enduring systems of belief that can be examined in the cognitive, emotional and behavioural realms in humans (Bandura, 1999). According to Fuson (1942) "an attitude is the probability of the occurrence of a defined behaviour (or social action) in a defined situation" (p. 856). There are several ways we acquire attitudes and the four main sources of attitude acquisition are

- Classical conditioning
- Operant conditioning
- Cognitive appraisal and
- Observational learning.

Classical conditioning means we associate behaviours with attitudes, for example, that it is good to tell the truth; that it is bad to steal. Operant conditioning is concerned with being rewarded or punished for behaviour and attitudes. Cognitive appraisal means we weigh up logical arguments to help determine our attitude, and finally, observational learning means we learn attitudes through peer behaviour and modelling. For the purposes of this study the research concentrated on operant conditioning, cognitive appraisal and observational learning aspects of attitude. Bagozzi and Burnkrant (1979) noted that attitudes had three major components:

(i) A knowledge about the object, beliefs, idea (Cognitive)

(ii) A feeling about the object, a like or dislike component (Affective) and

(iii) A tendency towards action towards the object component (Behavioural).

Fishbein and Ajzen (1972) tested the relationship of attitudes towards behaviours and intentions and their definition of attitude “as a predisposition to respond in a generally favourable or unfavourable manner with respect to, or in the presence of the object” (p. 488) was relevant in the current work. Fishbein and Ajzen (1972, 1975) conceded there was a widespread belief that a person’s attitude towards an object was related to his beliefs about it, and these were seen as determinants of behavioural intention. However, they acknowledged that a change in attitude was often fraught with difficulty, where “attempts to produce changes in beliefs, attitudes or intentions have generally taken the form of manipulating information or manipulating behaviour” (p. 517) with varying results. They extended their definition of attitude in later work, where they proposed a “theory of reasoned action” (TRA) (Ajzen & Fishbein, 1980) and this will be reviewed in the section on attitude measurement models.

Bagozzi (1981), in a blood donation study, had tested the hypotheses concerning the attitude-behaviour relationships in a longitudinal field study of students, faculty and staff (n=157) at Massachusetts Institute of Technology (MIT). His survey questions were based on behavioural intention (BI) where “all things considered, are you likely to choose to give blood in the future and social normative beliefs such as how would the people whose opinions you value the most react if you discussed whether you should be a blood donor” (p. 614) and other standard behavioural questions of psychological measurement. This research examined actual behaviour under volitional control and stated “that attitude influences behaviour only through its impact on intentions” (p. 624). By this, Bagozzi agreed with the findings of Fishbein and Ajzen (1975) but was aware of the limitations of his research, as “we examined only a very specific single-act criterion” (p. 624) namely, giving blood. In further blood donation work Bagozzi (1982) expanded the study to query how psychological reactions influenced subsequent behaviour. In a new departure, the "expectancy value judgements influenced intentions both indirectly through affect and directly" (p. 580), meaning rational judgements could affect behaviours based on the motivational impact on feelings and attitudes.

In relation to attitude of pre-service teachers specifically, Sime and Priestley (2005) queried where pre-service teachers formed their attitudes about using technology in schools. They established that,

> the students identified a range of experiences from their practices (i.e. teaching practice) in schools as having helped them to contextualise their understanding of the uses of ICT in teaching, and by implication, representing contexts for the processes of becoming a teacher (p. 138).

In a further précis of the literature on attitudes, Baron, Byrne, and Branscombe (2006) outlined the main components of attitude and stated "attitudes *do* (*sic*) often affect our behaviour, and this is especially likely when attitudes are strong, accessible and well established" (p. 126). They also argued that due to the importance a social context plays in the link between attitudes and behaviour, often personal and direct experience with an attitude object, are likely to remind someone of their attitude to that object and thus affect their behaviour towards that object (pp. 127-149). Yet Valtonen et al. (2015) realised that the focus of research in this area had moved from a focus on attitude only to the influences of subjective norms (experienced on school placement) and a pre-service teacher's self-efficacy (akin to technological self-efficacy discussed shortly), as influencers to use of technology in the classroom. Therefore, the focus of the current work was the role of pre-service teachers' attitudes and self-efficacy towards technology and how these influenced their subsequent use of technology (their behaviour) in the school placement classroom.

Summary

This section has examined intrinsic and extrinsic factors that impede use of technology in a classroom. Some first order barriers persist in an Irish classroom, where lack of equipment or access to broadband have been noted in the literature. However, a recent focus in the literature on the persistence of second-order barriers, especially by Teo et al., demonstrates that technology integration in a classroom environment is difficult. The impact of the beliefs and attitudes of pre-service and in-service teachers to technology were noted, where often these second order barriers were challenging to overcome. Yet, recent literature has commented on the influence of a school environment and social norms, and these were especially relevant to the current work.

The next section will explore the psychological concept of self-efficacy and outline how this intrinsic factor was influential to the current work. It will then review how self-efficacy has been applied to technology, and analyse how computer self-efficacy, and measurement of this, was relevant in the current study.

Computers and Self-Efficacy

This section will outline the concepts of self-efficacy, and its application to the current research. Self-efficacy acts as a proxy for second order (intrinsic) barriers discussed earlier and its application in the current study is now described. Technological self-efficacy, as a concept, is then proposed and its application to teachers (pre-service and in-service), in particular, is outlined. The link between self-efficacy and attitudes to use of technology in the classroom has been established in the literature (Rovai & Childress, 2002). Using the *Computer Attitude Scale,* (as devised by Gressard and Lloyd (1985)), Rovai and Childress (2002) measured computer self-efficacy, computer liking and computer usefulness in their study. The results "suggest that attitudes about computers, particularly computer confidence or self-efficacy, are useful" (p. 233) and they advised that pre-service teacher education courses should focus on building confidence and expanding students' knowledge of computers to help them retain a positive attitude to the use of those computers, for their future classrooms.

Self-Efficacy

To gain an understanding of teachers' use of technology in the classroom, the psychological concept of self-efficacy was key to understanding their intrinsic motivation. Based on the theory of social cognitivism, self-efficacy was defined as "people's (sic.) beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, 1977, p. 191). Bandura (1977) explained the concept of self-efficacy further, where a strong sense of self-efficacy meant one approached difficult tasks as challenges to be mastered rather than as "threats to be avoided" (p. 192). He outlined that those who doubted their capabilities shied away from difficult tasks and often viewed them as personal threats. To further explain his theory of self-efficacy he stated that "to realize their aims people try to exercise control over the events that affect their lives, they have a stronger incentive to act if they believe control is possible, that their actions will be affective" (Bandura, 1977, p. 214). Thus, a pre-service teacher in a classroom on school placement is unlikely to use technology if they are not confident of their own capabilities to do so. However, some authors were critical of Bandura's research, where Eastman and Marzillier (1984) were concerned that the proof of self-efficacy was flawed. They had noted the limited nature of the behavioural tasks being assessed in Bandura's work and suggested the "conceptual and methodological difficulties are necessary before Bandura's claim that self- efficacy is a unifying construct can be properly evaluated" (p. 213). However, self-efficacy is well established in psychological literature as an effective measurement of a person's confidence in their own ability to achieve a required outcome.

Bandura (1997) specifically looked at four ways in which self-efficacy, or belief in ones' capabilities, regulated human functioning. In the cognitive domain, those with higher self-efficacy were more likely to set themselves "difficult challenges and commit themselves firmly to meeting those challenges" (p. 4). Bandura's area of interest was based on the motivational element of self-efficacy, where "it determines the goals people set for themselves, how much effort they expend, how long they persevere and how resilient they are in the face of failures and setbacks" (p. 4). Motivation was regulated by the expectation that a given course of behaviour produced a certain outcome. Self-belief, or a high level of self-efficacy, partly governed the motivating influence of outcome expectancies. To put it plainly, when faced with obstacles and failure, people who doubt their capabilities give up quickly, whereas those with strong self-efficacy persevere and exert greater effort when faced with challenges (Bandura, 1997). Recent research into the area of self- efficacy has focused on the domains of motivation and commitment of pre-service teachers (Chesnut, 2017) and the relationship between pedagogical knowledge and self-efficacy (Depaepe, 2018). In the context of the current research, the concept of self-efficacy has been extended to include technology, and a person's belief about their ability to use technology, this is examined in the next section.

Computer Self-Efficacy

Computer self-efficacy was explored by Compeau and Higgins (1995) when discussing the role of an individual's belief about their abilities to competently use computers. A group of managers and professionals (n=2000) were questioned to assess their computer self-efficacy and a ten-item instrument for measurement of computer self-efficacy was devised. This ten-item instrument looked at variables such as encouragement by others, others use of technology, support of others, self-efficacy, outcome expectations, affect, anxiety and use. Their findings suggested "individuals in this study with high self-efficacy used computers more, derived more enjoyment from their use, and experienced less computer anxiety" (p. 203).

An understanding of self-efficacy and outcome expectations was necessary to understand computer use and behaviour and Compeau and Higgins' (1995) research gave us a way of measuring this. Schunk and Ertmer (1999) had explored whether there was any relationship between use of computers, self-efficacy and achievement of goals with a group of undergraduates (n=44). An Introduction to Computers course was devised and students were required to complete six laboratory projects during their course. The first group in the study were given goals to evaluate their progress on the course, and the second group were not. Their findings suggested that "providing college students with process goals is an effective way to enhance achievement outcomes" (p. 257) and their results supported self-efficacy as a concept for acquisition of computer skills, as "self-efficacy bore a strong, positive relation to achievement and perceived self-regulation competence" (p. 258). However, a limitation of their work was that the sample was primarily female and had few male participants. Other models of technological self-efficacy measurement have been suggested in the literature. In research on smart phone acceptance, Chen, Chen, and Yen (2011) used Compeau & Higgins' (1995) ten-item instrument to measure self-efficacy, in conjunction with the Technology Acceptance Model (TAM), as devised by Davis (1989). Chen et al. (2011) argued that the concept of self-efficacy could be added to TAM to explain a user's comfort with using technology. As such, the concepts of self-efficacy and computer self-efficacy were linked, and their application to pre-service teachers' use of technology in the classroom is explored in the next section.

Efficacy and use of technology.

Whether a teacher's technological self-efficacy has an effect on use of technology in their classroom has been explored in the literature. In Australia, a variety of studies have considered pre-service teachers and the skills needed to effectively integrate technology into their teaching, primarily led by Dr. Peter Albion and his colleagues. A particular Queensland government initiative (Digital Education Revolution) required that all pre-service teachers integrate technology into all aspects of their teaching (Albion, 1999). By applying the concept of self-efficacy, as described by Bandura (1994) to his work, Albion established that "teachers' beliefs in their capacity to work effectively with technology are a significant factor in determining patterns of classroom use" (Albion, 1999, p. 2) re-iterating the link between beliefs about computers and self–efficacy using technology. The following year Albion (2000) established that "student teachers who report strong belief in their personal capacity to work with computers are more likely to report feelings of self-efficacy for teaching with computers" (p. 1353) and found this concept of self-efficacy an enabler for the integration of technology by those participants. In further research on this topic, Albion (2007) questioned the ability of millennial learners to integrate technology and outlined that,

> first year university students while reporting high levels of confidence (self-efficacy) when using the internet, do not necessarily manifest matching levels of competence (p.1244).

However, his study had focused primarily on specific tasks associated with searching the library for answers to a quiz, but were relevant for the current research, where a gap between confidence and competence using technology was explored.

> The evidence from the assessment task appears to indicate that students are generally familiar with working online and can complete a variety of simple tasks, but they are sometimes not aware of the significance of the information they encounter and may lack persistence or flexibility in extracting key information from the sites they locate (p. 1246).

Paraskeva, Bouta, and Papagianni (2008) surveyed a group of secondary school teachers (n=286) to establish a relationship between general self-efficacy and computer self-efficacy. They identified that Greek teachers' "computer self-efficacy is moderate to high, as a result of their high sense of general self-efficacy and confidence in their capabilities, combined with their desire to master and use modern technologies" (p. 1090). This study also suggested that pre-service teacher training in ICT could change teachers' attitudes and confidence with technology. Yet, the study was quite limited as it suggested that "teacher training in technology as an educational tool can change teachers' attitudes toward and confidence with technology" (p. 1090) but did not specify how this could be done. Niederhauser and Perkmen (2010) assessed 92 pre-service teachers' computer self-efficacy, based on a devised 25-item scale. Their results established that "intrapersonal factors, like outcome expectation, play a central role in whether teachers choose to integrate technology into their instructional practices" (p. 441) and suggested that personal self-efficacy was not enough of a motivator to use technology, in the longer term. Furthermore, they outlined that social recognition by peers, and the influence of peers, should also be considered (akin to subjective norms (SN) and facilitating conditions (FC) elements of TAM reviewed shortly) when technology integration practices of pre-service teachers were considered.

In an evaluation of the Australian Digital Education Revolution (DER) initiative, Albion (2011) argued that "students should graduate with relevant knowledge and skills for using ICT, and that ICT should be integrated to improve student learning" (p. 74). Having researched a sample of first years from a variety of education courses, in three different Australian universities, 50.5% felt confident to a great extent about using ICT and a further 17% were confident to a very great extent using technology (pp. 76-77). Yet, when queried further about their specific skills (e.g. managing digital photos or working with audio and video) the responses reflected lower confidence levels. He concluded that "Australia's Digital Education Revolution (DER) is still in its early stages and it is not entirely clear what it will mean in the typical classroom" (p. 80). Ten years into the DER initiative, there had been some improvement in pre-service teacher education in relation to using computers in the classroom, and the confidence and self-efficacy of these students had improved. Yet, "their experiences and resulting skills appear to be balanced more towards consumption of digital content than creation" (p. 80) and as such, their skills using technology remained limited. However, as noted earlier, technological self-efficacy of pre-service teacher educators has been noted in recent literature (Instefjord, 2017; Tondeur, 2016) and this remained a factor in the current work.

Summary

This section has explored the concepts of self-efficacy and technological self-efficacy and their relevance to the research study established. Self-efficacy is well established in psychological literature as a belief an individual has in their own abilities to achieve a desired outcome. This concept of self- efficacy has been adapted and utilised to measure confidence using technology. However, recent literature has noted that often confidence using technology has not equated to competence, which was relevant to the current study.

The Compeau & Higgins' (1995) ten item computer self-efficacy scale was relevant in the research, and its use is explained further, in chapter three.

The next section will outline the theoretical framework and measurement model underpinning the research study and justify how the technology acceptance model (TAM) was utilised with the pre-service teacher participants, in the research study.

Theoretical Framework and Measurement Models

In this section, psychological attitude measurement scales are reviewed and how these attitude measurement scales have been applied to technology, explored. The Theory of Reasoned Action (Ajzen & Fishbein, 1980), as a pre-cursor for the Theory of Planned Behaviour (Ajzen, 1991) which informed the Technology Acceptance Model (TAM) (Davis, 1989) being utilised at the core of this study, is outlined. Justification of the use of TAM to measure attitudes to technology, and its application to the current work, is then discussed. While measurement models for pre-service and in-service teachers' attitudes, and use of technology are available in the literature, their application to an Irish pre-service teacher cohort is unique to this research.

Theory of Reasoned Action

The Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) was based on three central constructs: behavioural intention (BI), attitude (A) and subjective norms (SN). "Generally speaking, the theory is based on the assumption that human beings are usually quite rational and make systematic use of the information available to them" (Ajzen & Fishbein, 1980, p. 5). There were two basic determinants to action – one was a personal factor and the other was social influence. The personal factor was an individual's positive or negative evaluation of performing the behaviour, termed the attitude toward the behaviour. The other factor was known as subjective norm, a perceived social pressure to engage or not engage in a particular behaviour. Finally, attitude was the degree to which performance of that behaviour was positively or negatively valued, expressed as a mathematical equation (http://people.umass.edu/aizen/att.html). A flow model of the behaviour process helped visualise the theory (this is kindly reproduced using a Creative Commons licence):

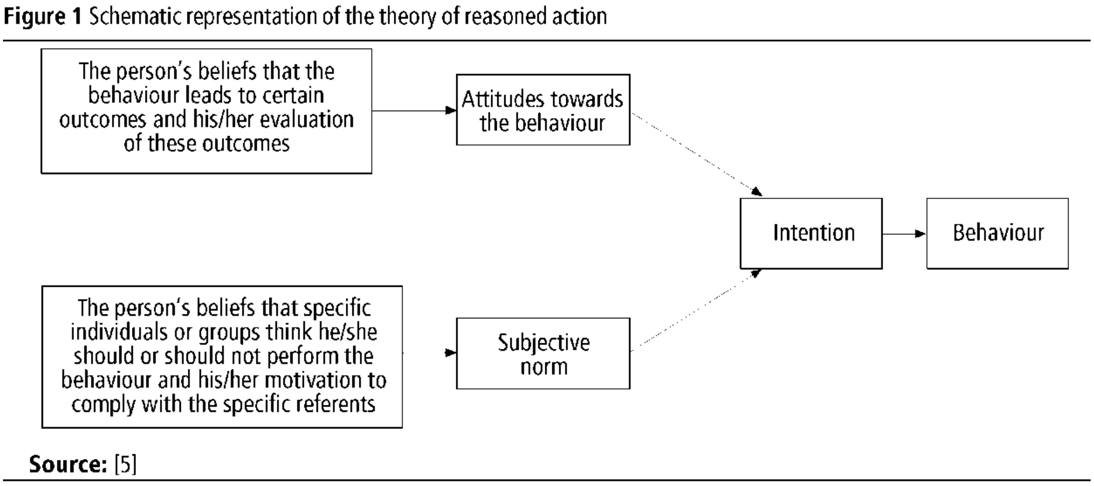


Figure 1 Theory of Reasoned Action, Creative Commons Licence Attribution, Non-Commercial

Theory of Planned Behaviour

The current thinking on the Theory of Planned Behaviour is outlined and, given the extensive research on this model in psychological literature, a cursory review of how it operated as a pre-cursor to the Technology Acceptance Model, at the core of the current research, is useful here.

Ajzen (1991) extended the TRA model to include perceived behavioural control, calling it the Theory of Planned Behaviour (TPB). This meant that while a person might intend to carry out a particular behaviour, their actuation was thwarted by lack of confidence, or control, over the behaviour. This perceived behavioural control extended the theory of self-efficacy (Bandura, 1977) where self-efficacy was defined as peoples' beliefs about their capabilities to produce designated levels of performance, as outlined earlier. One can see the similarity between self-efficacy and how lack of confidence could upset the intended behaviour's occurrence, or actualisation of the behaviour, as suggested by Ajzen (1991).

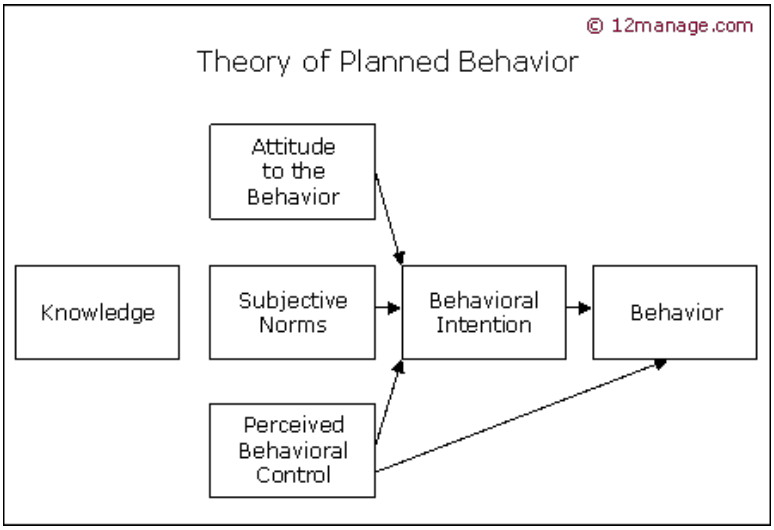


Figure 2 Theory of Planned Behaviour Model, Creative Commons Licence Attribution, Non-Commercial

The theory of planned behaviour model was used as a conceptual framework for dealing with "the complexities of human social behaviour" (p. 206). Yet Ajzen (1991) was aware there were limitations to his work and conceded that while there were significant relationships between behavioural beliefs and attitudes towards the behaviour, the exact form of these relationships had yet to be defined. Yet, this theory was particularly useful to the current research to measure pre-service teachers' attitudes to and subsequent use of technology.

Armitage and Conner (2001) reviewed the TPB model and determined that however strongly a belief is held, the implementation into action was at least partially determined by personal and environmental barriers. They were also critical of TRA and TPB as these measures tended to rely on self-reporting mechanisms. Looking at behavioural intention, they agreed that intentions do capture motivational factors that influence people to take an action and do indicate how hard people are willing to try. In a later article Armitage and Christian (2003) looked at the development of the theory of planned behaviour from the theory of reasoned action. In an introduction to a special issue on the topic, they agreed that "the easier the behaviour is, the more likely one will intend to perform it" (p. 191). Salleh and Albion (2004) examined the use of TPB as a framework in a project with Bruneian teachers. Using a self-report survey, statements were based on the constructs of subjective norms, perceived behavioural control, attitudes to behaviour, intention to use and actual use of ICT. Having extended the theory of TPB to studies of ICT classroom implementation, their findings were useful for the current research where "teachers' attitudes towards use of ICT and subjective norms significantly predict their intentions and subsequently intentions significantly predict behaviour" (p. 1395). Nevertheless, other variables also predicted teachers' decisions to use ICT, and demographic variables, moral norms, self-identity and affective beliefs were influential, thus TPB while a "good fit it is recommend that future research include these variables in investigations" (p. 1396).

Smarkola (2008) queried the efficacy of the theory of planned behaviour (TPB) model in relation to computer usage intentions of pre-service teachers. Despite being a small research sample (N=19), her groups of student and qualified teachers reported high levels of computer confidence. Yet, this computer confidence did not translate into actualisation of use of technology in their classrooms. Critical of using the TPB model, Smarkola (2008) argued that assessment of computer usage within any profession should be based on a behavioural model that complements the profession's environment. She proposed that an addition to TPB should include resource facilitating conditions as proposed by Taylor and Todd (1995) in their earlier Decomposed Theory of Planned Behaviour (DTPB) model. She concluded that "educational technology issues should not be viewed as a classroom technology integration process but as a human process regarding beliefs and behaviours in computer usage for teaching and learning" (p. 1212), this human process was especially relevant for the current research.

Discussion about the on-going validity of the TPB model persists in current literature (Sadaf, Newby, & Ertmer, 2015; Sadaf, Newby, & Ertmer, 2012a). Ajzen

(2012) reviewed the legacy of the theory of reasoned action and planned behaviour models. He analysed the impact of TRA and TPB on social psychology and reminded us that "perceived behavioural control is conceptually equivalent to Bandura's (1977) concept of perceived self-efficacy" (p. 17). Culminating in a positive affirmation of his original Fishbein and Ajzen (1972) model, he reminded us that a "large body of empirical research attests to the predictive validity of the TPB, the premier reasoned action model" (p. 24). Yet, in a recent editorial, Sniehotta, Presseau, and Araújo-Soares (2014) argued that TPB as a model, should be retired. While they agreed the model had "shaped psychological theorising" (p. 2) they felt the "field has moved on, scientists now use extended forms of the theory" (p. 4), thereby acknowledging TPB's limited application. This contention was strongly refuted subsequently by Conner (2014) and Ajzen (2015). Both decided that Sniehotta et al's (2014) argument for retirement of TPB was "misplaced or lacking in strong evidence" (Conner, 2014, p. 141) and suggested the "arguments were misguided, resting on a poor understanding of the TPB and the nature of psychological research" (Ajzen, 2015, p. 131). While the debate continues, the application of TPB to the current work was that it acted as a pre-cursor to the Technology Acceptance Model (TAM) utilised in the research. Elements of TPB were mirrored in TAM variables, such as subjective norm, behavioural intention and attitude.

Technology Acceptance Model

The Technology Acceptance Model (TAM) was designed to measure how users accept and use technology and suggested that when users are presented with new technology, they make decisions about how and why they would use it. As an expansion of previous work on the Theories of Reasoned Action and Planned Behaviour, the Technology Acceptance Model extended many of the attitude measurement statements to include technology acceptance statements. This section will explain TAM's application in various studies, it will outline elements of TAM that are used in the current work, it will provide a brief critique of TAM and it will look at other technology measurement models in the literature.

Technology acceptance model defined.

Koohang (1987) queried pre-service teachers' attitudes towards computers, specifically looking at anxiety, confidence and liking as measurement variables. Using the Computer Attitude Scale (CAS) (as devised by Loyd and Gressard (1984)) with a small group of pre-service teachers (n=60), 'confidence' and 'liking' were established to have a positive effect on use of computers by those participants. However, given the small sample size, the scale was not universally accepted. Yet, Davis (1989) was critical that valid measurement scales for predicting computer use were in "short supply" (p. 319) and suggested a new scale of measurement for acceptance of technology. Focused on two theoretical constructs of perceived ease of use (PEU) and perceived usefulness (PU), Davis' research queried how these constructs acted as a valid way of predicting behavioural intention (BI) of technology use. "The importance of perceived ease of use (PEU) was supported by Bandura's extensive research on self-efficacy" (Davis, 1989, p. 321) where self-efficacy was a determinant of user behaviour. In conducting his study with IBM employees, Davis' survey was developed rating the usefulness and ease of use of two IBM systems available to them. In subsequent research, the PEU and PU statements were administered to MBA students at Boston University. Davis' findings proposed and validated new measurement scales for PU and PEU; these variables were hypothesised to be strong predictors of acceptance of technology by both cohorts. Davis (1989) did suggest that further work could include looking at the relationship between these constructs (PEU & PU) "before claims about the behavioural predictiveness can be made conclusively" (p. 334).

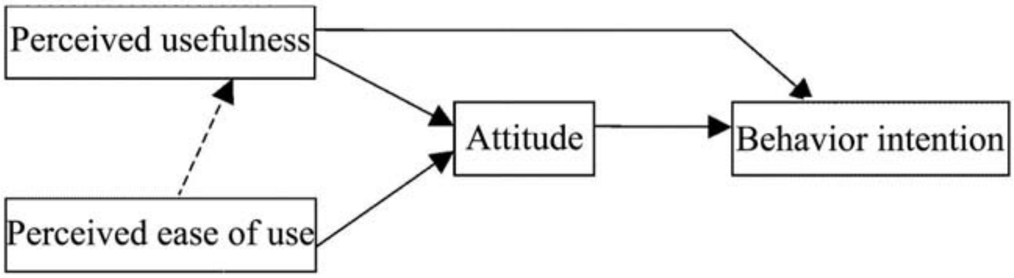


Figure 3 Technology Acceptance Model, Davis (1989) Creative Commons Licence Attribution, Non-Commercial

Venkatesh and Davis (2000) extended TAM (known as TAM 2) to include social influence and cognitive instrumental processes to the original perceived usefulness and ease of use constructs. They outlined that social influence, such as subjective norms (SN) (akin to this variable in TRA) and the cognitive instrumental process (job relevance) significantly influenced user acceptance of technology. Using four different systems in four different organisations, they established that this 'extended model' (TAM 2) was strongly supported. TAM 3 then extended the model further (Venkatesh & Bala, 2008) to include decisions made around implementation of IT in the workplace. TAM elements such as perceived ease of use (PEU) and perceived usefulness (PU) were determined to enhance employees' adoption of IT in the workplace. Of limited relevance to the current research as TAM 3 was administered in four different business type organisations, not schools, it sought to establish TAM as an effective measurement tool for acceptance of IT more generally, not just in educational contexts.

On-going use and application of TAM.

TAM has continued to be the predominant model used in the literature around measurement of technology acceptance, by different users, with different types of technologies and in different work place situations, in the past decade. In a meta-analysis of TAM studies, King and He (2006) reviewed 88 published papers on the use of the

TAM model and agreed "TAM has come to be one of the most widely used models in Information Systems (IS), in part because of its understandibility (sic) and simplicity" (p. 740). However, they were critical of the "TAM correlations, while strong, have considerable variability" (p. 751). Nonetheless, they did concede that the TAM constructs of perceived usefulness and behavioural intention were highly reliable measures in a "variety of contexts" (p. 751), hence their relevance for the current research.

Teo's on-going work has focused on establishing TAM as a reliable and consistent measurement model of technology acceptance, over the past 10 years. Teo et al. (2007) had questioned pre-service teachers' attitudes to technology in particular, and extended TAM to include subjective norm (SN) and facilitating conditions (FC). Their 2007 study was conducted with 239 pre-service teachers enrolled in teacher education colleges in Singapore. A survey was devised comprising statements about perceived ease of use, perceived usefulness, subjective norm and computer attitude. Teo's application of the TAM model to pre-service teachers was especially relevant as the main focus of the current research study was to explore the determinants of attitudes toward computers by pre-service teachers. Teo's research had queried the constructs of perceived usefulness and perceived ease of use, and argued they had a significant effect on attitudes to computers. Results from Teo's work supported Davis' (1989) earlier research and established the validity and reliability of TAM as a model to measure attitudes to technology. Subjective norm was also proven, by Teo, as a significant influence on pre-service teachers' attitudes to technology. Thus, the TAM survey included in the Teo et al. (2007) paper formed the basis for the first survey in this research, administered to the pre-service teachers in first-year of their college preparation course.

Teo, Ching Sing, et al. (2008) explored TAM's application to attitudes to technology, but removed the attitude statements from one group, and left the attitude statements in for the second group. They wanted to empirically test TAM given criticism of it as a measure of attitude. They argued that attitude in TAM should be researched further "as attitude to computer use (ATCU) has been established as a significant predictor of the intention to use technology, especially in setting where the use of technology is voluntary" (p. 1141). However, this conference paper was short and did not go into detail about the TAM measurement constructs or statements used therein.

Park (2009) applied TAM to acceptance of e-learning by a group of 628 undergraduate university students. They identified that TAM was a "useful theoretical model in helping to understand and explain behavioural intention to use e-learning" (p. 158). Of note was their finding that, in accordance with Bandura's (1994) self-efficacy theory, both subjective norm and self-efficacy played "an important role in affecting attitude towards e-learning and behavioural intention to use e-learning" (p. 158). Teo (2009b) conducted a study querying perceived usefulness as a determinant of behavioural intention to use technology. With a large sample of 475 students, he outlined "when technology is perceived to be useful and using it would improve their performance and make them more efficient, pre-service teachers are more likely to use technology" (p. 309). A limitation of that research was that it was a self-report survey, but it again raised the concept of self-efficacy and its applications to pre-service teachers' use of technology. Teo and Noyes (2011) queried the influence of perceived enjoyment on pre-service teachers' intentions to use technology and outlined that "even if they did not have a positive attitude toward technology per se, as long as it is perceived to be useful, and/or easy to use in ways that enhance their productivity" (p. 1646), thus validating perceived enjoyment as an addition to TAM. Teo (2010) extended TAM to include subjective norm (SN), facilitating conditions (FC) and technological complexity (TC) as further variables to the model. Again, using a sample of pre-service teachers from Singapore, a multiple item survey was administered. These findings added to the literature as they supported the contention that "the three external factors subjective norm, facilitating conditions and technological complexity were also significant in predicting pre-service teachers' attitude to computer use" (p. 74).

On-going research by Teo (2011) applied the TAM survey to in-service teachers. His findings did support "perceived usefulness, attitude toward use and facilitating conditions have direct influence on behavioural intention" (p. 2437) and argued that when in-service teachers had positive feelings towards the use of computers, they were more likely to use them in the classroom as these feelings reinforced their behavioural intention (BI) to use the technology. Yet, in a later study Teo (2011) established that subjective norm was "not found to be a significant influence on teachers' intention to use technology" (p. 2432). He suggested that in-service teachers did not have a choice as to whether they used technology or not, as they often "have to use technology with a more regulated and formal environment" (p. 2437). While subjective norm was the perceived social pressure to engage or not engage in behaviour, pre-service teachers may still feel they have volitional control. However, the perception of school placement as a regulated environment was also relevant for the pre-service teachers in the current study.

Teo (2012) then integrated TAM with the Theory of Planned Behaviour (TPB) model and administered it to pre-service teachers. This new combined TAM-TPB model queried the relationships between perceived usefulness, subjective norm, perceived ease of use, attitude towards usage, facilitating conditions and behavioural intention to use in a new survey instrument. His results identified that "integration of TAM and TPB was fairly efficient as a model to predict the behavioural intention to use technology among pre-service teachers in Singapore" (p. 13). He established that "when pre-service teachers have a positive attitude and believe that technology would improve their work performance and make them more efficient, they are likely to use technology" (p. 13). While his findings supported integration of both models, further work was required to validate it in other contexts, settings and with other participants. As a model for pre-service teachers, it was however, relevant for the current study. Pynoo et al. (2012) then administered a combined TAM and TPB model (C-TAM-TPB) with in-service teachers, and determined it was an effective measurement of how these in-service teachers used an educational portal, in their research. Their results established that in-service teachers used technology in two distinct ways, acting as "uploaders (sic.) and receptive users" (p. 315), where they used technology as either consumers or creators of content. Ursavas' (2013) later evaluation of TAM, described it as a "robust, powerful and parsimonious model capable of explaining user's technology acceptance in a variety of contexts" (p. 22) and was still valid, for his pre-service teacher participants.

Criticism of TAM.

Despite being the prevalent model in the literature to measure use of technology, TAM was not without its critics. Yang and Yoo (2004) questioned the measurement of attitude per se. In their study, there were statistical differences between cognitive and affective attitude measurement, which led them to question the universal applicability of the attitude construct in Davis' TAM. Indeed, Bagozzi (2007), despite being a previous co-author of Davis (1989), acknowledged "that, in favouring a simple model, researchers have overlooked essential determinants of decisions and action, and turned a blind eye to inherent limitations in TAM" (p. 244). For example, Bagozzi (2007) suggested that the most salient feature lacking in TAM, was self-regulation where "true self-regulation in an agentic sense…entails an activation of the will, which operates on felt deterministic urges via reasoning processes" (p. 250). In effect, through self-regulation users (of technology) can change their behaviour, if their previous "learned values, dispositions, traits and virtues" (p. 251) change their use intentions. Recently, Lala (2014) provided a review of TAM's application for marketing [of technology] where she contended that it was time for a unified approach, and that TAM continued to prove problematic for researchers. However, despite ongoing criticism of the model, it has continued relevance in the literature and its ongoing application to technology is next considered.

Recent work on TAM has focused on validating the constructs of PEU, PU, BI, SN and FC with either different types of participants, in different conditions or by adding explanatory statements to the constructs, with regard to use of technology. From extending TAM to include usability measures with a learning management system (Lin, 2013), to querying the effect personality types might have on the predictive validity of TAM (Svendsen, Johnsen, Almås-Sørensen, & Vittersø, 2013), to looking at subjective norm in a Chinese context (Sawang, Sun, & Salim, 2014), to applying TAM to next generation learning management systems (Ros et al., 2015), to adding explanatory statements to the PU variable (Scherer, Siddiq, & Teo, 2015) to finally, combining pre-service and in-service teachers' acceptance of technology (Teo, 2015), the applicability and relevance of TAM to the current work, was well established in the literature. Indeed, in the current research, the use of TAM with Irish pre-service teachers was a new departure.

Other Models of Technology Use

Other models have been proposed in the literature, and were considered, to measure attitudes to technology. While there were many, none were as pertinent to this study as TPB, TRA and TAM. For example, the *Access Competence and Motivation* (ACM) model (Viherä & Nurmela, 2001) queried whether communication capability was a determinant for technology use in Finland. Having access to technology (A) and competence in using technology (C), combined with a motivation (M) to be online was their central premise. Their research concentrated on what modern IT and communications systems require of their users. Their study veered into criticism of modern technology, as being "a social trap" (p. 263) and their ACM model was limited in its application, and therefore not relevant for the current study.

Wu, Chen, and Lin (2007) had proposed a model called *End User Computing Acceptance* (EUC) model. They based their work on TRA and TAM, adapting statements from TAM, to include self-efficacy statements, into a survey. Out of 800 surveys, only 142 responses were returned, so the data sample was quite small. Despite this, their results did state that "perceived ease of use (PEU), perceived usefulness (PU) and computer enjoyment (CE) all directly influenced actual usage of technology" (p. 173). While computer enjoyment was suggested as another variable to add to TAM, computer enjoyment has not featured in other literature on the area and was therefore not relevant to the current research.

The *Meta-Cognitive Model of Attitudes* (MCM) (Petty, Briñol, & DeMarree, 2007) was based on the presumption that attitudes had an evaluative component. Their model held that "attitude objects can be linked in memory to both positive and negative evaluations that can vary in the degree to which they are endorsed or not" (p. 662). They further explained that "the number of prior positive and negative experiences, the recency (sic.) of those experiences and the context in which those experiences took place will matter" (p. 662). Again, these findings were of note in the context of positive and negative experiences of technology use by participants, for the current study.

The *Task Technology Fit Model* (TTF) (Dishaw & Strong, 1999; Goodhue & Thompson, 1995; Yen, Wu, Cheng, & Huang, 2010) queried the link between user attitudes and task-technology fit as a predictor of performance with technology. This meant that the task for which the technology was used should be a good fit for the task it supported, in effect, was the technology appropriate for the task at hand. The impact of TTF on utilisation was shown as a link between task technology fit and beliefs about the consequences of using the technology, akin to self-efficacy described earlier. However, the construct of perceived usefulness in TAM had been established in the literature, and thus the TTF model was not suitable for the current research.

As there was plenty of literature about the applications of ease of use and perceived usefulness, Venkatesh et al. (2003) finally proposed a “unified view” (p. 425) as “information technology acceptance research has yielded many competing models, each with different sets of acceptance determinants” (p. 425). In their work, they reviewed eight predominant models of measurement of technology acceptance. They mentioned social cognitive theory (Bandura, 1977; Compeau & Higgins, 1995), the theory of reasoned action (Fishbein & Ajzen, 1975), perceived usefulness (PU) & perceived ease of use (PEU) with subjective norms (SN), Davis’ (1989) motivational model, the theory of planned behaviour (Ajzen, 1991), and finally a combined TAM and TPB model (Venkatesh et al., 2003). Having conducted four longitudinal field studies in different institutions, they arrived at the *Unified Theory of Acceptance and Use of Technology Model* (UTAUT). While they agreed that self-efficacy could be a direct determinant of intention to use technology, the UTAUT model did not include it as a direct determinant. What UTAUT did establish was that “attitude to technology is defined as an individual’s overall effective reason to using a system” (p. 455) and there were constructs from existing models of attitude measurement that aligned with their newly proposed model. These were attitude towards behaviour (as established in earlier TRA, TPB and TAM models), intrinsic motivation and affect towards use.

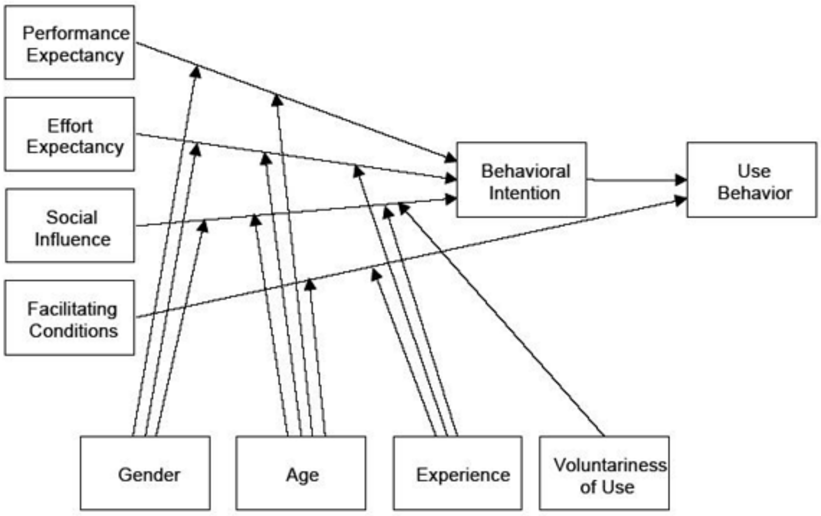


Figure 4 The UTAUT Model-Venkatesh et al. (2003), Creative Commons Licence Attribution, Non-Commercial

Therefore, research into applications of the UTAUT model emerged in the literature. For example, Birch and Irvine (2009) investigated whether Canadian pre-service teachers were influenced by the variables present in the UTAUT model. Of particular interest in that study, was that social influence had the lowest correlation with behavioural intention, contrary to Venkatesh et als' (2003) earlier findings. However, the behavioural intention responses indicated a high intention of participants to use ICT while on teaching practice. Yet, given the small sample, (n=82), they conceded "those with low intention to use ICT may have chosen not to complete the survey" (p. 311) and as such, was only a first step toward universal acceptance and application of the UTAUT model. Later, Teo (2012) applied the UTAUT model to pre-service teachers and argued it was useful construct when querying their intention to use technology (BI). Using a sample of 264 pre-service teachers in Singapore, who were selected as they were regular users of technology, and they "exercise volition over their technology use" (p. 5). However, Teo (2012) had only focused on one particular groups' behavioural intentions, and the validity of the UTAUT model needed additional research with different groups of participants, to establish its validity and reliability. Recently, Nistor, Lerche, Weinberger, Ceobanu, and Heymann (2014) extended the UTAUT model to include specific cultural influences and how different cultures exhibit different attitudes to technology. With a large sample from Germany and Romania (n = 2866), they acknowledged that "national and professional culture may shape use of computer-based learning environments" (p. 36) where facilitating conditions and computer anxiety featured strongly for German technology users, but not for their Romanian counterparts. Of note in their conclusion was the suggestion that future research should be mindful of cultural influences on acceptance of technology by users, re-iterating the role of subjective norms and facilitating conditions, as previously suggested by Teo (2010).

Summary

In this section, psychological attitude scales were reviewed and how those attitude measurement scales were applied to technology, explored. The theories of reasoned action and planned behaviour were discussed, as they acted as a pre-cursor for the Technology Acceptance Model (Davis, 1989; Venkatesh, 2003). The reliability and validity of TAM has been established by Teo and his colleagues frequently, over the last decade. As such, it was chosen as an effective measurement tool of technology acceptance for the current study. However, criticism of the model has emerged in the literature where the concepts of self-regulation and belief, as a prelude to action, have not been considered. Other models of technology acceptance measurement have been proposed in more recent literature, including the UTAUT model. However, their validity had not been established at the commencement of the current research study. Furthermore, use of TAM with Irish pre-service teachers was a new departure and formed the basis for one survey section, which will be discussed in the next chapter.

Chapter Two Conclusion

In conclusion, this literature review was designed to provide context to the study being undertaken by the researcher. This literature informed the chosen methodology as outlined in the next chapter. At the outset, a review of pre-service teacher education in Ireland was provided. The focus of this section was to contextualise the domains of education and technology and outline the impact various Irish government policies have had on the area of technology integration in schools. It was established that Ireland has had an inconsistent approach to technology integration in classrooms, indeed, Ireland is lagging far behind other countries with a continued techno-centric focus. However, recent government initiatives provide an insight into a future vision for education that is more indicative of a cohesive approach to technology integration in schools, pre-service teacher education and higher education.

In the second section the substantive literature looked at the practice of use of technology by in-service and pre-service teachers alike. It reviewed the literature on the phenomenon of the digital native (Prensky, 2001) and queried why these millennial learners (Dede, 2005) who used technology every day, on a personal basis, were not using technology, to the same extent, in their professional lives. The section also provided a critique of the concept of digital natives, where in recent literature, this concept of being more technologically competent by virtue of when someone was born, has fallen out of favour. Indeed, the whole concept of millennials as being more confident users of technology is problematic in current literature. This section also outlined how pre-service teachers acquired technological knowledge and queried the concepts of teacher role identity (Knowles, 1992), and models of good technology use experienced during pre-service teacher education. The second section then questioned the persistence of first and second order barriers to use of technology, and whether these applied in an Irish context.

It also expanded on second order intrinsic barriers, such as beliefs about technology, attitudes to technology, self-efficacy and technological self-efficacy. The concept of technological self-efficacy was germane in the current study, as measurement of confidence using technology in a personal capacity was under investigation. The final section focused on psychological theories associated with measurement of attitude, behavioural intention, subjective norms, facilitating conditions and the theoretical framework (TAM) chosen, to measure these constructs.

In the next chapter the emergent research questions are presented, and the chosen epistemology considered. This chapter will justify the methodological approach taken to investigate pre-service teachers' use of technology, in personal and professional contexts. It will also outline how this approach was employed during analysis of the data collected, over the course of the four-year research study, with each cohort.

Chapter Three Methodology

In this section, the researcher will outline the epistemological basis for the research and the philosophical underpinnings of the work. The methodological approach chosen is discussed, and how this methodology is applied to the current work. Methods used during the course of the study are then detailed, and their application to the research questions deduced from the literature. An outline of the data analysis procedures, based on the methodological approach, is then presented. An explanation of the ethical considerations is provided and finally, limitations of the research methodology are discussed.

Logic of the Enquiry

The rationale for the research arises from the researcher's current position as head of information technology in a college of education and her previous role in providing continuing professional development within a non-education professional organisation. Both roles involved the design and execution of online courses. Having thus gained some relevant experience of the technology requirements of both groups, to successfully complete the online courses, the researcher began to observe emergent positive and negative attitudes to technological innovations in each profession. During her M.Sc. in technology and education (Egan, 2009) the researcher focused on the attitudes of pre-service teachers to technology and their use of new technologies. That work involved students creating podcasts to share with each other, as a study aid. While students could create the podcast, provided it was demonstrated to them first, they did not share podcasts with each other, and had problems using the podcasting technology outside of their directed classes. One quote from a participant prompted further enquiry into the attitudes of pre-service teachers to technology – 'chalk and talk worked for me, so why should I use technology at all?'

As a consequence of this research, the researcher began to explore use of technology by pre-service teachers further, and published conference papers using the Technology Acceptance Model theoretical framework (TAM) to measure attitudes to technology, and their effect on subsequent use of technology, in a classroom. This further strengthened the researcher's interest in the topic, and since 2010 a number of different pre-service and in-service teacher cohorts have been surveyed about their attitudes to technology both in and out of the classroom (Egan & FitzGibbon, 2010; Egan et al., 2012; Egan, FitzGibbon, & Oldham, 2013; Egan, FitzGibbon, Oldham, Girvan, & Hallissy, 2013; FitzGibbon, Egan, Oldham, & Girvan, 2012) and the results presented at conferences.

This research uncovered a gap in the literature on personal use of technology by Irish pre-service teachers. This prompted further enquiry as to how pre-service teachers' attitudes to technology were cultivated and formed during their undergraduate education and how these attitudes impacted on actual use of technology in the classroom, especially during school placement blocks. These students were the millennials (Dede, 2005) who were using technology every day on a personal basis, why were they not bringing this familiarity with technology into the classroom?

In the current work, the TAM theoretical framework has been extended to include other psychological models of attitude measurement, such as the Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB) and variables to measure self-efficacy and subjective norms. These models were well established in the literature as consistent methods of attitude measurement. Recently, additional variables have been included to measure technological attitude per se and such technological attitudes' effect on use of technology on a personal and professional basis (Lee & Lehto, 2013; Pynoo & van Braak, 2014; Ros et al., 2015).

Research Questions

These research questions were deduced from the review of literature and were primarily focused on the area of pre-service teachers' attitudes to technology, and their subsequent use of technologies, either personally or in the classroom. There were five emergent questions at the core of this research.

Research Question One

Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the net generation or millennial learners (Cuban et al., 2001; Dede, 2000; Tapscott, 1998)?

Research Question Two

What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes (Cosgrove et al., 2005; Shiel et al., 2006)?

Research Question Three

What barriers, if any, do pre-service teachers perceive as impacting on their use of technology in the classroom (Ertmer, 1999; Ertmer et al., 2012)?

Research Question Four

Does pre-service teacher's technological self-efficacy correlate positively with their use of technology while on school placement (Albion, 2007; Bandura, 1977)?

Research Question Five

Do pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM variables (facilitating conditions and subjective norms), act as a positive predictor of their use of technology while on school placement (Davis, 1989; Teo et al., 2007; Venkatesh & Davis, 2000)?

A detailed analysis of the epistemological paradigm that forms the basis for the research methodology and methods used to explore these questions is outlined in the next section.

Epistemology

An overview of the numerous research paradigms is a good introduction when conducting research (Mertens, 1998, p. 7). Epistemology looks at the theoretical perspective employed by the study – where it deals with the "nature of knowledge, its possibility, scope and general basis" (Crotty, 1998) and is "inherent in the theoretical perspective and therefore the methodology we have chosen" (p.8). It is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible, and whether this knowledge is both adequate and legitimate (Crotty, 1998, p. 8). Often referred to as the research paradigm the epistemological and methodological stance of the researcher needed to be outlined clearly from the outset (Denzin & Lincoln, 2008; Mertens, 1998) thus identifying the philosophical approach taken. This also revealed the bias of the researcher, and as such, should be stated at the outset (Crotty, 1998; Mertens, 1998).

A number of research paradigms were identified in the literature (Behling, 1980; Blaikie, 2004; Creswell, 2009; Creswell & Clark, 2007; Crotty, 1998; Finch, 1986; Mertens, 2010; Moses & Aknutsen, 2012) and for the purposes of this study, both positivist and interpretivist paradigms were considered, as a pragmatic mixed methods approach was preferred. As Bryman (2006) outlined,

> when a given problem is studied, different approaches to research will ask different questions, collect different data and use different frames of analysis (p.11).

An epistemological analysis sets the context for a study. The fundamental questions of what was the nature of knowledge and how we can obtain the necessary knowledge and understanding (Denzin & Lincoln, 2008; Lincoln, 1985) can all fit into one of many research paradigms available. Figure 5 gives an overview of the epistemological paradigm, guiding theoretical perspectives, methodological overview, methods and data analyses employed in the current work. Each element of the paradigm is then discussed in detail.

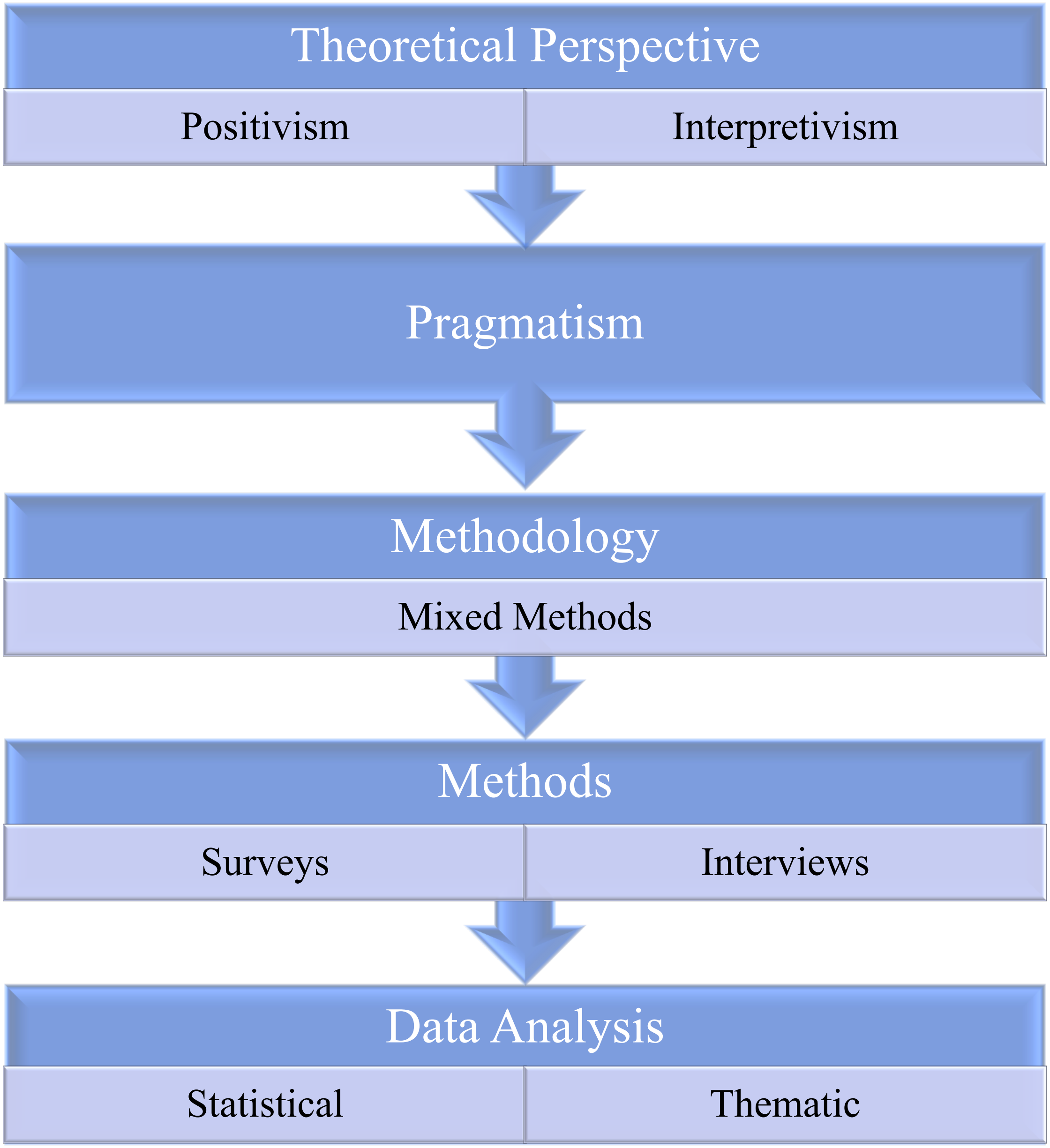


Figure 5 Research paradigm, adapted from Crotty's (1998) Theoretical Framework (p. 4).

Positivism

Positivism treats social facts as existing independently of the activities of both the participants and researchers. A positivist epistemology implies a search for causes requiring quantitative measurement and statistical analysis, for example, usually in the form of survey research (Finch, 1986). Mertens (1998, 2010) detailed how,

> the underlying assumptions of positivism include the belief that the social world can be studied in the same way as the natural world, that there is a method for studying the social world that is value-free, and that explanations of a causal nature can be provided (p. 10).

Indeed, where positivism addressed the nature of knowledge, objectivity was important, where the researcher must observe in a dispassionate manner. Often positivism was criticised for its reductionist view and Habermas (1972) was critical that the scientific method had become almost unassailable, and as such, had neglected and "silenced an important debate about values, informed opinion, moral judgements and beliefs" (Crotty, 1998, p. 48) leaving no room for anything other than a scientific approach. Positivists believed the world was out there to be measured, whereas interpretivists believed that the world was socially constructed (Cronin, 2008). A positivist approach looks at the social world based on hard facts, surveys and experiments, and often looked for relationships and regularities between selected factors (Cohen, Manion, & Morrison, 2011). May (2011, p. 10) was critical that the positivist tradition was characterised by "prediction and explanation of phenomena and the pursuit of objectivity" where the researcher was detached from the topic under investigation. Rubin and Rubin (2012, p. 15) acknowledged that if the purpose of the research was to test theories and discover general principles, it was positivist in its nature. A typical positivist methodology therefore, would be a systematic enquiry-based approach to research, and was usually quantitative and decontextualized. This detached positivistic approach to measurement of use and attitudes was the basis for the three surveys used in the current work, with each cohort of pre-service teachers.

Interpretivism

Finch (1986, p. 7) established that qualitative research and interpretivism looked not so much for causes, as for meanings, and while rejecting the scientific model, saw the task of research as uncovering the meaning of social events, and problems, based on an understanding of the lived experience of human society from the human point of view. The underlying epistemology of interpretivism uncovers meaning, requiring an in-depth approach to research, such as unstructured interviews and participant observations to gather data. Where positivism saw knowledge as "hard, and objective", Finch (1986, p. 9) defined interpretivism as "personal, subjective and unique". The interpretivist approach was defined by Crotty (1998) as "culturally derived and historically situated interpretations of the social-life world" (p. 67). Cohen, Mannion, and Morrison (2007), contended that interpretivism looked at the "world of human experience" (p. 36) and how an individual created, modified and interpreted the world in which they found themselves. Such an approach was more aligned with social theories that people constructed their own social reality through interpretation of events, contexts and situations, acting on the basis of those events.

Cohen et al. (2011, 2007) defined anti-positivism as based on subjective accounts, participant observation and personal constructs, stressing the importance of the 'subjective' experience of participants. Psychologists, such as Blumer (1986), would say that people are creative and deliberate in their actions, and as such, construct their own social world. By doing this, situations are always evolving, and are subject to change – thus, the social world should then be studied in this naturalistic, interpretive state. Participants will interpret events, contexts and situations and act on the basis of their experience of these events. Gilbert (2008, p. 366) in his analysis of the interpretive tradition, looked to Max Weber, a German sociologist, who defined interpretivism as not so much "explanations and predictions of social events, as understanding what meaning and what significance the social world has for people who live in it" (Calhoun et al., 2002; Weber, 1993, 2015). Cohen et al. (2011, 2007) differentiated between the interpretivist and scientific traditions by stating that the "scientific method is rule-governed, the cause of the behaviour lies in the past and it is based on a rational edifice" (p. 22), whereas the interpretive tradition looked to a "concern for the individual, a focus on action, and it begins with individuals and seeks to understand their interpretations of the world around them" (p. 21).

Pragmatism

The key early proponents of pragmatism were Peirce (1958) and Dewey (1916, 1938, 1956) who advocated that education and learning constituted a social process, and that the school itself was where reform could happen. In education, the school and the social environment therein were key factors in driving change and Dewey was an advocate of hands-on learning, where the teacher was no longer the sage on the stage but a facilitator of learning and a guide on the side. The key features of a pragmatic philosophical stance on research were outlined by Creswell (2009) where "pragmatists agree that research always occurs in social contexts" (p. 11). Equally, pragmatic research was conducted to allow for "not just what works but emphasises the research problem and uses all approaches available to understand that problem" (p.10).

The current research, as described, was based on both positivist and interpretivist research traditions using the surveys to gather empirical, positivistic data for each cohort and then an interpretivist approach to gather the experiences of pre-service teachers' use of technology on their school placements, using semi-structured interviews. As such, it fell into the pragmatic epistemological paradigm, as it sought to expand on the positivist focus of the research to explain the phenomena occurring in the locus of the research, with interpretive data. Pragmatic researchers often favour this mixed methods research design and the current research was no exception.

Research Design

The research design employed sought to investigate concepts, theories and basic principles of reasoning on attitudes and uses of technology by each cohort. The research design had mixed methodological characteristics and the following section explains the basis of this approach further.

Mixed Methods

While the researcher was biased towards a positivist epistemology (as exemplified by use of surveys) elements of the interpretivist paradigm (semi-structured interviews) were employed to gather data in relation to the phenomenon of use of technology by participants, and to interpret their responses. As such, a pragmatic sequential mixed methods approach was expedient (Burton, 2009; Lichtman, 2010; Menter, 2011) to gather the data to address the research questions that formed the basis of this work.

Sale, Lohfeld, and Brazil (2002, p. 130) suggested mixed methods as a means of studying complex social phenomena consisting of both interpretive and positivist aspects. The central premise of a mixed methods study was that the use of quantitative and qualitative approaches provided a better understanding than one approach alone (Creswell & Clark, 2007). Cronin (2008) and Gilbert (2008) clearly outlined that the main reason that researchers used multiple methods was that "they wished to know more" (p. 127). They described how mixed methods had been used to increase the level of confidence in research findings, to generate new knowledge through a synthesis of the findings from different approaches, to hear different voices and bring to play multiple constructions of a phenomenon, to reflect the complexity of a phenomena and to demonstrate theoretical claims that knowledge was both qualitative and quantitative (p. 128). Further, Creswell

(2009) also argued that qualitative and quantitative research “used together produce more complete knowledge necessary to inform theory and practice” (p. 39). Equally, Saldaña (2011) determined that a strategic and purposeful combination of qualitative and quantitative methods, combining a survey with a sample of participants chosen for follow up interviews, was an effective method to measure attitudes. To ensure paradigmatic corroboration (where the quantitative results of one data set did not simply harmonize or complement the qualitative data but corroborated it) mixed methods was used “to provide analytic texture to your work, to compensate for the deficiencies of one method and to strengthen the findings” (Miles, Huberman, & Saldaña, 2014, pp. 26 - 27). In this study, a mixed methods design enabled quantitative comparison of two cohorts’ responses to surveys administered, followed by a qualitative comparison of codes and themes that arose during semi-structured interviews with a subset from each cohort. By adopting this position of methodological pluralism, and triangulation of well-designed methods, the mixed methods approach employed in this work provided pragmatism, breadth and depth to the findings. Yet, mixed methods approaches are not without criticism where Bryman (2006, p. 139) argued that by mixing methods many researchers paid little attention to paradigm differences in actual research practice, and different methods were not treated as exclusive to a particular perspective. However, in the current research this was negated by a sequential explanatory design, as outlined in the next section.

Sequential Explanatory Design

The sequence of methods used was important, as was whether the methods were conducted sequentially or simultaneously (Creswell, 2009; Creswell & Clark, 2007), whether one method influenced the operationalisation of the other and whether all the methods were given equal weight that in turn could affect the outcome of the research. The researcher used a “sequential explanatory design” (Creswell, 2009, p. 211) where the first phase of data collection, for each cohort, focused on quantitative data, and the second phase, on qualitative data. The second phase of data collection (semi-structured interviews) was informed by the emergent results of the first phase (surveys).

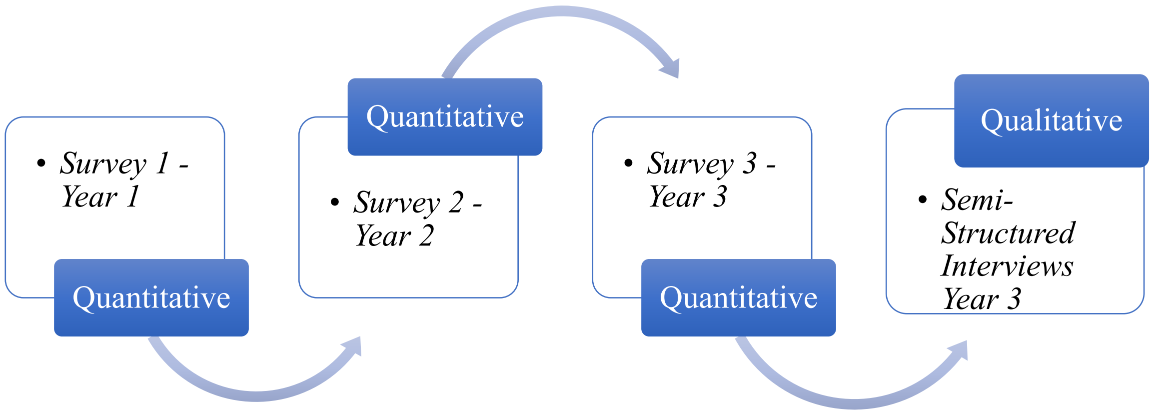


Figure 6 Sequential explanatory design as applied to the current research.

Sequential explanatory design has often been criticised as the duration of data collection can be extended over a long period of time (Cohen et al., 2011; Creswell & Clark, 2007; Mertens, 1998; Silverman, 2010, 2013). However, this was not a concern for the current research. The Bachelor in Education degree was of three years' duration and participants' responses were collected after each block of school placement during that time and, as such, the sequential explanatory design provided an expedient and timely approach for the current research.

Timeline for the study.

A timeline for the research study detailed how and where each sequential research element sat in relation the overall research structure. Members of each cohort were subjected to the same research schedule during each year of their undergraduate study in the institution. The timeline for the research was based on a typical academic year schedule, where school placement occurred as a block release and surveys and semi-structured interviews were scheduled around these school placement blocks. In the diagram, it can be seen that survey I happened at the beginning of first year, then survey II and survey III were administered after a block of school placement, in subsequent academic years. Finally, semi-structured interviews were conducted during the third year of the students' studies, subsequent to their final school placement block.

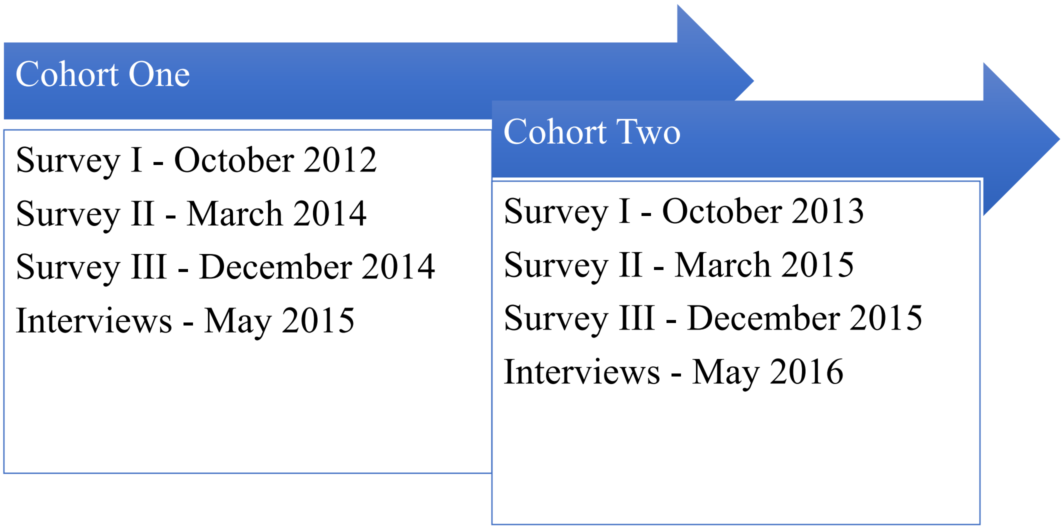


Figure 7 Timeline for each cohort & sequence of study

Methods

van Manen (1990) defined methods as "charged with methodology considerations and implications of a particular philosophical or epistemological perspective" (p. 42). Methods, as outlined by Creswell (2009) and Creswell and Clark (2007), involved "forms of data collection, analysis and interpretation that researchers proposed for their studies" (p. 15). Methods are often described by authors as "tools, and methodologies as a well-equipped tool box" (Moses & Aknutsen, 2012, p. 3). In the current work, the particular methods employed were surveys and semi-structured interviews, the specific tools used from the mixed methodological tool box. A rationale for each method used in this research is provided in the next section, and the limitations of each method acknowledged. These methods were chosen based on previous literature and on similar research in this area (Albion, 2007; Teo, 2009a, 2009b; Teo, Ching Sing, et al., 2008).

Other research methods were considered, such as non-participant observation where the "observer observes but does not participate in what is going on in the social setting" (Bryman, 2012, p. 273). This method was ruled out due to sampling, timing and geographical issues where members of each cohort would be observed while conducting a lesson, on school placement. Moreover, the logistics of one participant per day, per observation, was not feasible due to the diverse geographic locations of respondents to the survey instruments, and the school placement schedule being of a finite duration. Other methods considered included focus groups but given the smaller numbers by the time respondents had reached year three of the research, it was more expedient to invite every respondent to interview, in the final phase of the research. The details of the methods used are now outlined.

Quantitative Methods Surveys

A survey "describes a population, it counts and describes what is out there" (Flick, 2009, p. 91) and can be a useful way of collecting data within a sample. Creswell (2009) defined survey research as providing a quantitative description of trends, attitudes or opinions of a population by studying a sample of that population. Mertens (2010) construed surveys as useful for descriptive research or as a method used within other research designs, allowing for data collection from a large number of people. Yet, some literature has been critical of data collection using surveys, where this method was reliant on an individual's self-reporting of their knowledge, attitudes and behaviours, and as such, could be dependent on how honest each respondent was in their responses to the questions posed (Mertens, 2010). Despite this limitation, surveys were chosen for the current research, as a quantitative description of attitudes and opinions from the pre-service teacher cohort, was the focus of the research when it commenced in 2011.

Survey research often has the intent of generalizing from a sample to the population and this was also a rationale for utilising surveys in the current research. In this particular instance, May's (2011) definition of attitudinal surveys as "gaining data on what people think about life in general and events in particular" (p. 95), was relevant. Generally, surveys follow a particular protocol in their research, design, transmission and layout. Mertens (2010, pp. 115-135) outlined the sequential steps taken when using the survey method in any study. A sampling strategy was decided upon, and for this study a cohort analysis approach was chosen. This involved studying the same specific population, but not necessarily the same people, over a period of time, utilising different methods therein. The literature refers to this approach as a "cross sectional survey" (Mertens, 2010, p. 172) where this type of survey research compares responses to a variable (in this case attitude & use) at a particular time, with different groups (cohort 1 & 2) of participants. For the current research, each survey was administered either before or after a school placement block and as such, presented a cross-section of responses at that particular juncture in a pre-service teacher's academic year, for each cohort.

The questions used in each survey instrument followed the norms for survey research (Mertens, 1998). Questions followed a typical survey format of demographic, behavioural, attitudinal and knowledge type questions and used five-point Likert type items (Edwards & Kenney, 1946; Kundu, 1972; Likert, 1932; Roberts, Laughlin, & Wedell, 1999). Often called background information, the demographic details in the surveys focused on identification of each respondent, by using their email account. This ensured these respondents could be traced from survey to survey, and finally to interview, for the duration of the research study. Respondents were advised as to why their details were being collected as part of the initial ethical section to survey I (and then II & III) and could choose not to respond before each survey instrument. This preamble ensured students had to opt into each survey presented to them, thus negating any ethical concerns or lack of awareness by students about their details being identifiable, during the course of the study.

Once survey I was created, an introductory paragraph was used to explain what the survey was about to respondents, how it was being conducted, the involvement expected of respondents and the ability to opt out of the surveys, by those respondents. Given the plethora of online surveys sent to students, McDonald and Adam (2003) were critical that response rates to online surveys were declining, and the proportion of non-deliverable emails, increasing. Yet, May (2011) advocated the use of technology when administering surveys as "computer technology enables significant improvements over traditional paper and pencil modes, where answers from respondents are immediately stored and ready for processing" (p. 118-119). Another key advantage was that an online survey tool meant the researcher was absent, and thus not influencing the survey, as the respondent could complete it at a time and location that suited them. For the current research, the cost saving associated with administration of a survey online was substantial, due to savings in postage and packaging incurred when a paper survey would normally be distributed. Respondents in the current research were sent an email pointing them to an embedded link to each survey in their virtual learning environment. They were then reminded of where the link to those surveys were and that they could access them at a time and place convenient for them, independent of the researcher and subsequent researcher influence on their responses to those surveys.

Pilot surveys.

The pilot studies for each survey were conducted during Michaelmas term, in early October 2012. The pilot participants were third year Bachelor in Education students. An email containing a link to the surveys was sent to all third years (N=112) and they were asked to complete them, on a voluntary basis. Third years were deemed appropriate for the pilot studies as they had some experience of technology in the classroom, and the group were aware that the researchers' intentions were to pilot each survey instrument.

The researcher was especially interested if pilot participants encountered any problems or did not understand some of the devised questions, on the survey instruments. Twenty-nine students responded to the pilot surveys. As a result of the pilot study, two questions were amended in survey I. The rating item used in question 11'how frequently you use technology on a personal basis' was amended to include clarity on what each frequency level meant (e.g. very often as many times a day). Question 18 asked about technologies students might use in a classroom and one option related to online travel booking was removed based on feedback from the same participant. No amendments were made to survey II & III, and they were finalised, published and sent to students at the requisite scheduled times, during the subsequent years of the research study.

Table 1 *Research question and survey section of relevance*

Research Question One	**Research Question Two**	**Research Question Three**	**Research Question Four**	**Research Question Five**
Survey I - Section I	Survey II & III - Section II	Survey II & III - Section IV	Survey I - Section II	Survey I - Section IV
Survey I - Section II	Survey II & III - Section III		Survey II & III - Section II	
Survey I - Section III				

Semi - Structured Interviews

Survey I.

Recruitment of participants for survey I was "convenience sampling" (Teddlie & Yu, 2007, p. 77) where each cohort was deemed homogeneous and respondents had the same type of characteristics (age profile, level of education and level of experience of being in a classroom). The sample was undergraduate Bachelor in Education students, known hereafter as pre-service teachers. Table 1 demonstrates how each survey section was related to the five research questions.

Survey I was based on a review of the literature, and previous papers on this topic (Ajzen, 1991; Armitage & Conner, 2001; Egan & FitzGibbon, 2010; Egan et al., 2012; Ertmer, 2005; Teo, Chai, et al., 2008; Venkatesh & Davis, 2000). Respondents were also asked to consent to the research, and enter their college email address, so they could be tracked, for the duration of the research. The survey then used Likert (1932) type items and questions were divided into five separate areas of enquiry, namely:

(i) Section I: Demographic data for each respondent & millennial learner criteria (age profile)

(ii) Section II: Self-reported expertise levels and self-efficacy (SE) statements with levels of agreement

(iii) Section III: Personal use of technology statements (what) with frequency of use of these personal technologies

(iv) Section IV: Technology Acceptance Model (TAM) statements, levels of agreement with each TAM variable (attitude, perceived ease of use, perceived usefulness, behavioural intention, subjective norm, facilitating conditions and technological complexity).

Section I was designed to ascertain the demographic details of each cohort, their age and gender. Then this section asked whether participants were millennial learners, and at what age they were first exposed to computers in either their home or school environments (Edwards & Kenney, 1946; Kundu, 1972; Roberts et al., 1999).

Section II asked respondents about their previous experience of using technology and their self-reported confidence using technology. Statements in that section were based on the self-efficacy (SE) statements from the psychological literature (Bandura, 1994, 1997) and also included statements on computer self-efficacy (CSE) (Compeau & Higgins, 1995). For example, self-efficacy statements such as 'I can navigate the contents of a computer' and 'I can complete a job or task using technology' were used here.

Section III asked about what technology the respondents used in their personal lives. Based on previous work by the researcher, and other literature of relevance, on personal use of technology (Egan & FitzGibbon, 2010; FitzGibbon, Oldham, & Johnston, 2007; Johnston, FitzGibbon, Oldham, & Seery, 2006; Teo & Noyes, 2012; Venkatesh et al., 2003) participants were asked whether they used the various technologies listed, and how frequently. Each version of this survey had a space where students could mention other technologies they used and these were then included, in the second version used with the second cohort. For example, in a recent paper (Egan, FitzGibbon, Oldham, et al., 2013) students referenced 'Viber' and 'Instagram' for the first time, and these technologies were then added to the list of technologies, at the next iteration of survey I administered to cohort two. Actual professional use of technology was not measured in survey I as students had no experience of being in a classroom at that stage of their undergraduate degree (year one).

Section IV was based on instruments well established in the literature and included statements from the Combined-TAM-TPB (C-TAM-TPB) model (Pynoo et al., 2012) to measure pre-service teachers' attitudes to technology. Statements in this C-TAM-TPB instrument were based on previous psychological literature, such as the Theories of Reasoned Action (TRA) and Planned Behaviour (TPB) (Ajzen, 2012;

Armitage & Conner, 2001; Bagozzi, 1986) and the Technology Acceptance Model (TAM) (Davis, 1989; Teo et al., 2007; Venkatesh & Davis, 2000). This section asked about respondents' levels of agreement to statements (from strongly disagree to strongly agree) about perceived ease of use of technology (PEU), perceived usefulness of technology (PU), behavioural intention (BI), subjective norms (SN), facilitating conditions (FC), technological complexity (TC) and attitude (A). For example, statements such as, 'I like using computers', 'learning on computers in fun' and 'it was easy for me to become skilful using technology' were used here. A full version of survey I is available in Appendix One Survey.

Surveys II & III.

Surveys II and III were delivered to the students subsequent to their school placement block in each academic year, commencing in the second year of their Bachelor in Education degree. These surveys were designed to collect data in relation to professional use of technology whilst on school placement.

These surveys were shorter than survey I, as they were focused on a singular topic, namely professional use of technology, and barriers experienced to using professional technologies while on school placement. These surveys again used Likert type items. Survey II and survey III had identical questions, to ensure each respondent reported professional use of technology after each instance of school placement. This also ensured a consistent approach to data collection, where students expected a survey about their use of technology on their completion of each school placement block.

Surveys II and III consisted of items drawn from recent work on professional use of technology by teachers (EU Commission, 2013; Davis, 1989; Davis, Preston, & Sahin, 2009; Ertmer, 1999; Frank, 2002; Kopcha, 2012; Prestridge, 2012; Teo & Noyes, 2012; Weber et al., 2004). The details of each section are outlined below:

- Section I: identifiers for each participant to link the data in this survey to data from previous surveys, administered as part of the larger study (survey I)
- Section II: professional use of technology: frequency of use of relevant technologies, using five-point Likert type items ranging from very often (many times a day) to never. An option for 'technology not available in the classroom' was also provided. Examples of such technologies included interactive White Board (IWB), PowerPoint and tablet devices. The full list of technologies presented to respondents can be viewed in the survey instrument (Appendix Two Survey II & III).
- Section III: professional use of technology teaching approaches: frequency of use of technology and teaching approaches therein, using five-point Likert type items ranging from very often (many times a day) to never. Statements such as 'looked for material online' and 'prepared exercises and tasks for students' were presented here. A 'technology not available in the classroom' option was also provided.
- Section IV: barriers (first and second level) that impacted on use of technology during school placement statements: levels of agreement using five-point Likert type items ranging from strongly agree to strongly disagree. Statements such as 'the school did not expect me to use technology', 'there was a lack of technical support in the school' and 'nothing prevented me using technology' were used.

Given the mixed methods sequential explanatory design used in the research, the results of the survey data were then used to inform the questions asked at interview, which are detailed shortly.

Quality & Reliability of Survey Instruments

Reliability refers to the consistency of the measurement instrument used (Heyes, Hardy, Humphreys, & Rookes, 1993) and a valid measurement tool is one that "genuinely measures the underlying construct" (Hinton, 2001, p. 301). The survey instruments used in the current research were based on literature in the area, and the validity and reliability of these instruments have been well documented in that literature (Davis, 1989; Davis et al., 2009; Teo & Noyes, 2011, 2012; Venkatesh & Davis, 2000) especially the sections relating to TAM, TPB & TRA. However, the literature recommended each survey instrument be tested again for reliability and consistency, before other general statistical analysis was conducted on any data set, and this was done to affirm the validity and reliability of the survey instruments (I, II & III) for the current research.

The reliability of the survey instruments was measured using the Cronbach alpha score. "Reliability is concerned with the ability of an instrument to measure consistently" (Tavakol & Dennick, 2011, p. 53). For example, TAM statements posed in survey I that measured a student's score for attitude (et. seq.), were checked for internal consistency. Internal consistency meant "the extent to which all the items in a test measure the same concept and hence it is connected to the inter-relatedness of the items within the test" (Tavakol & Dennick, 2011, p. 54). The number for alpha was expressed mathematically as a number between zero and one. As such, an alpha score of 0.7 or greater indicated a reliable inter-item correlation (Tavakol & Dennick, 2011) and was the value adopted for the current research, and the norm appropriate for social science research.

Survey Data

This section outlines the various statistical tests that were conducted on the survey data gathered. The survey instruments used were statistically analysed based on a positivistic analytical approach. Various standardised statistical tests were conducted on the data in all three surveys, and each test used is now further described and the justification for its use demonstrated. The differences between nominal, ordinal and interval data were key considerations before any statistical tests were performed on the data sets and given the on-going debate in the literature about rating scales (Hinton, 2001; Wilson & MacLean, 2011), an outline of how each survey section was treated in the current research is appropriate.

Nominal data.

Nominal data was defined as data that showed "the frequency of occurrence of instances of the categories being measured" (Heyes et al., 1993, p. 28). Other authors described it as data "that are merely labels" (Gray & Kinnear, 2012, p. 3) or that it can be "meaningless to calculate statistics on these numbers as they are only nominal, used as names" (Hinton, 2001, p. 21). This nominal data represented categories such as gender, age, nationality, class group or otherwise, where any other number would have equally represented the nominal data.

In the current research, survey I, section one asked for demographic details of the respondents to the study. This nominal data included questions about gender and age. As such, non-parametric statistical tests were suitable to analyse this data, where frequency counts, mode and median scores were more appropriate tests conducted on the data set (Hinton, 2001; Wilson & MacLean, 2011). For example, to say the mean score for age profiles of the respondents was 19.5 years old did not tell us the most frequently occurring age of respondents where a mode score would have been more demonstrative, of the data set.

Ordinal data.

Ordinal data does not assume any underlying normal distribution, it is merely a way of participants measuring the perceived order of data but does not attribute any inherent value to the differences between the ordinal categories (Stevens, 1946). Ordinal data is described as ordering type data, where a "rank only has meaning in relation to the other data in the set" (Gray & Kinnear, 2012, p. 261). In social sciences, the most frequent use of ordinal data was in Likert (1932) type items, where respondents were asked to rank their levels of agreement to various statements posited. For example, a 'strongly agree' may rank higher for one respondent than 'agree' for another but was dependent on the respondent's perception of the difference between these two categories. Thus, it was difficult to measure and is therefore not an independent measure of difference (Bryman, 2012) where "ordinal variables whose categories can be rank ordered but the distances between the categories are not equal across the range" (p. 336). For example, participants were asked to self-rate their use of technology in survey I section two. The expertise levels presented were very poor experts, poor experts, somewhat good experts, good experts and very good experts, echoing Brandtzæg's (2010) earlier stratification of types of computer expertise levels. A respondent's interpretation of their own ability to use technology was thus ordinal data. Similarly, survey I section four used ordinal data to collect respondents' levels of agreement with statements about their self-efficacy and with the TAM variables presented. Survey I section three collected ordinal data on respondent's frequency of use of personal technologies. Survey II section two collected ordinal data on respondent's frequency of use of professional technologies. Survey II sections three and four collected ordinal data measuring respondents' levels of agreement to statements about how they used professional technologies in the classroom, and barriers they perceived as impacting on their usage of those technologies. The results of these particular survey sections are presented in chapter five.

Review of statistical tests for each research question.

The following table (Table 2) demonstrates the various statistical tests conducted on the data sets for each cohort, each survey instrument and each section therein.

Table 2 *Statistical analyses conducted on data*

	Survey & Section	Nominal Data	Ordinal Data
Research Question One - Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the 'net generation' or 'millennial learners'?	Survey I - Section I, Survey I - Section II Survey I - Section III	***Gender & Age*** - Chi-square, Cronbach alpha, frequency count, mean, standard deviation	***Personal Technologies used – non-normal distribution -*** Frequency count, mode, median, cross tabulations & chi-square, rank order correlation, Spearman's rho & t-tests.
Research Question Two - What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes?	Survey II & III - Section II Survey II & III - Section III		***Professional Technologies used – non-normal distribution*** - Frequency count, mode, median, cross tabulations & chi-square, rank order correlation, Spearman's rho & t-tests.
Research Question Three - What barriers, if any, do pre-service teachers perceive as impacting on their use of technology in the classroom?	Survey II & III - Section IV	***Normal distribution of data?*** Chi-square, standard deviation - Cronbach alpha, frequency counts, mean, factor analysis, Pearson's product moment correlations *r*, & paired sample t-tests	
Research Question Four - Does pre-service teacher's technological self-efficacy correlate positively with their use of technology while on school placement?	Survey I - Section II Survey II & III - Section II	***Normal distribution of data?*** Chi-square, standard deviation - Cronbach alpha, frequency counts, mean, factor analysis, Pearson's product moment correlations *r*, & paired sample t-tests	
Research Question Five - Do pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM variables (FC& SN), act as a positive predictor of their use of technology while on school placement?	Survey I - Section IV	***Normal distribution of data?*** Chi-square, standard deviation - Cronbach alpha, frequency counts, mean, factor analysis, Pearson's product moment correlations *r*, & paired sample t-tests	

Interval data.

Interval data is described as measuring data (Heyes et al., 1993) where the units of measurement are based a standardised measurement, where each unit of measurement has an agreed value, for example weight, time and temperature. As such, use of the word scale in the current research to measure levels of agreement to items on a survey instrument was problematic, where data may not be treated as continuous at the item level. Social scientists have argued that asking participants to rate something and then treating the result as a scale item was a concern, as ratings could be open to interpretation by respondents. They suggested that a "decision on how ratings should be treated depends upon several considerations, including the statistical properties of the data and the number of points on the rating scale" (Gray & Kinnear, 2012, p. 3).

In the current research, surveys I, II & III had asked participants to rate their levels of agreement with statements in sections therein. Preliminary investigation of responses to these items would calculate the mean and standard deviation figures, and check if the results followed a normal distribution (Hinton, 2001; Wilson & MacLean, 2011). If, based on the results of this preliminary analysis, the data was normally distributed, then parametric statistical tests could follow. However, if the results of the preliminary mean and standard deviation calculations for these scale items were not normally distributed, then non-parametric statistical analysis of the data was required. Thus, an overview of parametric and non-parametric statistical analyses and how these types of analyses applied to the current study was required.

Tests for normality.

As the data collected was both ordinal and nominal in nature, tests for normality of the data sets were conducted on the Likert type items and frequency count items to see if the data was normally distributed, and if they could then be subject to parametric or non-parametric statistical tests, as a result. (Ghasemi & Zahediasl, 2012). The frequency count data and the Likert-style items were checked for a normal distribution using the Shapiro-Wilk test in SPSS, as this test was more suitable for smaller sample sizes (less than 100 participants) (Ghasemi & Zahediasl, 2012; Heyes et al., 1993; Hinton, 2001; Peers, 1996). The Shapiro-Wilk test statistic checked for normality of the data where if the significance value of this statistic was greater than $p<0.05$, the data was normally distributed. Another method for testing the data for normality was to create histogram charts of the datasets and see if they conformed visually to a normal distribution. However, outlier data can be difficult to identify using this visual method alone, so a better visual method was to plot the expected values of the data against the actual observed values in a Q-Q plot (a quartile to quartile plot) where the observed values should be very close, or on, the diagonal line, created in SPSS. If the data was normally distributed then the observed data points would not stray from this diagonal line (Wilson & MacLean, 2011). An example of a Q-Q plot demonstrates this – where here the observed and expected values of a 'barrier' statement was plotted on an x and y axis (Figure 8), and the line of best fit was diagonal and all data points were close to, or on, this diagonal line, hence the data was normally distributed. The full results of these tests of normality are presented in chapters four and five, in relation to each research question.

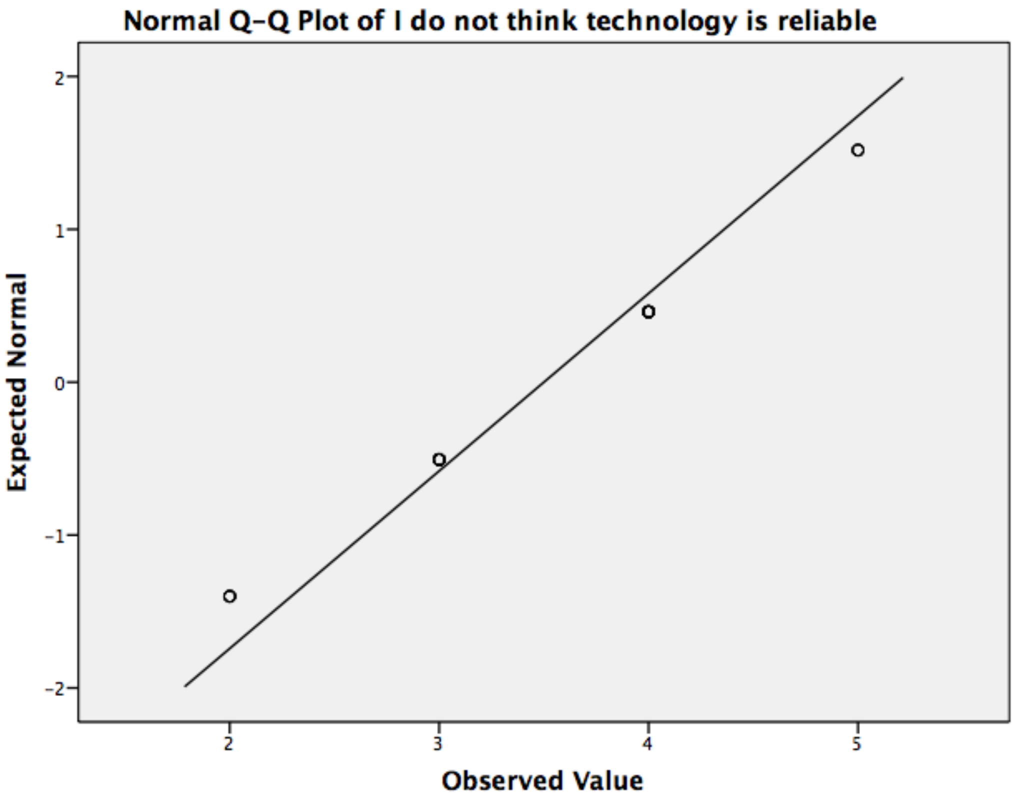


Figure 8 Sample of the observed and expected values Q-Q plot

Chi – square tests.

The chi-square test was also a suitable measure of validity and goodness of fit, where it was common to check "whether there is a particular bias in a choice of items where if there was no bias, each item would be chosen an equal number of times" (Heyes et al., 1993, pp. 58-60). This test was used to examine whether a pattern of frequencies significantly differs from the expected pattern of frequencies, so it could be used to decide if a set of observed frequencies were a good fit for a particular pattern of expected frequencies (Hinton, 2001, pp. 250 - 251). In the current work this test was used for nominal data in each survey instrument, to check whether items that measured the same variable (for example age profile of pre-service teacher respondents in survey I) were chosen equally. It was also used for ordinal data to check if any frequency counts were outside the expected frequency counts for those variables, such as barrier statements, frequency of personal and professional technologies statements and teaching approaches statements, presented to participants in surveys I, II and III.

Non-Parametric Analysis

Non-parametric statistical analysis makes no assumptions about the interval scale of measurement used by participants, nor does this type of analysis presume any underlying normal distribution of response patterns (Hinton, 2001). However, debate in the literature had centred on the results of non-parametric analysis, where "for five point Likert items, the t-test and Mann-Whitney-Wilcoxin (test) generally have similar power…except for skewed, peaked or multimodal distributions" (deWinter & Dodou, 2010, pp. 1- 16). As such, non-parametric Mann-Whitney-Wilcoxin tests were said to produce the same types of results as parametric t-tests where,

> the choice between the two analyses is a tie, if you need to compare two groups of five-point Likert data, it usually doesn't matter which analysis you use…both tests almost always provide the same protection against false negatives and always provide the same protection against false positives (Frost, 2016).

In the current research, t-tests were conducted on the survey data sets to check for any significant differences in the results. However, as some of the data had a skewed distribution (for example the frequency counts of personal items where items listed were an alternative, rather than in order of preference, and could not be treated as a scale item, per se) other non-parametric tests had to be considered. An outline of the non-parametric statistical tests used on the ordinal data collected is now described.

Descriptive statistics.

Frequency counts, mode and median scores were calculated using SPSS, for ordinal data collected, in each survey instrument. The mode and median scores were measures of a central tendency where "the median is said to be a resistant statistic because the size of the median is unaffected by extreme values in the distribution" (Balnaves & Caputi, 2001,

p. 144). The mode was defined as the "value that occurs most frequently" (Bryman, 2012, p. 713). Hence, frequency counts, mode and median scores are reported for levels of agreement to ordinal items presented to respondents in survey I, II and III, in chapter four.

Spearman rank order correlation.

Non-parametric statistical analysis, on results from the survey instruments, concentrated on cross tabulation of responses to survey items listed and this "displays the distribution of one variable for each category of another variable" (Schutt, 2009, p. 514). Gilbert (2008) described cross-tabulation "as a way of looking at the relationships between items, usually in order to explain differences on one item in terms of differences on the other" (p. 359). This type of analysis constructed cross-tabulations between participants' scores for items such as expertise and then matched that with dependent variable items such as uses of professional technology and frequency counts therein, in survey II & III.

These cross-tabulation matrices were then used to measure whether a relationship existed between two sets of variables in a data set. The matrices were "generated so that patterns of association can be searched for" (Bryman, 2001, p. 341). Measurement of the relationship between these variables, in non-parametric data sets, does not assume any standard distribution and Spearman's rho (Greek letter ρ) coefficient was the calculation used. Spearman's rho is the "non-parametric correlation coefficient, designed for the use of pairs of ordinal variables, where the strength of the relationship (if any) is calculated between -1 and +1, for these variables" (Bryman, 2001, p. 344). As such, Spearman's rho measures the strength and direction of the association between ordinal variables, if any. In the current study, Spearman rho calculations were conducted on research questions one and two for personal and professional technologies used by members of each cohort and are reported in chapter four. The results of the Spearman rho calculations were then checked for significance, where "a test of statistical significance allows the analyst to estimate how confident they can be that the results deriving from the study are generalizable to the population from which the sample was drawn" (Bryman, 2001, p. 347), the results of which are, again, reported in chapter four.

Parametric Analyses

Parametric analyses were conducted on nominal data that followed the normal distribution of expected values for responses to the survey instruments. For example, responses to barriers to using technology in the classroom followed a normal distribution, and therefore item means, factor analysis and Pearson product moment correlation coefficients were calculated for these items. An outline of how each of these parametric tests was conducted is now described.

Descriptive statistics.

Statistical tests conducted on nominal data collected during the research included descriptive statistics such as frequency counts, mean scores and standard deviation calculations. For the nominal data, the mean response scores for each item were calculated, and then the standard deviation was used to check for any outlier scores in the data gathered at survey I and whether these responses were normally distributed. Hinton (2001, p. 13) had advocated the use of a mean score where "if we take the mean as our central position, then we can compare each of the scores with the mean and find out how far each score varies or deviates from it" (p. 13). An example of nominal data included respondents' age and gender items, in survey I, and the results are reported in chapter four.

Pearson's product moment coefficient correlational analysis.

Further analysis, similar to the non-parametric correlation matrix referred to earlier, calculated the Pearson product correlation coefficient on the parametric data from the survey instruments. The Pearson product correlation *r* coefficient demonstrated the strength of the relationship between variables, where a score between -1 and +1 was calculated (Gray & Kinnear, 2012; Hinton, 2001; Wilson & MacLean, 2011). This correlation matrix was essentially each score from each variable, arranged in rectangular form and checked visually for any correlation scores of significance, therein.

For example, in the current research, cohort ones' responses to survey I TAM variables were checked for similarity to cohort twos' responses for the same variables. A distinct lack of difference between the responses given by each cohort, to each survey, was noted in the research and this preliminary investigation then warranted further investigation. The results of the correlational analysis conducted, for each research question, as applicable, are reviewed in chapter five shortly.

T-tests.

T-test statistical calculations were used to examine if there were any significant differences in the answering patterns to each of the research questions posed, by members of each cohort. They were used to calculate the probability that the difference between the two conditions (for example, use of technology) was significant, by calculating the amount of difference between the two mean scores (for each cohort), and taking into account the variations in scores in the two conditions (for example, school placement blocks, in each academic year). Paired t-tests were used as responses for these data sets could be traced back to individual respondents, in each cohort (Hinton, 2001, p. 91), where any such significant statistical differences could be calculated.

Factor analysis.

Subsequent statistical analysis on the parametric data focused on factor analysis. This was conducted to establish if the relationships between items in a dataset could be reduced to a set of underlying or latent factors. "Factor analysis is essentially a data reduction technique as it is used to see whether there is a set of factors that can explain the variation of the variables under study" (Hinton, 2001, pp. 304 - 306).

There were a number of criteria that were considered before factor analysis was undertaken on the datasets – and the main consideration was whether the data set was a suitable size for factor analysis. Further, exploratory factor analysis was conducted to confirm the quality of the survey instruments used. The Kaiser-Meyer-Olkin (KMO) calculation examined the data sample for adequacy to perform factor analysis, and a score over 0.5 was deemed acceptable in the literature (Gray & Kinnear, 2012; Wilson & MacLean, 2011), where this KMO adequacy test was conducted in SPSS. Once the data set had passed this sample adequacy test, exploratory factor analysis and confirmatory factor analysis was then performed on the data sets. Cohort two (n = 102) was a larger sample than cohort one (n = 88) and as factor analysis was sensitive to sample adequacy, the KMO test was conducted on cohort two.

Cohort two respondents were divided randomly (using a random sampling function in SPSS) into two sub-groups. For the first sub-group, exploratory factor analysis was used to check variables within section IV of survey I, for their validity. Within this TAM section (Section IV) there were 40 statements, of these 40 statements, when exploratory factor analysis was conducted, 11 latent factors were established. The results indicated that four factors (behavioural intention, perceived ease of use, perceived usefulness and attitude) were above the required KMO level of 0.6. The other five latent factors (subjective norm, facilitating conditions, technological complexity & computer self-efficacy) were present but with a lower KMO score (Davis, 1989; Pynoo et al., 2012; Teo, 2009b, 2011; Teo, Ching Sing, et al., 2008; Venkatesh & Davis, 2000). To confirm these four latent factors existed for both samples, confirmatory factor analysis was conducted on the second sub-sample. A full report of the exploratory factor analysis

(EFA) and confirmatory factor analysis (CFA) conducted on survey I is discussed in chapter five, for each of the TAM variables.

The consequence of factor analysis, in this study, was that the survey instruments used were shown to be valid measurement tools. However, a limitation of the factor analysis conducted was that the sample size of each cohort was quite small, and while the KMO score had allowed for factor analysis, any expansion of the survey instruments to larger cohorts would need to be checked for internal validity first.

Qualitative Methods

Qualitative data was gathered during the course of the research study, as outlined in Figure 6 earlier. Due to the pragmatic theoretical paradigm employed, using a mixed methodological framework, interviews were conducted to expand on the positivistic data collected during the first data collection phase (surveys) with members of each cohort.

> An insistence that any research worth its salt should follow a purely quantitative logic would simply rule out the study of many interesting phenomena relating to what people actually do in their day-to-day lives (Silverman, 2013, p. 11).

Typical qualitative data collection has a list of common attributes, as defined by Creswell (2009), where this type of research should be conducted in a natural setting and the researcher is the key instrument in data analysis. Furthermore, analysis should be inductive where patterns, categories and themes emerge from the data ensuring that participants' meanings are a key characteristic of the analysis process. To ensure this, the researcher should focus on the meaning a participant holds about a problem, rather than their own inherent bias. In essence, this type of research is interpretive, where the researcher makes an interpretation of what they see, hear and understand in the data (pp. 175–176). In the current study the qualitative method chosen was interviews where participants were asked about their views on the nature of their technology use, and could discuss their experiences of this, in detail, with the researcher. The nature of the interview method chosen, how the interview questions were devised, steps taken to negate researcher bias and an overview of the analysis methods conducted, during the study, are now discussed.

Semi – Structured Interviews

There are typically four different types of interview; structured, semi-structured, focused interview and a focus group (Denzin & Lincoln, 2008). Using interviews in social research meant the researcher had to,

> maintain and generate conversation with people on a specific topic or range of topics, and the interpretations social researchers make of the resultant data constitute the fundamentals of interviews (May, 2011, p. 131).

As such, semi-structured interviews were chosen as a method due to lack of explicit responses about use of technology from survey participants, and to understand what this use of technology meant to those participants, following initial analysis of the three survey instruments administered to each cohort, as part of the sequential explanatory design of the research.

In a semi-structured interview format, the interviewer is freer to probe beyond the answers in a manner which might appear prejudicial to the aims of standardisation and comparability (May, 2011, p. 134). Moreover, Rubin and Rubin (2012, p. 29) advocate the use of a semi-structured approach, which is carried out in a responsive interviewing style. This was appropriate in the current research as the researcher had a specific focus and had prepared a limited number of questions in advance of the interview. The use of probes and prompts was then required to further encourage the interviewees to expand on their responses to the preliminary questions. This probing ensured a fuller response, rather than a fully structured interview asking a list of questions, and not exploring further explanations of these responses, as advocated by the literature (Cronin, 2008; Denzin & Lincoln, 2008; Gilbert, 2008; Mertens, 1998, 2010; Mertens & Ginsberg, 2009). Hence, this semi-structured approach sought to encourage the interviewee to answer at length and in detail about the topic under discussion, their use of technology. For any type of interview, Kvale and Brinkmann (2009) outlined the seven stages of conducting a semi-structured interview and suggested the following approach:

(i) thematising the interview project

(ii) designing

(iii) interviewing

(iv) transcribing

(v) analysing

(vi)verifying

(vii) reporting (p. 102).

For the purposes of this study, this proved a favourable framework and ensured a structure to the interview process, which was well established in the literature.

However, criticism of face to face interviews in the literature is focused on the presence of the researcher in the room, where this may influence the types of responses participants give, during the interview process (Creswell, 2009). Equally, an interviewee may not be particularly articulate, or receptive to the interview questions, and responses may be short, and not reflective of their actual experiences using technology. As such, Corbin and Strauss (2015) were critical that in a semi-structured interview "sometimes participants have something important they might want to add but because the researchers didn't ask about it, the participants didn't think researchers were interested in that topic" (p. 39). In the current research, participants had time at the end of the interview, to follow up any area they felt may not have been covered adequately, or if there was anything they needed to add to their responses, or otherwise, before the interview ended. This sought to negate the problems associated with a non-receptive interview participant, in the current study.

Researcher as insider.

Mullings (1999) queried the role of the researcher as insider or outsider in her article on techniques for conducting qualitative research. Concerned with the power relationship implicit and present in any researcher and researchee relationship, Mullings was clear that any researcher's role was never impartial. A researcher's race, class, gender, nationality, economic factors and other identifiers always affected their biases, and she commented these "will influence how the world is viewed and interpreted" (p. 337). This concept of researcher as insider was relevant in the current research.

To negate any demand characteristics (Weber & Cook, 1972) such as "good, negative, faithful or apprehensive participant roles" felt by the students in the current work, the researcher assured the participants that participation in the research would not have any impact on their grades. Equally, the researcher ensured there was minimal contact between herself and the research participants and outlined the voluntary nature of the study in a clear and concise manner to the students, from the outset (Kimmel, Smith, & Klein, 2011; Lichtman, 2010; Morawski, 2005; Orne, 2002). On the topic of demand characteristics and 'good subject effect' Nichols and Maner (2008) suggested that common concerns relating to participants changing their behaviour to suit the expectations of the researcher, could be negated by ensuring "every effort is made to maintain the confidentiality of the study" (p. 162) and this was best done during the informed consent process, before the study begins, and during the study by "reducing one on one contact with an experimenter" (p. 163).

In the current work the researcher was not a member of the academic teaching staff, but rather worked in an administrative support function, in the institution. The researcher had no teaching contact with the Bachelor in Education students during their time in college. During the research study, the only contact the researcher had with participants was at the interview data collection phase. The researcher used a variety of techniques to negate demand characteristics at the data analysis stage, such as getting other colleagues from the CRITE research group to analyse early data, and by ensuring participants were assured of the anonymity of the research, at all stages of data collection, as previously outlined.

Ethics & informed consent.

Interview participants were advised of the nature of the interview and the objective of the research study at the outset. As noted by Miles, Huberman & Saldaña (2015), participants should be aware of the proposed duration of the interview, that their comments would be confidential and that their anonymity would be assured throughout the research process. To ensure this, each interview participant had to provide further written consent to partake in the interview phase of the research and were advised of the likely duration of the interview; where their data would be held, for how long, and that they could review the transcripts when available. Furthermore, interview participants confirmed their consent verbally and in writing again, by signing a consent form, before the interview commenced.

> Securing a participant's permission is not a single hurdle to be jumped; dialogue and ongoing renegotiation are needed throughout the study (Miles, Huberman & Saldaña, 2015, p. 60).

Once participants had consented to the process, the interview phase of the research commenced.

Semi-Structured Interview Protocol

The interview schedule was mapped to the research questions outlined at the beginning of this chapter (Research Questions). Cronin (2008, p. 200) suggested the same interview guidelines are used for each and every interview, and there must be an explicit protocol for conducting the interview. In the current research, the interviewer made sure to introduce herself, explain the purpose of the interview and outlined the expected types of questions and duration, similar to the advice given by Gilbert where,

> during the course of the interview the researcher is advised to use open questioning in order to gain spontaneous information, rather than rehearsed positions and questioning techniques should encourage respondents to communicate underlying attitudes, beliefs and values, rather than glib or easy answers (Gilbert, 2008, p. 249).

The interview protocol guide contained a heading, outlining where and when the interview was conducted; instructions for the interviewer, so that these could be replicated by another researcher in the future, and then the interview commenced with an ice-breaker question, to ensure the interviewee was made comfortable, and was aware of the objectives of the interview (Creswell, 2009). Once the initial protocol had been established the introductory phase of the semi-structured interviews, in this research, commenced.

The introductory phase of the interview probed participants' personal uses of technology and reminded participants of their previous self-reported user type (survey I data) and asked if these expertise levels still applied, three years later. It also asked what technologies participants had available at home, and probed participants' thoughts on whether it had influenced their technology use during college.

The second section of the interview schedule moved into particulars about what technologies participants had used while on school placement, what type of lessons they had taught using technology and how participants had used technology specifically in the classroom; thereby addressing the second research question. This section also probed responses to the fourth research question, about participant's own self-efficacy using technology, while on school placement. This data was then matched with quantitative self-efficacy responses obtained in surveys II & III.

The third section of the interview explored participants' attitudes to technology, whether participants' attitudes differed when using technology on a personal rather than professional basis, and what participants would describe as effective use of technology in a classroom. This section sought to answer the fifth research question querying whether participants' TAM responses would act as a positive predictor of their use of technology on school placement. The responses from this fifth section were then matched to the TAM statement responses, from these participants, in survey I, and the interviewees' uses of technologies in surveys II & III.

The interview then moved into a section on other factors and influences to use technology in the school placement classroom. Designed to respond to the third research question that queried the barriers experienced by pre-service teachers that impacted on their use of technology in the classroom (Ertmer, 1999; Ertmer et al., 2012), the interview questions further probed the presence of barriers to using technology in a school placement classroom.

Finally, the interview opened a discussion with respondents about their perceived models of good practice when using technology in the classroom and explored whether they had seen models of good practice, if any, during their time in a classroom. The interview questions were designed to further probe other influences to use technology, and any other barriers that impeded participants' use of technology. All interview questions and samples of the interview transcripts are available at Appendix Three Interview Questions.

Pilot interviews.

Pilot interviews were conducted with two third year students. These interviewees were chosen based on their non-participation in the main research project but were deemed appropriate as they were Bachelor in Education degree students and they had just completed two sets of school placement blocks. As such, they were in a similar position of experience using technology, to the research participants.

During the pilot interviews both participants were advised of the nature of the research and that the interview would be recorded. Equally, it gave the researcher an opportunity to test the audio recording equipment and microphones in the interview room. Participants were asked for their feedback on the nature of the questions, whether any interview questions were unclear and their opinion of the duration of the interview. Both pilot interviews lasted just under forty minutes, and both participants felt the duration of the interview was appropriate.

As a result of the pilot interviews, the researcher amended the wording of one question where participants found 'define what you think is good use of technology' specific and suggested the wording 'describe what you think good use of technology is' as easier to comprehend. Equally, the researcher found the experience of piloting the interview questions meant she could practise maintaining silence while an interviewee responded and how the use of non-verbal cues and prompts allowed the interviewees to elaborate on points without interruption. Furthermore, at the outset of both pilot interviews, the researcher discovered that she had not introduced either participant; this was amended in time for the actual interviews.

Sample Selection

A stratified purposeful sampling strategy was then used to identify potential participants for the semi-structured interviews (Creswell, 2009), from the survey data, in phase two of the research. Based on data emergent in survey I, II & III for each cohort, user typologies were identified (Brandtzæg, 2010). These five user typologies were very poor experts (VPE), poor experts (PE), somewhat good experts (SGE), good experts (GE) and very good experts (VGE). For each cohort, members of each expertise sub-group were then approached by email and invited to attend interviews with the researcher. In cohort one, all participants to survey III were emailed (n = 54) and eight agreed to be interviewed. In cohort two, all participants to survey III (n = 37) were emailed, and six participants agreed to the interview phase of the study. As none of the survey respondents, in either cohort, had rated themselves as very poor experts of technology, there were four levels of expertise type invited to interview.

Interview Transcripts

Each semi-structured interview was recorded, using a USB microphone connected to a computer, utilising Audacity (free sound recording software). Back-up recordings were also made using an mp3 digital voice recorder, at the same time, in case of any technical issues during the interview process. Recordings are used in qualitative research as "we cannot rely on our recollections of conversations alone" (Silverman, 2013, p. 253).

Interviews were then transcribed verbatim, as "verbatim transcription offers the advantage that all possible analytic uses are allowed for" (Mertens, 1998, p. 257). The researcher used an online transcription application (O Transcribe) to slow down the audio recordings to 25% of their regular speed, without speech distortion. This meant the researcher could type the content of the interviews directly into word processing software, while listening to them. The act of transcription was also part of the research process as this "involve [d] close, repeated listening to recordings which often reveal[ed] previously un-noted recurring features" (Silverman, 2015, p. 254). In the current research, these interview transcripts were then reviewed and further edited, while listening to the audio files to ensure comprehension and accuracy of the data therein. These transcripts were imported into nVivo (a software package) to commence initial first level coding.

Thematic Analysis

One of the main issues with qualitative research is that very few standardised instruments of data analysis exist. In this study, thematic analysis was used to analyse the interview data collected (Braun & Clarke, 2006). The general feature of thematic analysis (TA) is that it "provides a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data" (p. 78). Braun and Clarke (2006) argued thematic analysis should be "considered a method in its own right" (p. 78) as it provided a way of identifying, analysing and reporting themes in a set of data, and gave a definite structure as to how the thematic analysis should be completed.

The six phases of thematic analysis, suggested by Braun and Clarke (2006), were (i) familiarisation with the data, (ii) coding (initial), (iii) searching for themes, (iv) reviewing themes, (v) defining & naming themes and finally (vi) writing up (Braun & Clarke, 2006, p. 87). Lichtman (2006) had acknowledged debate in the methodology literature on how coding was completed where some authors had suggested a top down approach (influenced by literature on the topic being studied) and others, a bottom up approach (where codes are created without trying to fit into a pre-existing coding frame). Top down coding or theoretical, deductive coding was described as "driven by the researcher's theoretical or analytic interest in the area, and thus more explicitly analyst-driven" (Braun & Clarke, 2006, p. 84). Of note however, was Creswell's (2009) contention that data analysis be conducted in a non-linear fashion, where "I see it as more interactive in practice; the various stages are interrelated and not always visited in order" (p. 185).

In the current work, areas of interest to the author were researched a priori during the review of the literature, and whether these themes were prevalent in the interview data set, was then explored. For example, barriers that impacted on use of technology as a theme emerged from the literature and were then explored as a topic with interview participants. The nature of the coding process undertaken is now discussed.

Coding process.

> The art of analysis requires knowing what ideas to pursue, how far to develop and idea, when to let go, and how to keep a balance between conceptualization and description (Corbin & Strauss, 2015, p. 65).

In the current research, the objective of the initial phase of analysis was to condense the transcription data into manageable categories, that could then be further analysed using a thematic analytical approach. When doing research, interaction with data takes place, where a "dialogue is occurring in the mind of the researcher" (Corbin & Strauss, 2015, p. 107). Memoranda (memos) about that thought process, reminded the researcher of concepts that were emerging from the data, and any ideas or concepts that were evident in the interview transcripts. Rules for inclusion for each node were also defined and noted in nVivo. This ensured only items of data that conformed to these rules were included in that data set. Figure 9 demonstrates where the rules for inclusion were located, in the software used.

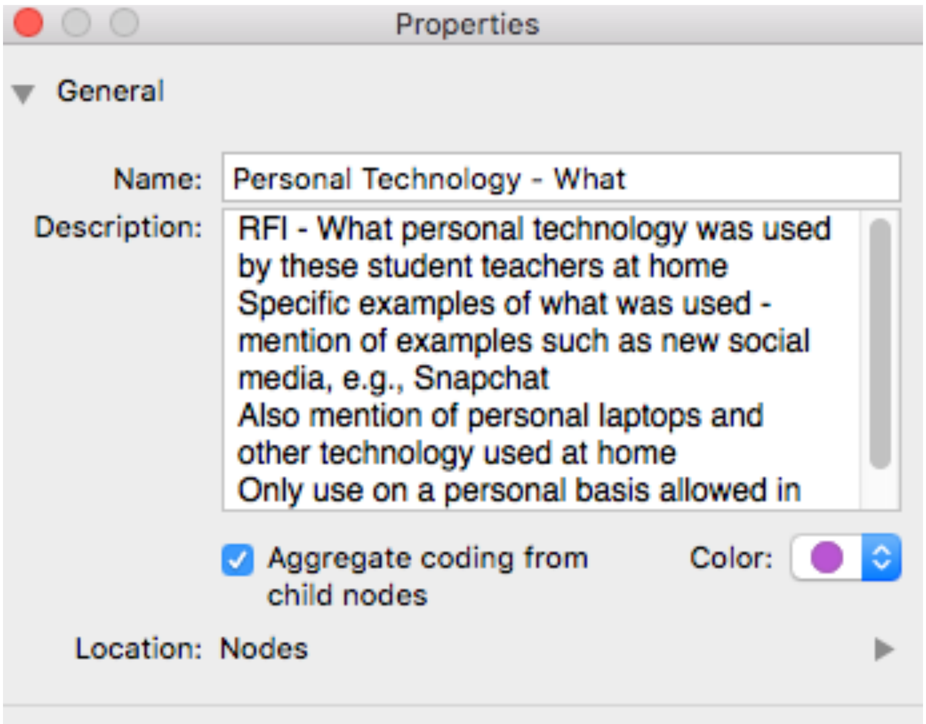


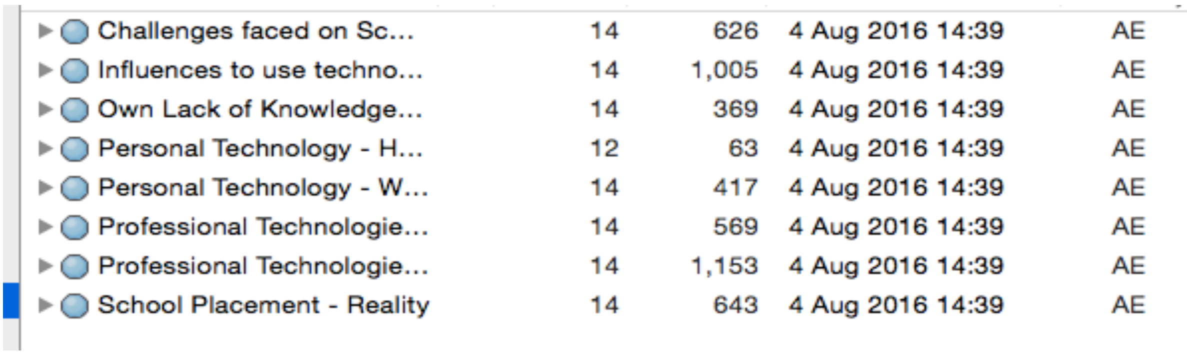
Figure 9 Sample of a rule for inclusion on personal technology code

A bottom up coding approach had also been suggested by other authors (Mertens, 1998; Silverman, 2010, 2013), and was employed in this research to deal with phrases and themes used by participants, on first cycle analysis of the interview transcripts. This focus on the words of the participants is also known as "in-vivo coding" (Saldaña, 2011, 2013). In-vivo coding was used with the selected qualitative data analysis software (nVivo) and ensured codes were created from actual words and phrases used by participants in the interviews. This was especially evident in the emotive words used by participants to describe their experiences using technology while on school placement, in the current research.

The approach taken by the researcher was a combination of top down and bottom up coding, where a priori codes were searched for during the (initial) coding, in conjunction with creation of new codes due to in-vivo analysis of the data. The researcher then reviewed these initial codes (named nodes in nVivo) and searched for themes evident in these codes. Thus, the initial nodes were then merged into overarching themes (tree-nodes in nVivo). Charmaz (2008) had advocated moving on to axial and focused coding during the final phase of coding. Axial coding looks to the relationship of categories to each other, and relating codes to each other (Charmaz, 2008). This then led to the researcher questioning what the larger story was and how these themes were related and if there were dimensions behind the categories that affected the naming of these overarching categories (Bryant & Charmaz, 2012; Charmaz, 2005, 2008). In the current work, during the axial coding phase, these coded materials were further reviewed to identify emergent patterns, themes and commonalities in nVivo (Braun & Clarke, 2006; Clarke & Braun, 2013; Lichtman, 2006; Saldaña, 2013). Figure 10 to Figure 12 demonstrate samples of the coding process conducted in nVivo.

Accessibility of Kit	6	18	15 Jul 2015 15:21	AE	18 Jul 2016 13:13	AE
Addicted	2	4	21 Jul 2015 15:43	AE	2 Aug 2016 11:53	AE
Age - Teachers	5	13	18 Jul 2015 14:34	AE	18 Jul 2016 15:50	AE
Age of supervisor	5	12	17 Jul 2015 13:42	AE	18 Jul 2016 16:08	AE
Annoying	5	9	13 Jul 2015 14:35	AE	15 Jul 2016 15:05	AE
Attendance Mgmnt	2	2	13 Jul 2016 14:53	AE	18 Jul 2016 14:56	AE
Attitudes	14	103	13 Jul 2015 14:00	AE	3 Aug 2016 10:24	AE

Figure 10 Sample of initial coding



Challenges faced on Sc...	14	626	4 Aug 2016 14:39	AE
Influences to use techno...	14	1,005	4 Aug 2016 14:39	AE
Own Lack of Knowledge...	14	369	4 Aug 2016 14:39	AE
Personal Technology - H...	12	63	4 Aug 2016 14:39	AE
Personal Technology - W...	14	417	4 Aug 2016 14:39	AE
Professional Technologie...	14	569	4 Aug 2016 14:39	AE
Professional Technologie...	14	1,153	4 Aug 2016 14:39	AE
School Placement - Reality	14	643	4 Aug 2016 14:39	AE

Figure 11 Sample of searching for themes

Confidence (self)	14	1,425	6 A
Influences to Use Techn...	14	601	6 A
Pedagogy Lacking	14	207	7 O
School Placement	14	1,065	6 A

Figure 12 Sample of reviewing themes - axial

Bias and validity.

As advised by Braun and Clarke (2006) “researchers cannot free themselves of their theoretical and epistemological commitments, and data are not coded in an epistemological vacuum” (p. 84). Often the “researcher themselves is the main instrument in the study” (Miles et al., 2014, p. 9) and as a researcher “you … serve as a filter through which information is gathered, processed and organised” (Lichtman, 2010, p. 268). Corbin & Strauss (2015) have suggested that “it is when it comes to analysis that perspectives, biases and assumptions can have their greatest impact” (p. 46).

Creswell (2009) refers to problems associated with qualitative analysis where “it is necessary to employ multiple strategies of validity to created reader confidence in the accuracy of the findings” (p. 177). One such approach, as advocated by Corbin & Strauss (2015), is to maintain a research journal. The objective of this journal was to note initial reactions to the various qualitative data collected. By writing these reactions down, they can be revisited and revised, during the analysis phase. In the current study, the researcher kept a reflective journal throughout the entire research process, and ensured initial reactions to data collected were noted, checked for signs of bias and negated, or affirmed, throughout the inductive coding process.

As a further step to negate any inherent researcher bias in analysis of the interview data, colleagues in a research group (CRITE) were asked to independently analyse cohort ones' interview transcripts. The results of this research groups' analyses created a set of codes, which were then reviewed at a group meeting with the initial codes created by the researcher, and any differences or similarities, discussed amongst members of CRITE. This group analysis approach proved extremely beneficial when looking at emergent themes in the interview transcripts and ensured inherent bias of the researcher, towards the emergent concepts from the qualitative data, were negated or affirmed, at that time.

Computer Assisted Data Analysis

As both qualitative and quantitative data was collected during the research study, various software analysis packages were utilised to aid in the data analysis process (Creswell, 2009). However, a software package, will not do the analysis for you, rather is merely a repository to keep the data in an ordered and coherent fashion (Silverman, 2010, 2013).

To analyse statistical responses to the three surveys, a statistical software analysis package SPSS (Statistical Package for the Social Sciences) was used (Gray, 2012; Ugras, 2012). The surveys were downloaded and imported into SPSS. SPSS was used to clean the data imported from each of the three surveys. Each response to a question was coded as a variable in the software, and these then had to be recoded into something other than VAR001, automatically provided by the software. For example, if a response to one of the TAM questions was coded, it became TAMPEU1, rather than VAR001 (where perceived ease of use (PEU) was one of the TAM variables).

The surveys were created in Survey Monkey (an online cloud-based survey development tool) and participants were asked to agree with statements using Likert type items ranging from very good/often to very poor/never options (Probert, 2009). Once the data was imported to SPSS, responses to the variables could be checked as to whether they made sense. For example, if someone had scored one on a scale for a particular variable, Survey Monkey had not attributed a value to this score, it had merely recorded the data. As such, when the data was imported into SPSS, it was not clear from the raw survey data if a score of one meant someone strongly agreed or strongly disagreed with that item. Thus, the data had to be reverse-coded in SPSS. The literature had advised either to recode the data so it made numerical sense or leave it alone and explain the rating scales used under any data reported – the researcher in this instance, chose to recode the data (Gray & Kinnear, 2012; Heyes et al., 1993; Hinton, 2001) so it made numerical sense and could more easily be understood by a reader, and other researchers, where a larger number indicated more agreement with the statements posed.

Once the data had been recoded and cleaned, various statistical tests were conducted on the data as outlined previously. SPSS proved extremely useful in creating charts and diagrams of statistical tests conducted on the data. However, with all computer packages, one needs to know what to ask the system before one sets about using it, and a skills gap on the whole area of statistical analysis was identified, by the researcher. As a result, the researcher attended the Certificate in Statistics run by the School of Computer Science and Statistics, Trinity College, during Michaelmas term 2014, to address that gap.

Semi-structured interview transcripts were imported into nVivo, a qualitative data analysis tool (Creswell, 2009; Corbin & Strauss, 2015; Silverman, 2013 & Miles & Huberman, 2014). This computer package also proved to be a very useful tool, when approaching the analysis of interview transcripts. This first cycle creation of nodes was then used to facilitate second cycle analysis of these a-priori (top down) and in-vivo (bottom up) nodes and then to create categories (tree nodes) in the software. The rules for inclusion for each tree node were then added as a memo into the nVivo software. The tree nodes and rules for inclusion therein formed the basis of the overall coding frame created. The query function on nVivo proved useful, and powerful, when looking for commonalities in the data, and was an expedient method of querying transcripts and data nodes, for relevant quotes from the data (Silverman, 2010, 2013).

Ethics of the Research

In a post-world war II era, the Nuremberg Code established that voluntary consent of the human subject to any research was absolutely essential (Groff, 2016). The Belmont Report (Biomedical & Behavioral Research, 1978) issued by the National Commission for Protection of Human Subjects, outlined six norms that should be followed when conducting research. These included,

(v) use of a valid research design

(vi) the researcher must be competent to conduct the research

(vii) consequences of the research must be identified

(viii) sample selection must be appropriate for the purposes of the study

(ix) participants must agree to participate in the study through voluntary informed consent

(x) the researcher must inform the participants whether harm will be compensated (pp. 26 – 34).

This could be summarized as first do no harm and can be applied to research to explain underlying ethical considerations before research is conducted. Other ethical principles, outlined by Belmont (1978), included beneficence, respect and justice. Since then, ethics has been at the forefront of any research undertaken and has been an "integral part of the research planning and implementation process, not viewed as an afterthought or burden" (Cohen et al., 2011; Cohen et al., 2007; Creswell, 2009; Creswell & Clark, 2007; Mackenzie & Knipe, 2006; May, 2011; Mertens, 1998, 2010; Miles, 2013; Sapsford, 2007; Shank, 2007; Yin, 2009).

Ethical approval for the current research was sought from both Trinity College, Dublin and the author's institutional ethics and research committee. The latter was required as the research sample was undergraduate Bachelor in Education students undertaking their three-year degree. Ethical approval took from September 2012 to October 2012. Once ethical approval for the study was secured and the research design approved, the study commenced in October 2012. The details of the ethical approval process are outlined in the next paragraphs.

Colleges' Ethics Committees

Ethics committees are used "in other areas and their focus is more generally on protecting all participants in the research process" (Flick, 2009, p. 36). Typically, an ethic's committee concern was around safety of the participants and ensuring research was undertaken voluntarily and that various consents to the research have been sought from participants, before a study can commence. They normally examine the research design and methods to ensure that research proposals have been reviewed for their ethical soundness and that research is strictly in accordance with the institution's ethical code (Flick, 2009; Gilbert, 2008). Some researchers have reported that such "institutional review boards are experiencing a new accountability culture" (Mertens & Ginsberg, 2009, p. 158) resulting in the board becoming involved in suggesting how the research should be conducted, and reported, regardless of the proposal's original research design.

High-risk participants.

Students in this work were considered high-risk participants due to their age profile and their relationship with the researcher. In a first-year undergraduate degree, there was a mix of those that were deemed adult (over 18 years of age) and those that had not yet reached eighteen years of age, thus they were deemed minors. However, the institutional research committee deemed the participants as adults, for the duration of their undergraduate studies, and any associated research conducted on them, as a group. As such, once a participant had consented to the study, their data could be used as part of the research. In any case, all participants to the research had reached the age of eighteen by the time they completed survey I, in first year of their college preparation course.

Informed consent.

The institute's ethical research committee's primary concern was that students had specifically consented to the research. To negate these concerns, participant's consent was sought before every phase of data collection, as the research study continued. The consent statement was at the beginning of each of the surveys administered, and students had to explicitly consent, and then had to insert their email address for identification purposes. The researcher outlined the commitment involved and explained that a variety of surveys and further optional interviews would be held with research participants, during their three-year college preparation course. The welfare of participants was continually considered and this was explained in writing in the consent preamble to each survey. The full introductory text of the first survey is duplicated here:

> You are asked to participate in a longitudinal research project being conducted by researcher, about your attitudes to and use of technology, during your time in college. During the study, participants will be asked to complete various surveys and be interviewed, over the next three years. All data collected will be anonymised for the purposes of publications, theses and conference papers. Participation in the project will have no bearing on your academic grades, as the data collected is for research purposes only. If you have any questions about the project, please email me at email address.

Students could also revoke their consent to the research at any time and were advised of this throughout the study. Of course, sample attrition then became a concern, but this is dealt with in the limitations of the study.

Before each interview participants were asked to sign a consent form that outlined the nature of the research, the extent of their involvement in the research, that the interviews would be recorded and that participants had the option to remove themselves from the research at any time. Participants were also invited to amend any responses to interview questions and could clarify any points they felt they had not explained fully at the end of the interview. They were also offered copies of their interview transcripts, and allowed review these, before they were analysed. None of the interviewees asked to see their transcripts.

Further, participants were assured of the security of the data they provided, and that this data could not be accessed by anyone, other than the researcher. Initially, each participant in the study was identifiable by his or her college email address, but once the participants' responses were downloaded from Survey Monkey into SPSS, they were assigned a case number. This case number was then assigned to their responses, for coding purposes, and their expertise level used as an identifier (for example, very good expert participant one became VGE1) in SPSS. Thus, the anonymity of individual responses was secure. As such, the confidentiality and anonymity of the participants was ensured for the duration of the research.

Locus of research.

Due to this limited number of pre-service teacher education institutions, one concern of the institutional ethics and research committee was, that in any results, the college would be identifiable as the institution. Flick (2009, p. 42) outlined that research can be problematic when it is on a specific type of participant or specific setting. Indeed, Mertens (2010) suggests that often "schools view research as a risky operation that can produce results that will damage their reputation" (p. 268) and are often wary of consenting to such research, as a result of this wariness. To reassure the committees' concerns, care was taken to ensure the identity of the college was never disclosed in publications about the research, and the researcher's affiliation to the institution and research was not specified. The researcher was cognisant of the requirement to protect the participants and institution, and therefore endeavoured to do so at all stages of the project.

Data protection.

Gilbert (2008, p. 152) outlined concerns about storage of data and assurances are usually given that responses are for statistical analysis only, and individuals are never identified. In the current work, data was downloaded from the online survey tool, then the collection instrument was closed, cleared and deleted from Survey Monkey. This participant data was then saved on an encrypted external drive that was backed up to another encrypted hard drive and both were stored in different locations, for the duration of the research. These password protected encrypted external drives were only accessible by the researcher, and passwords were changed every two months on a cyclical basis, to ensure the integrity and security of the data therein. All data will be destroyed 13 months after completion of the research study. This complies with current data protection legislation which states that personal data should only be held by a data controller (the researcher) for one purpose (the study), and once that purpose has ceased to exist (completion of research and publication), the data should then be destroyed in a timely manner (Data Protection (Amendment) Act, 2003, Section 2D; Data Protection Act, 1988). The data is due to be destroyed in December 2018.

Limitations of Methodology

A number of limitations to the current methodology do exist, and the research should be read being cognisant of these.

A mixed methods study has limitations for a number of reasons, the primary one being that "each element, qualitative and quantitative must be done properly and analysed properly, in its own epistemological framework" (Gilbert, 2008). As such, a lot of data was generated and tracking participants' responses across the three-year of the research, for each cohort, was challenging. Another limitation of mixed methods was whether it was a "scientific enough" (Wahyuni, 2012). Yet, this methodology is well established in the literature in recent years (Bryman, 2006; Creswell, 2009; Creswell & Clark, 2007;

Johnson & Onwuegbuzie, 2006; May, 2011; Mertens, 1998, 2010; Miles et al., 2014) and with due care and attention it can be a very powerful research methodology.

The self-report nature of survey responses was recognised as a potentially limiting factor when reliability of participants' responses was considered. Mertens (2010) was critical of self-reporting by individuals, and thus the validity of the information was contingent on the honesty of the respondent. Equally the data can be affected by "demand characteristics" (Nichols & Maner, 2008; Orne, 2002; Weber & Cook, 1972) of the cohort and influence of the researcher on cohorts' various responses, especially at interview. However, as outlined earlier, the researcher had little connection to these participants, other than during the research study, and took steps to negate any demand characteristics, in a logical manner.

The sample attrition rate over three years was a limitation that was a concern in the current research study, given the duration of the involvement required of participants (three years). Repeated requests to attend or participate in ongoing research events such as follow up surveys (surveys II & III) and subsequent interviews impacted on the sample size, for each cohort. Another factor affecting sample size was the usual attrition rate associated with any college course, such as students having to repeat examinations, a year, or dropping out of a course midway through. This was a feature of this research project and is mirrored in other similar research projects with a similar research design (Chatfield, Brayne, & Matthews, 2005; Hill & Rowe, 1998). However, despite these limitations, the research was conducted successfully with two cohorts, each over a three-year period, and as such, is a reflective data set of pre-service teachers attending a college preparation course.

Chapter Three Conclusion

This chapter discussed the methodology chosen to address the research questions that formed the basis of the study. These research questions were based on use of technology in a variety of settings, by pre-service teachers. Two cohorts of pre-service teachers undertook the research over the course of each of their three-year undergraduate Bachelor in Education degree. The epistemological paradigm chosen for the research study was pragmatism. An analysis of the mixed methods approach used in the research study was provided. A review of the benefits of survey and interview research was then presented, and how this mixed approach was used to address the research questions at the core of the study. The nature of the statistical and thematic analyses of the data collected was then outlined. These included a number of parametric and non-parametric statistical tests on the quantitative data, including descriptive, factor and correlational analyses. A thematic analysis approach was used with the qualitative data gathered, and the justification of this approach discussed. The validity of thematic analysis was also critiqued, given the inherent nature of researcher bias in this type of analysis. The ethical processes that were conducted to ensure reliability and validity of the methods used were then examined, including approval by two institutional ethics' committees, before the study commenced. Software packages that aided data analysis were then presented, and the affordances of SPSS and nVivo explained. The limitations of the methodological approaches chosen were also noted, where sample attrition and sample size were concerns prevalent in the current study.

The next two chapters review the survey and interview data gathered over the course of the four-year research study. Chapter four provides details of the non-parametric statistical survey results, and associated interview results; chapter five will outline the results of parametric data analysis, and the associated interview findings therein. Each chapter will demonstrate how the data gathered has addressed the research questions presented earlier in this chapter and provide an initial analysis of the implications of the results.

Chapter Four Findings Part One

The first findings chapter details the results of the research study, in both quantitative and qualitative format, for the first two research questions. This chapter will outline the different statistical tests conducted on the non-parametric data sets and will also provide reliability and validity statistics for the methods used for each of these research questions. This chapter will then detail the thematic analyses conducted on the qualitative data collected to respond to the first two research questions. Some initial baseline demographic results from the data gathered over the four years of the research study are presented, then the specifics of each research question, and the data sets of relevance for each, and their subsequent analyses, are discussed in detail.

Parametric and Non-Parametric Analyses

Various standard statistical tests were conducted on the data gathered in all three surveys, and the differences between nominal, ordinal and interval data were key considerations before calculations commenced, as outlined in chapter three. Nominal data represented categories such as gender, age, nationality, class group or otherwise, where any other name or number would have equally represented the nominal data. Ordinal data did not assume any underlying normal distribution and applied to the Likert and rating style items used in the survey instruments, in the current study.

Tests for normality.

As the data collected included both ordinal and nominal data, the data sets were checked initially to see if they were normally distributed, in SPSS. If the data sets were normally distributed they could be subjected to parametric statistical tests, as a result. Using the Shapiro-Wilk test in SPSS, which was appropriate for smaller sample sizes (less than 100 participants), normality tests were conducted on the survey responses to all data sets, for each cohort. Then, further tests for normality included checking the data visually using histogram charts and Q-Q (quartile to quartile) scatter plot graphs. The scatter-plot graphs were used to plot the actual observed values where the observed values should be on, or near, the diagonal line, if the data conformed to a normal distribution. For example, responses to barriers to using technology in the classroom (research question three) followed a normal distribution, and therefore item means, factor analysis, t-tests and Pearson product moment correlation coefficient scores were calculated for these items. The results of these parametric tests are treated separately in chapter five.

Non-normal data.

Non-parametric statistical tests were conducted on the ordinal data collected during the research, which did not follow a normal distribution. For example, when the frequency counts of Likert type items for personal use of technology were checked for normality using Shapiro-Wilk test, histogram and Q-Q plots, the results indicated that the data had skewed distributions. Having found that data were not sufficiently normally distributed for parametric tests to be used, non-parametric tests were employed in this chapter. Table 3 outlines the statistical tests conducted on the data of relevance, for this first findings chapter.

Table 3 *Outline of non-parametric statistical tests conducted on the survey data gathered*

	Survey & Section	**Nominal Data**	**Ordinal Data**
Research Question One - Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the 'net generation' or 'millennial learners'?	Survey I - Section I , Survey I - Section II Survey I - Section III	***Gender & Age*** - Chi-square, frequency count, mean	***Personal Technologies used – non-normal distribution -*** Frequency count, mode, median, cross tabulations & chi-square, rank order correlation, Spearman's rho & t-tests.
Research Question Two - What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes?	Survey II & III - Section II Survey II & III - Section III		***Professional Technologies used – non-normal distribution*** - Frequency count, mode, median, cross tabulations & chi-square, rank order correlation, Spearman's rho & t-tests.

Cohort One and Two Baseline Data

The total returned sample for cohort one (C1), when incomplete responses to the first survey were removed, was 80 participants. The total returned sample for cohort two (C2), when incomplete responses to the first survey were removed, was 104 participants.

The schedule of data collection for each cohort followed a similar pattern, where survey I was distributed in first year, survey II in second year, survey III and semi-structured interviews conducted during the third year of the pre-service teacher's college preparation course.

Table 4 *Data collection schedule for cohort one*

Sample	**Collection Method**	**Timeline**
Cohort One	Survey 1	October 2012
Cohort One	Survey II	March 2014
Cohort One	Survey III	December 2014
Cohort One	Interviews	May 2015

Table 5 *Data collection schedule for cohort two*

Sample	Collection Method	Timeline
Cohort Two	Survey I	October 2013
Cohort Two	Survey II	March 2015
Cohort Two	Survey III	December 2015
Cohort Two	Interviews	May 2016

The gender breakdown of both cohorts is displayed in Table 6. Generally, pre-service teacher education students tend to be female (as per the make-up of the primary school teaching profession which is 84% female, 16% male Statistics Office (2011)) and the pre-service teacher participants in the current study followed the same pattern. Hence, gender was not taken as a variable in this study.

Table 6 *Cohort one and two gender profiles*

		Cohort One	Cohort Two
Gender	Male	10	16
	Female	70	88
	N =	80	104

Sample attrition

As the study was of three years' duration, for each cohort, sample attrition became an issue as the research continued. Unfortunately, sample attrition is a feature of all data collection that takes place over a number of years and the participants in this research were no exception (Cohen et al., 2007; Creswell, 2009; Creswell & Clark, 2007; Ng, Nicholas, & Williams, 2010). While participation was at its highest rate in year one, by year two (and year three) for each cohort, numbers had begun to diminish. In cohort one, out of an original 80 participants (survey I), only 51 participants responded to the survey

II. The response levels for cohort one's final survey III was 54 participants. Sample attrition was higher with the second cohort, where in survey I there were 104 participants, but by survey II there were only 37 participants, and in their final survey in third year, the participation rate was again the same 37 participants. Further, for each cohort, recruitment of interview participants showed a similar low response rate. Participants who had responded to all three surveys, in each cohort, were invited to interview. In cohort one, all 54 participants were invited to interview, of which, eight agreed. In cohort two, all 37 participants were invited to interview, of which, six agreed. Thus, there were 14 interview participants across both cohorts (n=14).

Research Question One

The first research question was whether based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the net generation or millennial learners? The primary source of data for this research question was survey I, section one where respondents were asked for ordinal data on their age profile. Then survey I, section two data was analysed to illustrate the personal technologies used most frequently by participants from each cohort. Additional comments were sought during semi-structured interviews, from participants, about any newer personal technologies they used that had not been in use, when survey I was completed. An outline of the statistical tests conducted on the survey data is provided, and the associated thematic analysis of the interview data for personal technologies used by members of both cohorts detailed.

Cohort Demographics

Non-parametric statistical calculations were conducted on the responses of each cohort to survey I, using SPSS. Survey I, section one asked about participants' ages. This ordinal data was collected during term one of each cohort's first year of their college preparation course. In Table 7, the age profiles of cohort one and two in the study are reported. The modal age of participants in cohort one and two were within the criteria for millennials or digital natives age range, as defined by Dede (2000) and Prensky (2001), where participants were aged 21 years old or younger (C1 mode age 21, C2 mode age 21). In both cohorts, a small percentage of participants were over the age of 21 (C1 12.5% and C2 8%). This was reflective of the level of mature students in the college generally, where the college allows an annual intake of 10% mature students (over the age of 21 on 1 January) in any given academic year.

Table 7 *Cohort one and two age profiles*

		Cohort One	%	Cohort Two	%
Age	≤ 21	70	87.5	96	92.3
	21-25	8	10	5	4.8
	26-30	2	2.5	2	2
	>30	0	0	1	.9
	N	80	100	104	100

Expertise Levels

Participants were then asked to assess their own levels of expertise using technology, based on Brandtzæg's (2010) review of technology expertise levels, in survey I, section two. The expertise levels presented were very poor experts (VPE), poor experts (PE), somewhat good experts (SGE), good experts (GE) and very good experts (VGE). This data was ordinal in nature. Participants' responses were based on their own self-rating score. Of note across both cohorts (Table 8) was that no participant rated himself or herself as a very poor expert.

Table 8 *Cohort one and two self-reported expertise levels*

		Cohort One*	Cohort Two*
Expertise Level	Poor Expert (PE)	8	8
	Somewhat Good Expert (SGE)	21	35
	Good Expert (GE)	36	45
	Very Good Expert (VGE)	15	16
	N=	80	104

**No 'very poor' experts reported in either cohort*

Thus, four expertise levels were reported in the survey data (survey I) and these were poor expert (PE), somewhat good expert (SGE), good expert (GE) and very good expert (VGE). For each cohort, the mode score was good expert (GE).

However, self-reported expertise levels while useful, were based on participants' own interpretation of the term expertise. Therefore, an alternative measurement of expertise was technological self-efficacy, as outlined in chapter two. A composite score for technological self-efficacy was calculated in SPSS, by creating a new variable that calculated the mean of the ten technological self-efficacy items for each participant (Compeau & Higgins, 1995). These composite TSE scores had highly significant correlations with the expertise levels that had been self-reported by the respondents in each cohort (Table 9). The full analysis of the self-efficacy scores occurs in the next chapter (research question four), however, it was noted that expertise and efficacy had significant associations. As such, these expertise levels were then used as a proxy for subsequent analysis of other variables in the research, such as barriers, attitudes to and uses of technology, on the premise that expertise levels may have had some impact on use of technology by the pre-service teacher participants.

Table 9 *Technological self-efficacy and expertise level correlation scores*

Measurement			**TSE *r***
Expertise Level	Cohort 1	N=80	.702** *(p<.001)*
	Cohort 2	N=104	.561** *(p<.001)*

***. Correlation is significant at the 0.01 level (2-tailed).*

Non-Normal Data Distribution

The details of what personal technologies pre-service teachers used, and the frequency of their use of these technologies in year one of the research, for each cohort is next reported. The responses to the personal technology items were rated on a five-point scale where one represented 'never used', two represented 'rarely used', three represented 'sometimes used', four represented 'often used (once a day)' and five represented 'very often used' (many times a day). In Table 10 the personal technologies used most frequently are reported for each cohort (C1 and C2), sorted by each cohorts' most frequently used personal technologies. The data was sufficiently non-normally distributed, based on the results of a Shapiro-Wilk test of normality, to require use of non-parametric statistical tests conducted in SPSS. *Figure 13 Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19 and Figure 20* give examples of this non-normal distribution of frequency of use for laptops, social media and smartphones where the observed values diverged sufficiently from the normal distribution for frequency of use. The histogram normal curve was also skewed providing further justification for the use of non-parametric statistical tests for this research question.

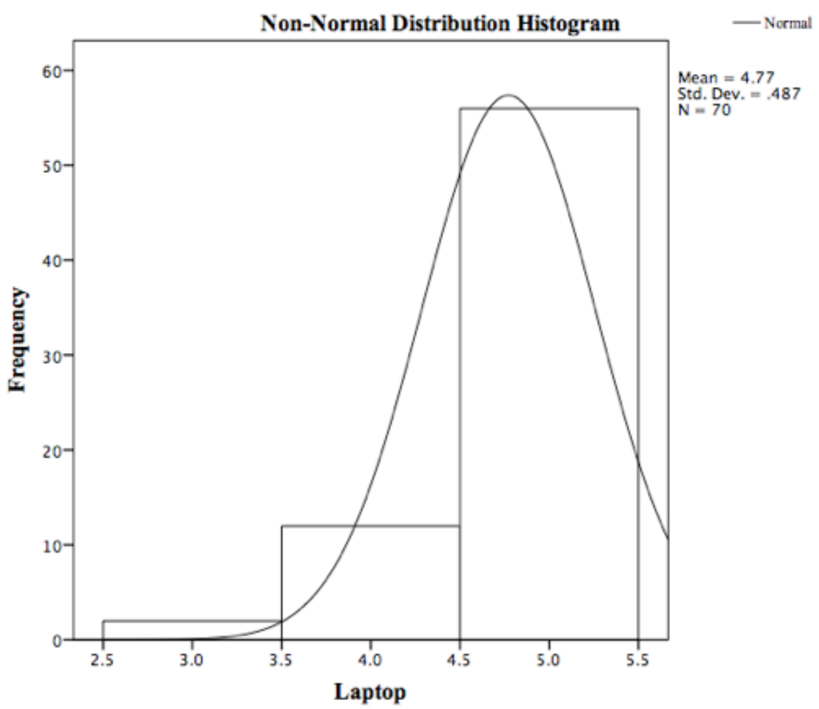


Figure 13 Skewed distribution of laptop usage cohort one

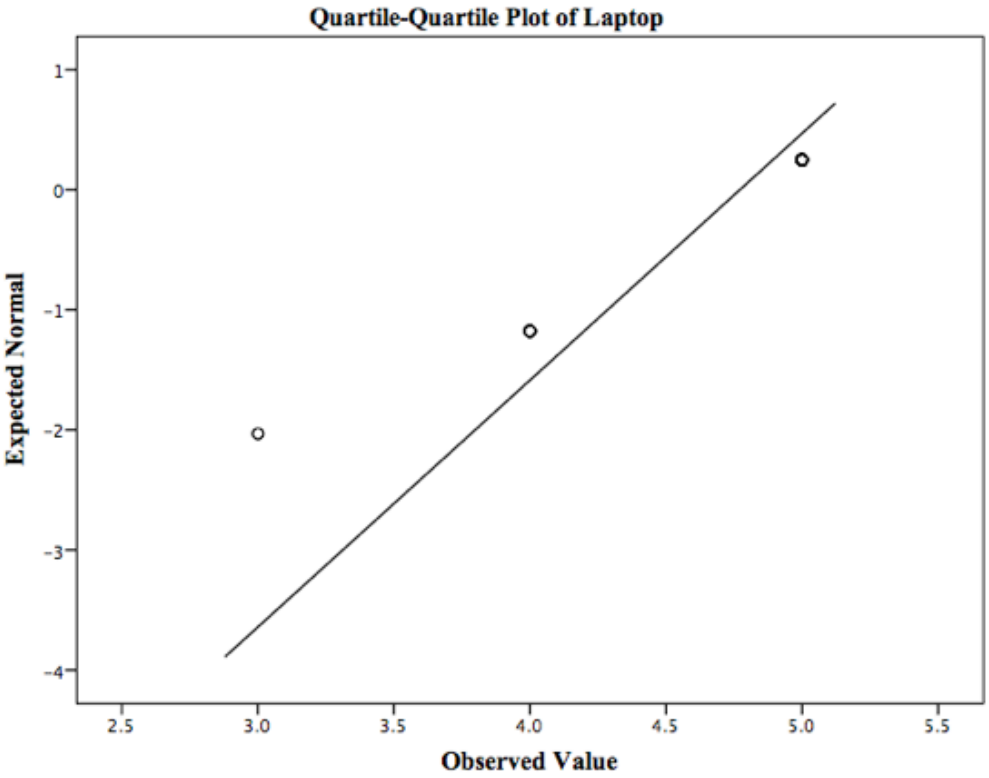


Figure 14 Quartile to Quartile plot of laptop usage cohort one

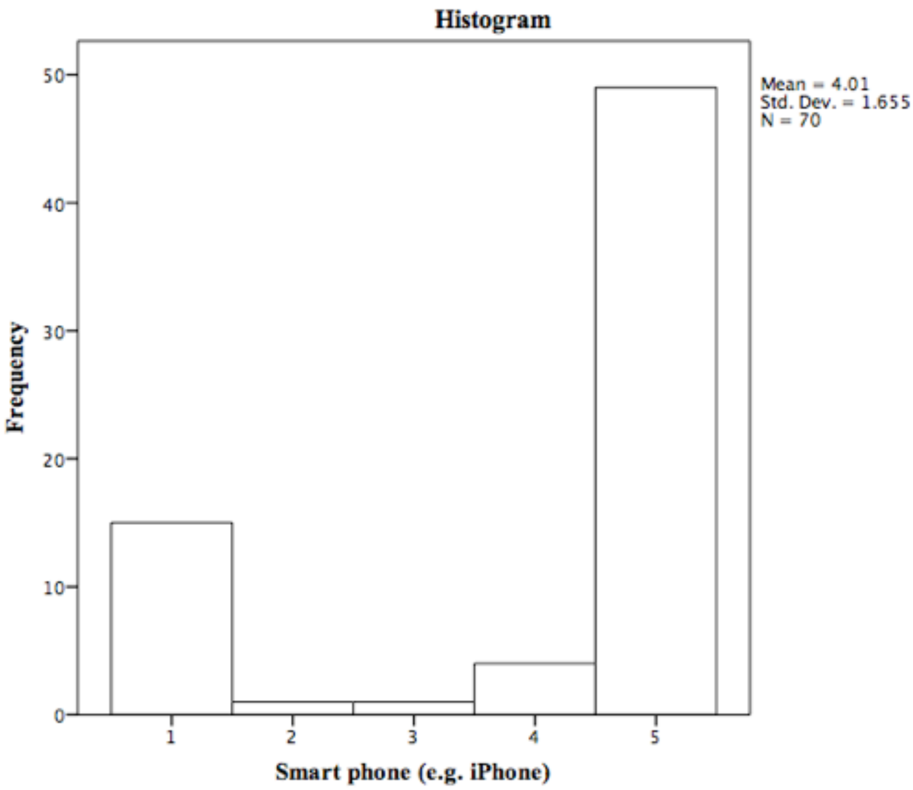


Figure 15 Skewed distribution of smartphone usage cohort one

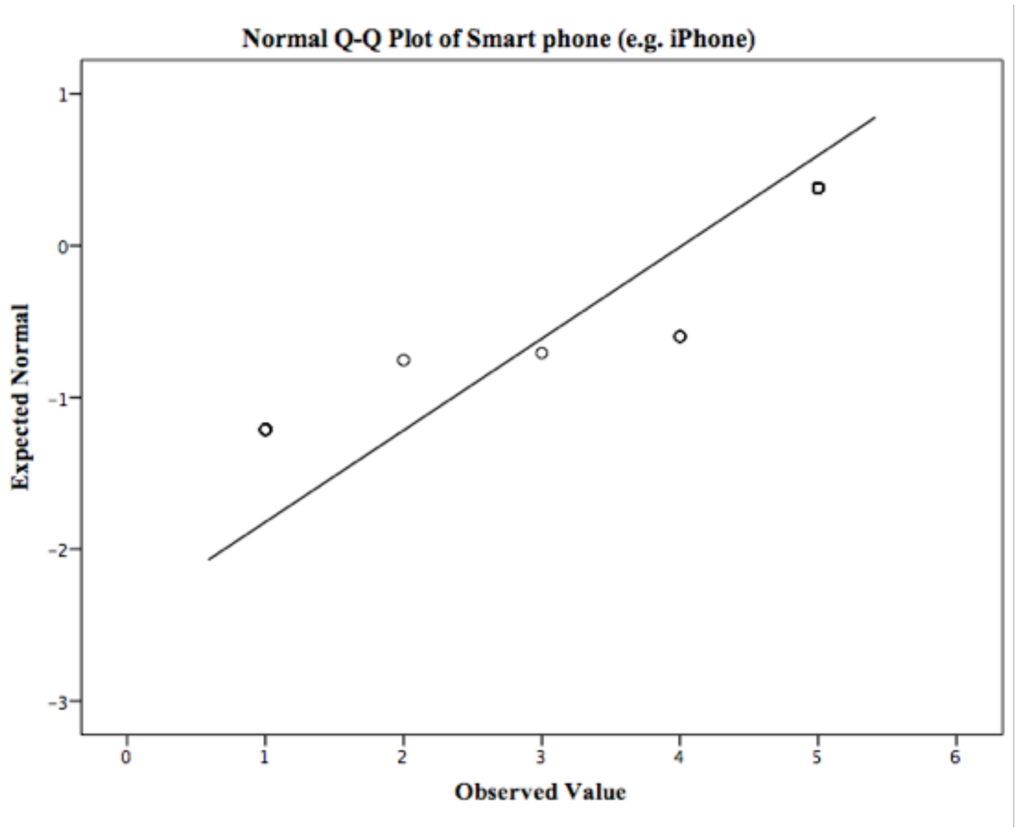


Figure 16 Quartile to Quartile plot of smartphone usage cohort one

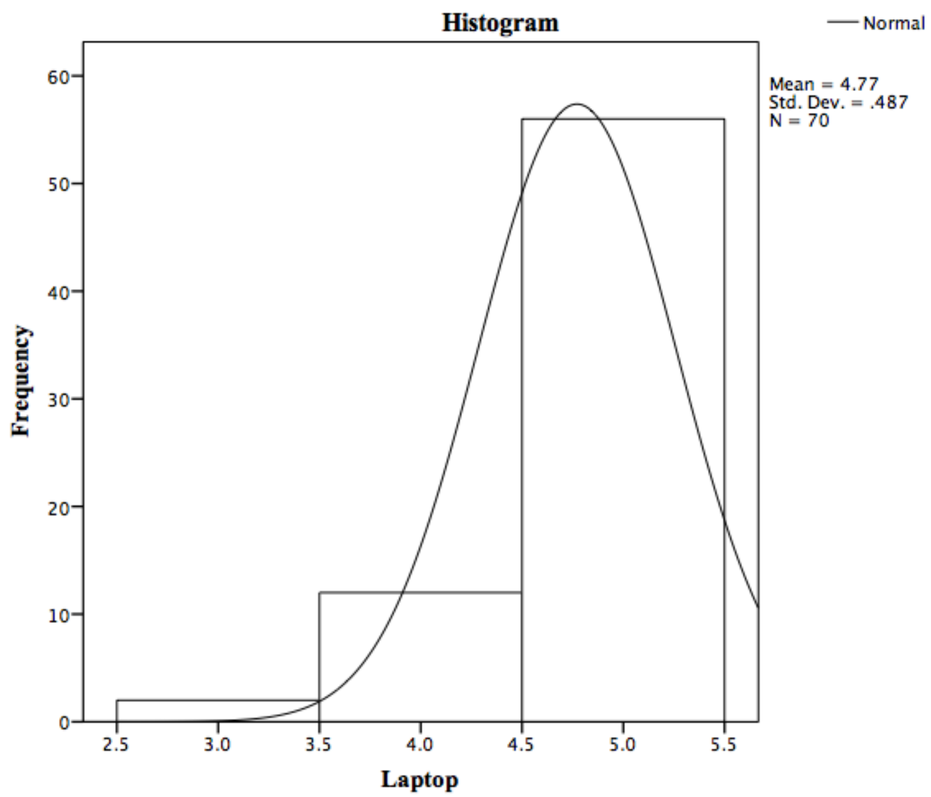


Figure 17 Skewed distribution of laptop usage cohort two

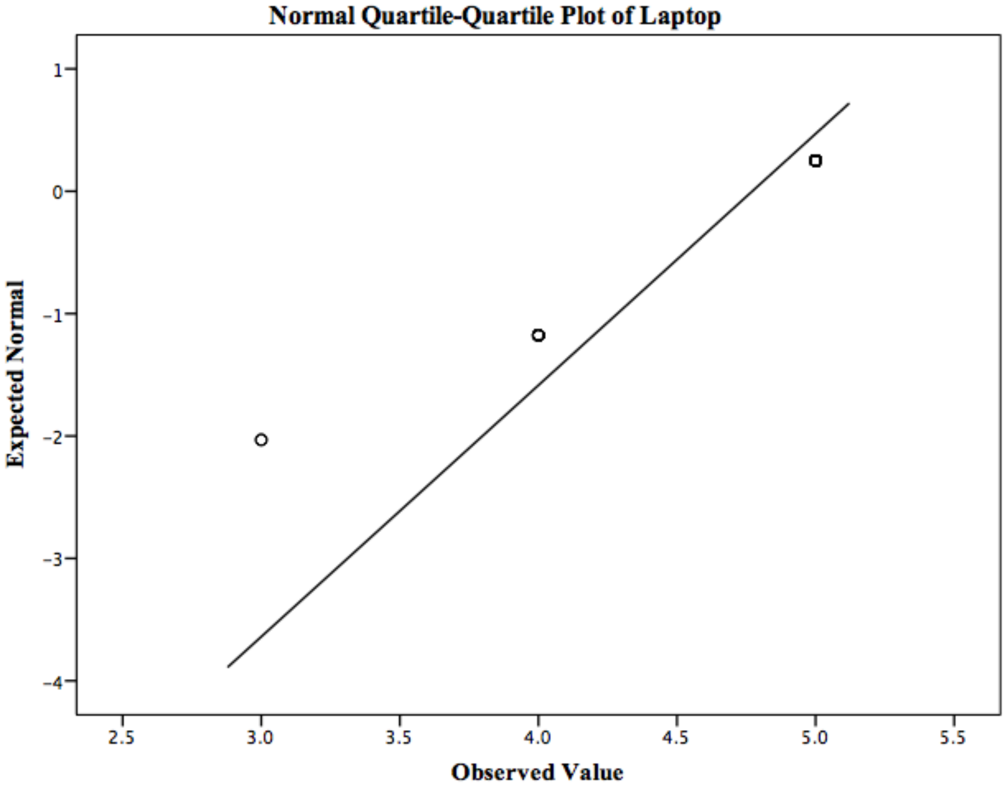


Figure 18 Quartile to Quartile plot of laptop usage cohort two

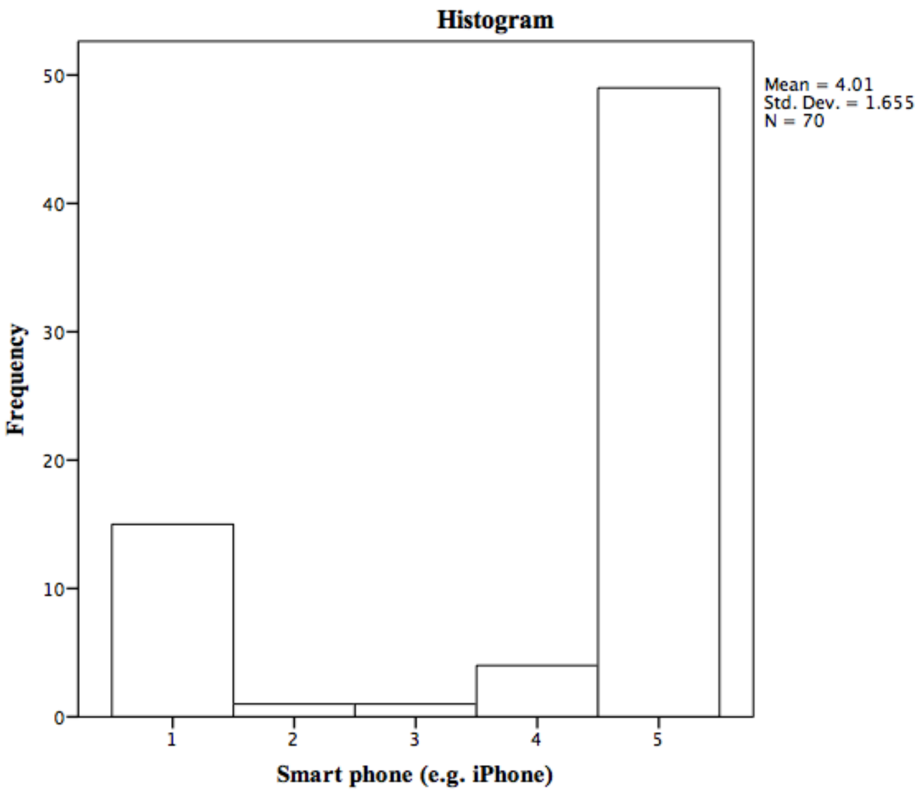


Figure 19 Skewed distribution of smartphone usage cohort two

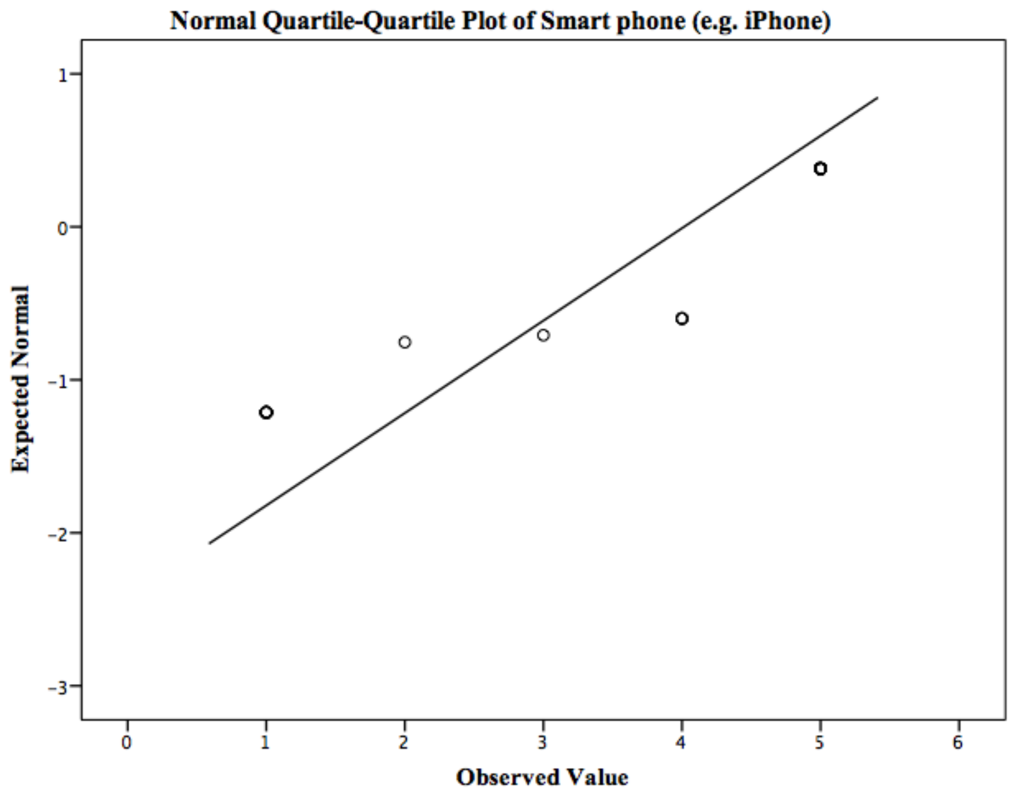


Figure 20 Quartile to Quartile plot of smartphone usage cohort two

Mode and median results.

As the data for each cohort followed a non-normal distribution, frequency counts, mode and median scores are reported (Table 10). As some personal technology items listed represented alternatives rather than more frequent usage of those personal technologies (for example, mobile or smart phones) it was not appropriate to add participants' scores to form a scale item for personal use.

Table 10 *Personal technologies used and frequency counts per cohort*

	Cohort one			Cohort two		
	N = 80	**Median**	**Mode**	**N = 104**	**Median**	**Mode**
Mobile phone	79	5	5	103	5	5
Laptop	80	5	5	103	5	5
Social Networking Site	80	5	5	103	5	5
Email	80	5	5	103	4	5
Search Engine	80	5	5	103	5	5
Smart Phone	78	5	5	103	5	5
Mp3/iPod Music player	78	4	5	102	5	5
Video sharing sites	80	3	5	103	4	4
Desktop machine	78	3	3	103	2	2
Online Booking Engines	80	2	3	103	2	2
Digital Camera	80	3	3	102	3	3
Online News	78	2	1	103	2	1
Skype	80	2	1	102	2	2
What's App	80	1	1	103	2	1
Online banking	78	2	1	102	2	1
Video camera	78	2	1	101	2	2
Online Games	80	2	1	102	1	1
Games Console	79	2	1	103	1	1
Photo Sharing sites	79	1	1	103	2	1
Face Time	80	1	1	102	1	1
Accessing Digital Books	80	1	1	103	1	1
IPad/Tablet device	79	1	1	101	2	1
Storing Personal Information	80	1	1	103	1	1
Blogging	80	1	1	102	1	1
eBook (Kindle)	80	1	1	102	1	1

Mode and median scores are reported in Table 10. A modal score was representative of what category of use occurred most frequently. However, a median score is more representative of the overall distribution of scores, for these personal technology items.

The most frequently used personal technologies by members of cohort one and two were their mobile phones, laptops, social networks, email, search engines, smart phones and mp3 music players. Cohort one used video sharing sites less frequently than cohort two (C1 SI *mdn* three, C2 SI *mdn* four). Of note was that differences began to emerge in use of desktop machines, where desktop machine usage had declined between cohort one and cohort two (C1 SI *mdn* three, C2 SI *mdn* two). Technologies rarely or infrequently used by either cohort included online booking engines (C1 SI *mdn* two, C2 SI *mdn* two), use of Skype (C1 SI *mdn* two, C2 SI *mdn* two) and video cameras (C1 SI *mdn* two, C2 SI *mdn* two). The median scores for these items were representative of the limitations associated with use of ordinal statements where participants were asked to order and interpret the frequency of use themselves, and in these instances, a participant's perception of the difference between never and rarely used was subjective. These interpretation limitations were explored at interview with a subset of participants from each cohort. The rest of the personal technologies listed in Table 10 were never used (*mdn* one) by participants in either cohort. The next section reviews this data in more detail.

Personal Technologies Used

Smart phones.

Smartphones featured in the top personal technologies used by both cohorts (C1 SI *mdn* five, C2 SI *mdn* five). Both smart phones and mobile phones had a median score of 5 and, as such, gave rise to a question as to whether participants had rated a mobile phone over a smartphone due to the position of this specific item on the survey instrument.

Mobile phone was listed before smart phone in the items listed on the survey instrument, and it may have caused some confusion, as the term is often used interchangeably where a smart phone is still a mobile phone, but with additional functionality.

During the interviews, three years after survey I (reported above) all interviewees mentioned their smartphones specifically. A level of dependency on their smartphones was noted, with comments such as: "with the iPhone like janky mac, I'd be lost without it" (C1 SGE1), "I'm so connected – it's non-stop" (C1 VGE1), "it's very hard not to be obsessed with it" (C2 VGE2), "so the iPhone has been, it's made a big difference" (C1 GE1) to "you're constantly checking" (C1 VGE2). This dependence was borne out of necessity as one interviewee noted,

> you kind of have to be able to use it like, if you want to book a flight you have to be able to do it, if you want to access maps or if you need to find out where you're going, you know, you need to be able to use it because I know with different things like, there's no phone numbers anymore, like some companies you don't have a…it has to be done through email, if I buy something online there's no phone number (C 2 VGE 1).

Laptops.

Participants second most frequently mentioned technology was their laptop (C1 SI *mdn* five, C2 SI *mdn* five) as all participants used their laptops many times a day. Many interviewees had purchased laptops before commencing college. Indeed, it was seen as an essential requirement: "obviously you can't not have those kinds of things when you're in university, you couldn't not have a laptop" (C1 VGE2), "oh yea definitely you couldn't do without it (laptop)" (C1 GE2). Laptops were used most frequently for general college work: "I'm constantly using the laptop for lesson planning and back-ups of stuff" (C1 GE1), "I obviously use the computer and laptop all the time (for college assignments)" (C2 SGE1) and browsing the Internet - "the laptops, using the internet a lot more, just with college" (C1 SGE2) and communication: "yea, it was like trying even to be in contact you had to have the laptop open for anything" (C1 SGE1). Participants were also confident in their ability to use their laptops: "I still find you know the old reliable laptop is great & from a personal point of view at home, I can function my laptop perfectly – apple, windows it doesn't really matter" (C1 VGE1) to "I would feel comfortable like, I have my own laptop and I feel pretty confident (using it)" (C2 GE2). The next logical question then became what these pre-service teachers were using their smart phones and laptops for and the most frequently mentioned use was to access social media platforms.

Social Media.

The frequency of use of social media (C1 SI *mdn* five, C2 SI *mdn* five) had not diminished for interview participants, in either cohort, since their responses to survey I in first year. The majority of interview participants mentioned a reliance on Facebook groups and Facebook messenger as a method of peer support and communication during school placement:

> Oh yea, yes we had a page like and kind of people put a question on – it's really handy or even group chats and stuff like that with your own friends on placement, they'd be saying this that and the other, and share resources which is handy (C1 SGE1)

This Facebook peer group support mechanism, was noted by the majority of interviewees across both cohorts where "I use Facebook - I kind of don't use it as much as I used to I tend to use it for big group chats – it's so handy for college - and groups there – definitely" (C1 VGE2), "every year I would say, definitely our year in college have a Facebook group - and that's where people kind of look for ideas" (C2 PE1) and "the class group on Facebook, which is great, yea, it's great - yea, it's great - so, like if anyone has any questions, pop them up – it's great" (C2 GE1). One interviewee mentioned other non-college related Facebook groups as useful resources too, and she noted how such communities of practice existed, with "real" teachers [sic.]:

> On Facebook, there're all these communities of real teachers going – you know, anything from I've a child in class that is doing this, what can I do suggestion wise, here look at this resource I've found, let's share it with everyone. So, you're actually learning from each other, you know? it's a great community – and you know there's teachers in the UK, Australia, America – you know and we're all kind of together and it's you know, it's online resources – teachers' online resource (C1 VGE1).

As such, Facebook had moved from being a personal social media tool (in first year) into becoming a professional support network and peer learning community by third year of the study, thereby merging the personal and professional contexts of use for these pre-service teachers. However, whether Facebook will continue to be used by these pre-service teachers in the future was unclear. In particular, two participants found it intrusive and were in the process of removing it from their devices:

> Facebook is another ball game completely – it can be your friend or your foe – you know…that's when it gets irritating so I actually disabled my Facebook over school placement, just to get away from that because it's hard enough as it is (C1 VGE2),
>
> Facebook, the messenger yea, but I won't like I'll delete that now in the summer time because like there'll be nobody from college trying to talk to me d'ya know (C1 PE1).

Other social media platforms, such as Twitter, Pinterest and Snapchat were mentioned by interviewees but varied in popularity and use. Twitter was not popular, exemplified by two participants: "personally, I'm not too taken with Twitter" (C1 VGE 1) and "I'm not a big fan of Twitter" (C2 GE1). Twitter had not been specified as an item in survey I, and as such, these comments may be confined to these two participants.

However, Pinterest was popular with the interviewees, and many used it for both personal and professional purposes, and tended to be very enthusiastic about it:

> Pinterest –it's fab, oh it is lovely, it's great, I love Pinterest (C1 VGE1),
>
> Pinterest is so good, Pinterest is brilliant even for your personal and your professional because like you put anything into Pinterest, you are going to get a million results, for anything (C1 VGE2),
>
> some of the best stuff I've found has definitely been on Pinterest – it's so good (C2 VGE1).

The popularity of Snapchat (an image sharing and chat application) was of note across all interviewees in cohort two but had not been mentioned by cohort one interviewees. Snapchat had existed since September 2011 and was gaining mainstream popularity by October 2013, yet, when cohort one participants were interviewed (May 2015) they had not mentioned it. One year later (May 2016) it was seen as a fun communication tool by the majority of interviewees in cohort two, being used frequently for personal use:

> Yea, oh I suppose yea Snapchat...I would be big on that, Snapchat (C2 PE1)
>
> like Snapchat is just huge now with young people (C2 SGE1)
>
> Yea, Snapchat is good because the picture disappears, yea, it's fun I suppose – it's good since the filters came people have become really obsessed with it, the filters are good fun though like Face Swap and all that (C2 GE1)
>
> I use Snapchat now more than I used to and it's very hard not to be obsessed with it (C2 VGE2).

It was interesting to note the prevalence of newer social media technologies (such as Snapchat) with cohort two interviewees, and the emerging dislike of older social media (such as Facebook) by cohort one interviewees.

Communication tools.

While the personal technologies used most often are of interest, the technologies not being used by both cohorts, in survey I, were also of note. Freely available (and at no cost) communication tools such as What's App, Skype & Face Time were not used widely by survey respondents in either cohort. Both cohorts' reported use of these technologies had low median scores. For example, cohort ones' use of Skype (C1 SI *mdn* two), WhatsApp (C1 SI *mdn* one) and Face Time (C1 SI *mdn* one) and one year later, with cohort two, Skype (C2 SI *mdn* two), WhatsApp (C2 SI *mdn* two) and Facetime (C2 SI *mdn* one) were all used infrequently, if at all, by the participants. Given the low median scores (between one & two) for use of these free communication tools, lack of use of these types of technologies was prevalent for members of each cohort.

However, pre-service teachers' awareness of at least some of these communication tools had increased since completion of their initial survey in first year. Interview participants from both cohorts, mentioned using these free communication technologies quite frequently: "Oh yea, I use Viber, WhatsApp, I use all of them" (C2 SGE1), "eh, yea I use em oh Viber" (C1 PE2), "I'd use Viber a good bit" (C1 SGE1) and "Viber, What's App" (C2 PE1) specifically.

Use of email, while mentioned in survey I as a technology used very often by both cohorts (C1 *mdn* five, C2 *mdn* four) had diminished by the time both sets of participants had reached third year, indeed, only one interviewee mentioned it directly during interview:

> Even email, it wasn't ...obviously I could use email but I never really used it to be honest, because you'd have no need for it - we wouldn't be emailing each other like, it would be a bit weird to email your friends, or, do you know what I mean, so email actually was really, maybe 6th year [final year in school] if you emailed teacher or something but, it's I would've seen email (C2 PE1).

Yet, participants had reported using email to back up their assignments or content on their laptops: "I'd always email stuff to myself just like the schemes and everything in case they're gone" (C1 GE1). Google Drive was also mentioned as a backup mechanism, used in conjunction with the Gmail platform: "I use Google Drive a lot" (C2 PE1), "yea, Google Drive, Google Docs yea" (C1 VGE2). The respondents may have differentiated between email as a method of communication, preferring free communication technologies and use of email as a storage device, but this was not clarified with respondents. One participant did mention that she tended to use email to communicate with lecturers only, and never used it with her friends, preferring instant messaging applications available via social media, such as Facebook Messenger (C2 PE1) for that purpose. This was suggestive of a delineation between professional and personal usage of email.

Tablet devices and apps.

Despite on-going advertising in the media of iPads/Tablet devices, neither cohort of pre-service teachers reported any frequent use of them at survey I. Cohort one scored median one for frequency of use (indicating never used and rarely used) and cohort two, one year later, (*mdn* two) on the same scale, representative of a marginal increase in use (sometimes used).

Yet, three years later, tablet use was becoming evident for both sets of interviewees: "I was completely happy with my 'tablet' – I keep calling it an iPad, my tablet and I think it's brilliant because it you get it to suit the needs of yourself" (C1 VGE1), "I have a tablet I only got it last year, and it is my extra hand, it is so handy" (C1 GE2) and "then in college I got an iPad, then for my 21st there last year" (C1 SGE2). However, laptops still tended to be the preferred device over a tablet: "well I have a tablet, but I like to do most things on my laptop" (C2 VGE2), "I have a tablet, I have a windows em, RT 2 or something, I've one of those and I have the keypad for it and everything and it's a little mini laptop, but I still don't use it, I use my laptop" (C1 VGE1), "then I would have a tablet I'd use that sometimes" (C1 SGE1), "I have I have an IPad and I'm perfectly in, I love using my iPad, but my tablet for my assignments I don't go to my tablet" (C1 VGE1).

The use of applications (apps) mentioned by interviewees was specific to either their smart phones or tablet devices, and they tended to be used out of practical necessity. For example, the Dublin Bus app was mentioned by participants (C2 SGE1 & C1 GE1) as particularly useful. Devices were then used for entertainment purposes: "all the different music that I listen to in iTube" (C1 GE1) and "I have like movie apps, stuff like that" (C2 GE1). These participants tended to use their personal devices as consumers of content and this was one of the main features of interviewees' responses about their personal uses of technology.

Few members of either cohort had used eBooks (survey 1), where cohort ones' use score was median one (never) and cohort twos' use score was also never (*mdn* one). Two participants mentioned a Kindle device at interview, but it had limited appeal: "the only time I've used my Kindle is actually for downloaded phrases when I went on holidays because I was doing inter railing" (C1 GE2), a point re-iterated by another participant who said "although they (Kindles) are handy I suppose if you're going on holidays…but I personally would prefer paper" (C2 VGE1).

Other Personal Technologies

Of note, was the decline in use of desktop machines within a 12-month interval (C1 SI *mdn* three, C2 SI *mdn* two). For example, cohort one had ten desktop machine users in survey I (out of a total 80 participants) and the following year, cohort two reported only five desktop machine users (out of a total of 104 participants). There was little reported use of photo sharing websites either (Pinterest, Instagram) at survey I (C1 SI *mdn* one, C2 SI *mdn* two). This result had changed, three years later, with interviewees in each cohort using Pinterest, Instagram and Snapchat frequently. Furthermore, respondents did not use digital cameras frequently (C1 SI *mdn* three, C2 SI *mdn* three) however a smart phone (that has an in-built camera function) may have since replaced this and was not clear from the data. Cameras were not mentioned during the interview phase of the research either, but given the reported increase in photo sharing websites, it is likely that participants were using their smartphone camera function to post to these photo sharing websites.

Chi Square & Rank Order Correlation

When chi-square analysis was conducted on self-rated expertise with personal technologies used, results proved unproductive as the reported frequencies in the cross-tabulations were often less than five, and thus too small for the test to be applicable. This remained the case when various categories of expertise were merged (for example, VGE and GE to form one category of good expertise and when levels of use were merged, such as very often with often). For example, use of laptops chi-square results (Table 11) demonstrated that 58% of the calculated cells had an expected count of less than five, which meant the data was not amenable to the chi-square test.

Table 11 *Chi-square test for laptop use cohort one*

	X^2	*df*	*p value*
Pearson Chi-Square	6.719[a]	6	.348
N	80		

a. 7 cells (58.3%) have expected count less than 5.

As chi-square analysis proved unproductive, Spearman rho (r_s) rank-order correlation tests were conducted on the survey data. Self-reported expertise levels were correlated against personal uses of various technologies where, again, few significant results were obtained. For example, in cohort one expertise levels correlated highly significantly with usage of mobile phones (C1 SI r_s *=.319, p<.001*) and video cameras (C1 SI r_s *=.311, p<.001*) and significantly with usage of social networks (C1 SI r_s *=.261, p=.19*) and photo sharing websites (C1 SI r_s *=.243, p=.031*) but given the small numbers in cohort one (N=80), they may not be important. In cohort two, self-reported expertise levels correlated only with laptops (C2 SI r_s *=.277, p<.001*) and video cameras (C2 SI r_s *=.275, p<.001*) where again the correlation coefficients were not very strong, although they were highly significant.

Millennials in this research were using their laptops in a highly significant manner to access social media, email and YouTube. Other results of interest included some highly significant associations between smartphone use and video cameras (C1 SI r_s *=.458, p<.001*) and significant results for smartphone use and photo sharing websites (C1 SI r_s *=.264, p=.021*). Cohort two had a similar distribution of results where smartphone use and photo sharing had highly significant correlations (C2 SI r_s *=.302, p=.002)* and cohort two reported similarly significant results for smartphone use and video sharing (C2 SI r_s *=.200, p=.042).* Further, laptop usage by cohort one and two survey respondents showed highly significant correlations with social media (C1 SI r_s *=.397, p<.001,* C2 SI r_s *=.241, p=.014)*, email (C1 SI r_s *=.509, p<.001,* C2 SI r_s *=.325, p<.001)* and YouTube (C1 SI r_s *=.381, p<.001).*

At the other end of the use scale, the technologies that were *not* used by either cohort were also quite similar. eBook readers and accessing digital books were the least used technologies in both cohorts, where cohort one had only one VGE and one GE use them often/very often, with similar low numbers in cohort two. The usage tables for each cohort display this information in more detail (Table 12 and Table 13) below.

Table 12 *Cohort one frequency of use (often or very often) of personal technologies by expertise level*

Personal Technology	**Poor Expert [n = 8]**	**Somewhat Good Expert [n = 21]**	**Good Expert [n = 36]**	**Very Good Expert [n = 15]**	**n = 80**	**% of Total**
Laptop	7	20	35	15	77	96
Search Engine	7	19	36	15	77	96
Social Networks	7	17	36	15	75	94
Mobile Phone	7	17	36	15	75	94
Email	7	17	34	15	73	91
Smart Phone	6	14	26	14	60	75
Mp3 Player	6	13	21	13	53	66
Video Sharing Sites	4	7	18	10	39	49
What's App	1	3	13	4	21	26
Accessing News websites	3	4	6	6	19	24
Online Banking	1	3	4	6	14	18
Skype	1	2	6	2	11	14
Desktop machine	1	2	3	4	10	13
Online Bookings	0	3	4	2	9	11
iPad/Tablet Device	0	0	6	2	8	10
Digital Camera	0	2	2	3	7	9
Photo Sharing Sites	0	1	4	2	7	9
Video Camera	0	1	5	1	7	9
Cloud Storage	0	1	3	3	7	9
Face Time	0	1	2	4	7	9
Online Games	0	0	3	3	6	8
Computer Games/Console	0	0	3	3	6	8
Blogging	0	1	1	3	5	6
Accessing Digital Books	1	2	2	0	5	6
eBook Reader	0	0	1	1	2	3

Table 13 *Cohort two frequency of use (often or very often) of personal technologies by expertise level*

Personal Technology	**Poor Expert [8]**	**Somewhat Good Expert [35]**	**Good Expert [45]**	**Very Good Expert [16]**	**n = 104**	**% of Total**
Social Networks	6	35	45	16	102	98
Mobile Phone	6	33	41	16	96	92
Search Engines	6	31	43	16	96	92
Laptop	4	34	40	16	94	90
Mp3 player	4	28	38	15	85	82
Email	4	29	37	13	83	80
Smart Phone	4	27	41	11	83	80
Video Sharing Sites	2	22	22	9	55	53
What’s App	0	13	17	8	38	37
Online News	0	6	13	7	26	25
IPad/Tablet	1	7	9	5	22	21
Online Banking	0	3	8	6	17	16
Storing Personal Information	0	7	6	3	16	15
Online Booking	0	3	8	4	15	14
Blogging	0	6	7	2	15	14
Photo Sharing Sites	0	3	8	2	13	13
Skype	1	2	6	3	12	12
Video Camera	0	4	5	1	10	10
Digital Camera	0	1	6	0	7	7
Face Time	0	1	3	3	7	7
Desktop machine	0	1	3	1	5	5
Games Console	1	1	0	3	5	5
Accessing Digital Books	0	0	3	0	3	3
Online Games	0	0	0	2	2	2
Ebook Reader	0	1	1	0	2	2

Expertise Levels & Personal Technologies

Participants had been asked to rate their levels of expertise using technology in survey I. These self-rated levels of expertise (poor expert (PE) to very good expert (VGE)) were matched with levels of use of particular personal technologies using the cross-tabulation function in SPSS (Table 12 and Table 13). Of note was that for each cohort, the most frequently used technologies did not seem to differentiate across expertise levels. For example, in cohort one, laptops, search engines, social networks and mobile phones featured as used often or very often across all expertise levels, where seven out of eight PEs and 15 out of 15 VGEs had the same scores. Equally, cohort two reported similar results, where the same four technologies were most frequently used, across all expertise levels. For example, six out of eight PEs used their laptop as frequently as 16 out of 16 VGEs. However, survey I, section I had not investigated *what* the different expertise levels were doing with these technologies, rather just their frequency of their use.

Technology at Home

Millennials 'grew up digital' (Forbes, 2012) and this research question sought to consider whether these pre-service teachers were indeed millennials by virtue of their personal uses of technology, rather than just their age profile alone, as identified in survey I. Thus, the influence of technology in the home was explored during interviews with participants from both cohorts, as this had not been explored during the survey data collection phase.

Desktop machines.

The presence of a "large computer - you know one of those boxy ones" (C1 VGE2) in the corner of a room at home was mentioned by the thirteen of the interviewees. When an old computer was mentioned, interviewees were quick to clarify (usually in the next sentence) that these machines were not connected to the Internet, or if they were, only dial-up connection was available. Two interviewees even made the sound of the dial-up connection, to describe in detail how slow the Internet had been for them (C1 VGE1 and C2 GE2). Interviewees also mentioned not being able to use a telephone (land line) at the same time as using the Internet, and mentioned family members trying to make phone calls, and being told to “get off the Internet” to facilitate this (C1 PE1, C1 VGE1, C2 PE1, C2 GE2). They reminisced that while technology was available at home, often it was of limited use without a broadband connection.

The desktop machines that were present in the homes of these pre-service teachers were generally used to play games, where typically parents had purchased educational games and participants were allowed use the computer to play them. “When I was younger we had all these CDs like, the magic school bus and we had these educational games” (C2 VGE2), “Mam had loads of like educational games like baggin the dragon and all these kinds of like maths games” (C1 SGE1), “the games or something it was just on a disk and yea it was like numbers and letters and that kind of stuff” (C1 SGE2) and “yea and the big computer, and I usually just did educational games on it, em, there was maths ones, and French especially because my Mam’s a French teacher so I had a lot of them” (C1 GE1). Generally, these pre-service teachers had reported growing up with technology in their homes, and had early exposure to games, but these were for educational purposes and not fun, as outlined earlier.

Parental influence.

Parental influence on what technology was purchased and available to use at home was a feature of most participants’ responses (C1 SGE1, C1 VGE1, C2 GE2, C2 VGE2). Where parents worked was also of note where, for example, one father worked with computers and showed this interviewee how to use video editing and Photoshop software programmes (C2 VGE2). Another interview participant’s mother worked in technology and had received a “free laptop as she worked in Intel, so we were allowed use that” (C1 PE1).

Parental purchases tended to be games consoles, for entertainment purposes, with specific mention of the various consoles available in the 1990s. These included "Gameboy, Sega mega something" (C2 VGE1), "PlayStation" (C1 SGE2), "Nintendo Wii" (C1 GE1) and "handheld Gameboys" (C2 PE1). However, some participants did not see the appeal of game consoles at all: "my brothers and sisters would've had like the Nintendos and all that kind of thing, but I was more into books" (C1 SGE1).

Rules at home about too much time being spent on the computer, and parents ensuring children were using the computer for educational purposes only, were mentioned by some interviewees. "I would've been on the computer a good bit, my Dad used to have to limit me, he'd be like come on now, you've been on that all day" (C2 GE2). Generally, parents were in favour of technology if it was seen as beneficial, with typing skills cited as one of the reasons these pre-service teachers were allowed use the computer, in the first instance:

> Yea, my Dad was really big into as I was saying, he was typing and he actually did a typing course to like learn how to type properly and he, you know, he was kind of like always, he'd always watch me typing up stuff if I used to type up stories for school and stuff, or like projects and stuff, I'd type it up and he'd be like I'm looking at you there doing your typing, you're not, he'd come in and he'd be like all I can hear is du du du du du, bam du du du du du bam because I used to smack down on the space bar, and he'd be like this is the proper way to do it (C2 VGE2).

Mobile phones.

Mobile phones were available to these participants when they were growing up, and participants mentioned they had used a mobile phone during their teenage years (C2 GE1, C1 GE1, C1 VGE1). Indeed, particular references to the "Blockia" (sic.) type mobile phone was noted by most of the interview participants (C1 GE1, C1 VGE1, C2 VGE2). These were the pre-cursor to their current smart phones and were made by Nokia, a brand that was very popular at that time. Mobile phones were bought typically for a special occasion, such as a birthday or religious event: "then I had a mobile phone when I was about 12, right after my confirmation I got that" (C2 GE1). However, these mobile phones' functionality was limited and they were used generally for parental peace of mind and safety purposes: "I remember my first phone was in 6th class and I got it so that I could hang out with my friends, it would be safer, because you're in Dublin, and I had three contacts, me, my Mam, my Dad" (C1 VGE1). Furthermore, participants had all experienced having a mobile phone in their teenage years, and this was further mirrored in their current reliance on their smart phone, as detailed earlier in this section.

Conclusion

This first research question investigated if the pre-service teachers in both cohorts could be considered members of the net generation based on their age profiles and personal usage of technology and the results suggested this first question was answered positively. However, as outlined in chapter two, their use of technology was based on familiarity with a few devices, rather than by virtue of when they were born. The pre-service teachers did fit the age profile for millennials, and technology was prevalent in the homes they grew up in, where personal computers, games consoles and mobile phones were the norm. Their current personal uses of technology, however, tended to technology they were comfortable using, and included their own smartphones and laptops, typically purchased due to their enrolment in college. These devices were utilised to access social media, Google search engines, email and latterly share photographs and communicate with each other. Of note in the research was the peer support community, akin to a community of practice (Lave & Wenger, 1991), mediated on social media that had replaced email, where email was seen as something more formal to communicate with a lecturer only, but not a peer. Further, personal desktop machine usage had declined from cohort one to cohort two, in the space of twelve months. Despite the media surrounding iPad and tablet adoption, these newer technologies had not been used by members of either cohort, but interviewees did aspire to purchase and use them in the near future. Finally, the self-reported expertise levels had little impact on use of personal technologies, where a poor expert used the same technology as frequently as a very good expert, in both cohorts.

The next section will outline the professional technologies used by the pre-service teachers while they were on school placement. It will examine the detail of what technology was available in classrooms, how the pre-service teachers used these technologies, and describe their general experiences using technology on school placement.

Research Question Two

The second research question investigated what technologies pre-service teachers were using in the classroom, while on school placement, and how these technologies were being used. It also asked pre-service teachers about their views and perspectives on their experiences of technology use while on school placement. A number of statistical tests were conducted on the data gathered in surveys II & III to respond to this research question, and this section reports on these. Qualitative data pertinent to this particular research question was gathered during semi-structured interviews, with a subset of participants from each cohort. Data from the semi-structured interviews added to the findings from the surveys and gave a broader picture of technology use in the classroom, thus they are presented together.

Non-Normal Distribution

The data in this second research question was sufficiently non-normally distributed, based on the results of a Shapiro-Wilk test calculated in SPSS, to require non-parametric analysis. Figures Figure 21, Figure 22, Figure 23 and Figure 24 give an example of this non-normal distribution for use of a digital projector (C1) where the observed values diverged from a normal distribution. The histogram normal curve was also skewed, thus non-parametric statistical tests were appropriate for the professional use of technology survey data, from each cohort.

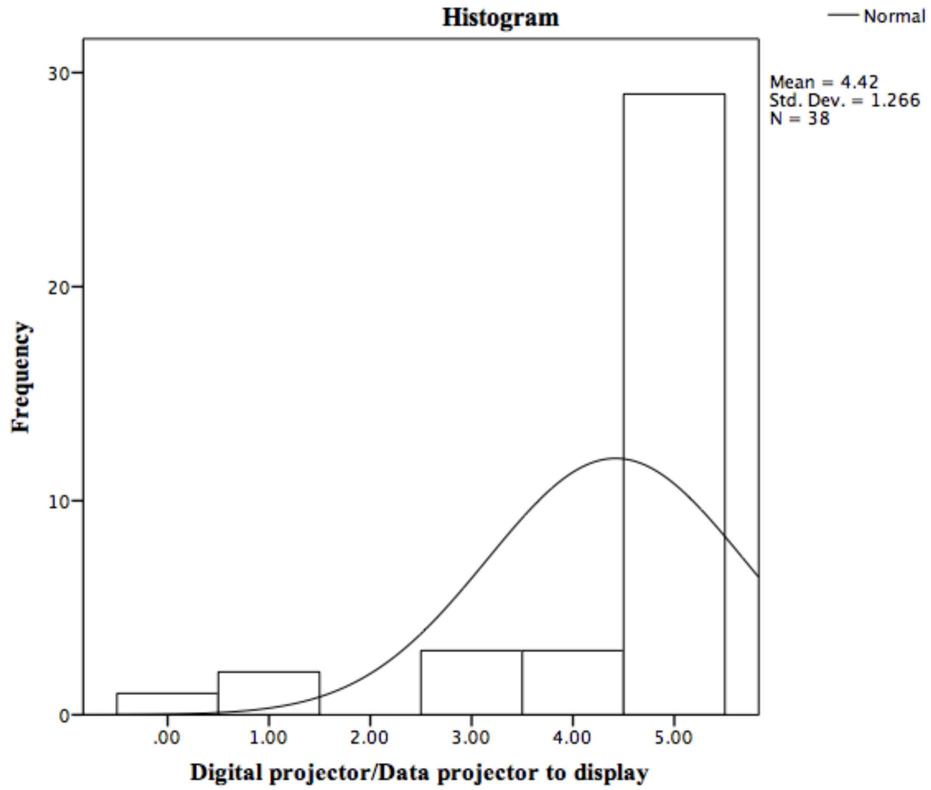


Figure 21 Histogram of skewed distribution of professional use of digital projector responses for cohort

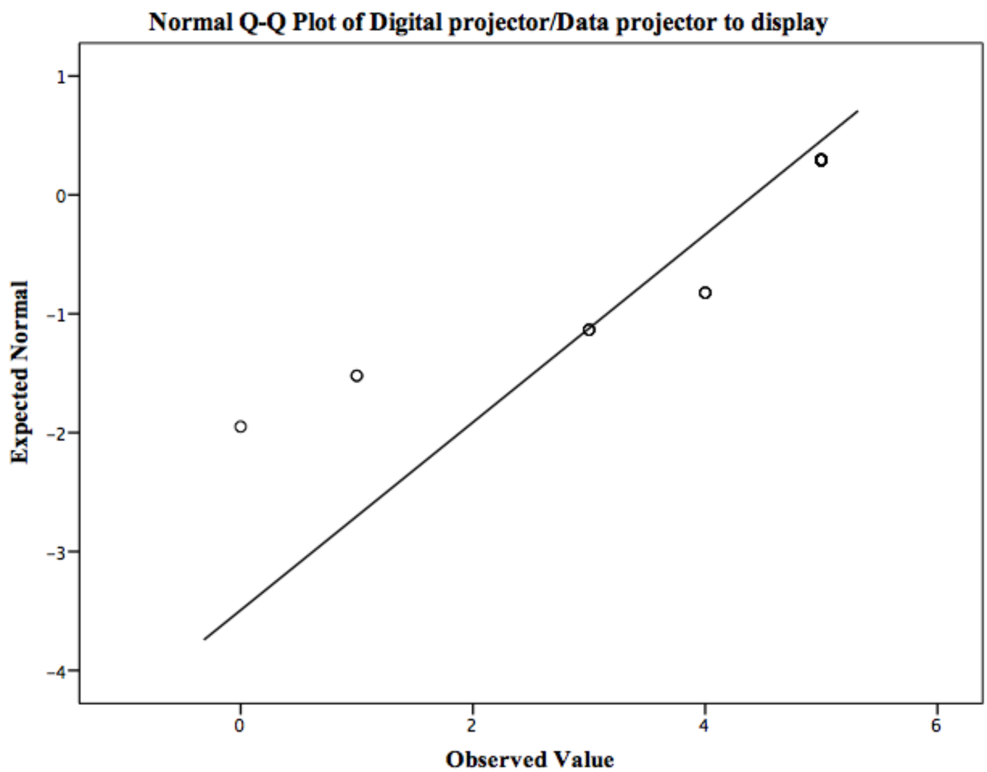


Figure 22 Quartile to Quartile plot of professional use of digital projector responses for cohort one

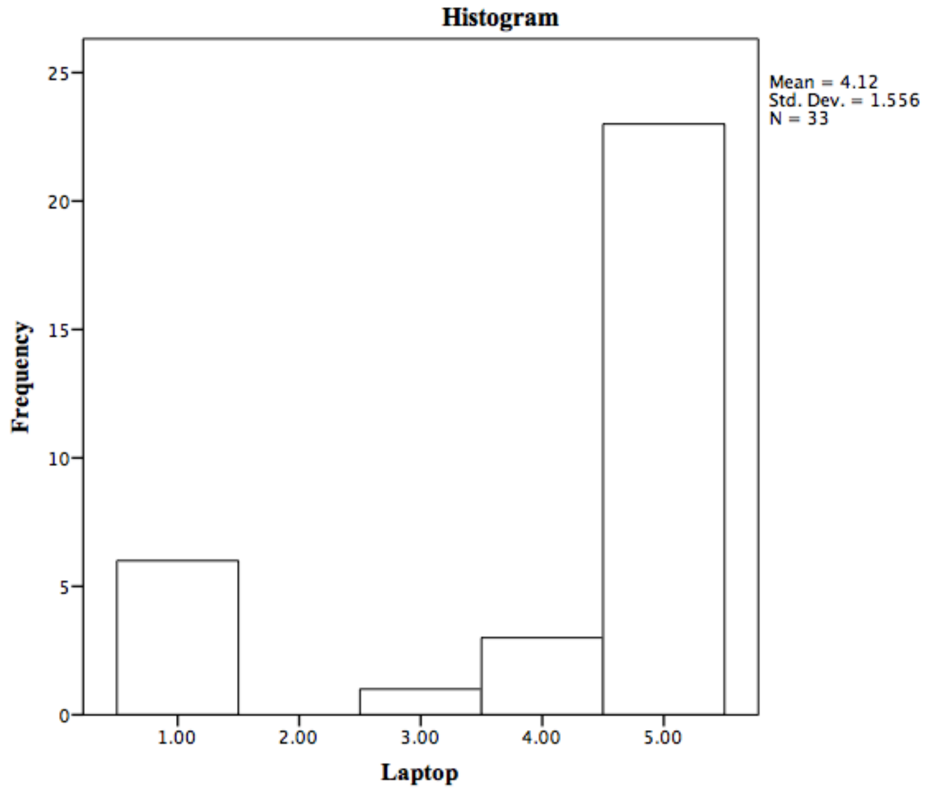


Figure 23 Example of histogram of professional use of laptop responses for cohort two

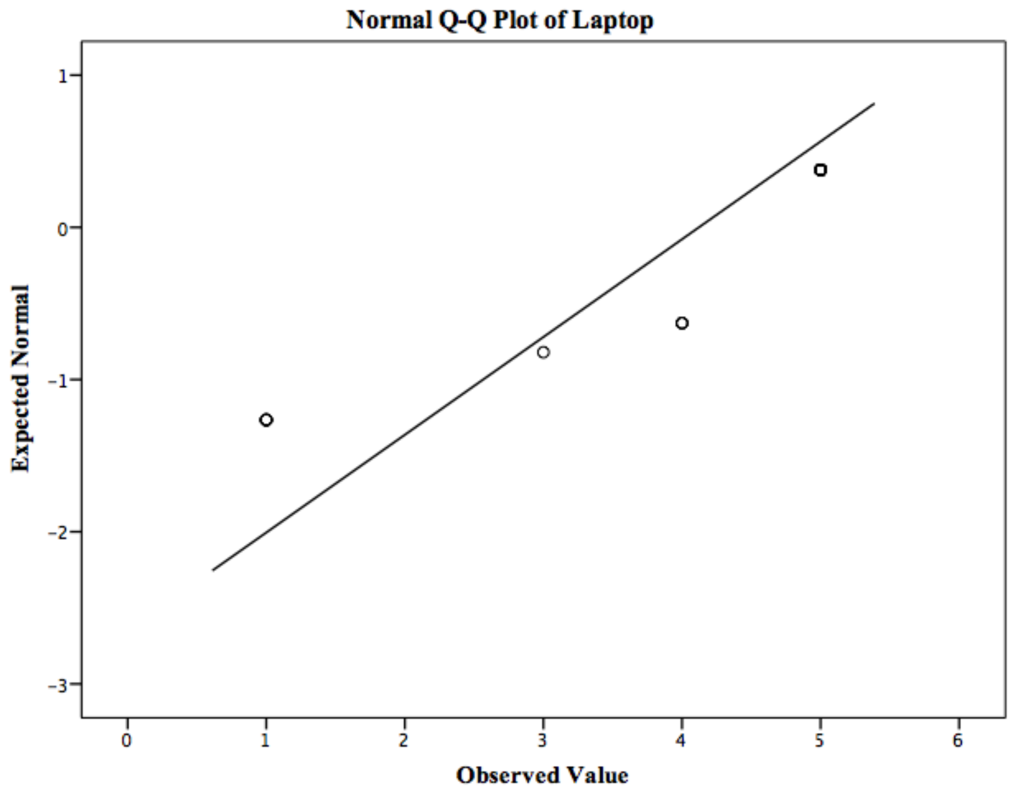


Figure 24 Quartile to Quartile plot of professional use of laptop responses for cohort two

Frequency Counts

As the data for the second research question was ordinal in nature, frequency counts, mode and median scores are presented. Table 14 and Table 15 show only those technologies that were used most frequently by each cohort. The range of frequency of use scores available to participants, as noted in chapter three, were represented by ‘never 1’, ‘rarely 2’, ‘sometimes 3’, ‘often 4’ and ‘very often 5’. It is of note that out of 46 technologies presented to participants in both surveys, the pre-service teachers used only 15 of these technologies, with any frequency (often or very often).

Table 14 *Cohort one professional technologies and frequency of use on school placement*

	Cohort One Survey II - March 2014			**Cohort One Survey III - December 2014**		
	N	**Median**	**Mode**	**N**	**Median**	**Mode**
Data Projector	50	5	5	52	5	5
Laptop	49	5	5	53	5	5
Internet	51	5	5	54	4	5
Interactive Whiteboard	50	5	5	52	5	5
MS PowerPoint	50	4	4	52	4	4
Search Engines	50	4	5	52	4	3
Online Games	50	3	3	51	3	3
Video Sharing Sites	50	3	4	52	3	3
MS Word	50	3	4	53	3	3
Professional Websites	49	3	3	51	2	1
Mp3/iPod Music Player	50	3	3	53	2	1
Prezi	51	3	1	53	1	1
Storing Information	50	2	1	52	2	1
Desktop Machine	47	2	1	52	4	5
Digital Camera	51	2	1	51	2	1

Table 15 *Cohort two professional technologies and frequency of use on school placement*

	Cohort Two Survey II - March 2015			Cohort Two Survey III - December 2015		
	N	**Median**	**Mode**	**N**	**Median**	**Mode**
Data Projector	37	5	5	38	5	5
Laptop	37	5	5	38	5	5
Internet	37	4	5	37	5	5
Interactive Whiteboard	37	4	5	38	5	5
MS PowerPoint	37	4	5	38	5	5
Search Engines	35	4	4	38	4	4
Online Games	37	3	4	37	4	4
Video Sharing Sites	36	3	3	38	4	4
MS Word	37	3	3	38	4	3
Professional Websites	35	3	3	38	3	3
Mp3/iPod Music Player	35	1	1	38	2	1
Prezi	35	1	1	38	1	1
Storing Information	36	3	1	38	3	1
Desktop Machine	37	1	1	38	5	5
Digital Camera	36	1	1	37	2	1

Data projectors & laptop.

The previous data tables (Table 14 and Table 15) outlined the most frequently used technologies, as reported in surveys II and III, by these pre-service teachers. During each school placement block pre-service teachers used data projectors (C1 SII *mdn* five, C1 SIII *mdn* five and C2 SII *mdn* five, C2 SIII *mdn* 5) and laptops (C1 SII *mdn* five, C1 SIII *mdn* five and C2 SII *mdn* five, C2 SIII *mdn* five) most frequently, where a median score of five represented many times a day.

These findings were further supported when interviewees were asked what technologies they had used most frequently in the classroom, while on school placement. Most classrooms were equipped with a digital projector and laptop, and if the laptop was not available, pre-service teachers tended to use their own personal laptops, which were connected to a digital projector:

> It was just projectors with a laptop, yea yea (C1 PE1),
>
> So it would've been just projector (C1 SGE1),
>
> Second year there was a computer and a projector, like a projector onto the normal white board (C1 SGE2),
>
> So the basic ones would just be the laptop of course (C1 GE1),
>
> For the most part, the schools I was in have the projector where you hook up your laptop to it (C1 VGE1),
>
> So in first year I had first class and there was an IWB but it was broken so I just had the projector part (C2 GE1) and
>
> No she had laptop yea, that she hooked up and then when I was teaching, I brought mine in (C2 VGE2).

Pre-service teachers had a variety of issues using these projectors and laptops, but these will be discussed under research question three when discussing factors that impacted on use of technology in the classroom.

Desktop machines.

Of note was an increase in use of desktop machines from one placement to the next, by respondents in each cohort. Cohort one had reported rare use of desktop machines (C1

SII *mdn* two) but then used them often by survey III (C1 *mdn* four). Equally, cohort two saw a similar increase in their pattern of use where in survey II they reported never using them (C2 *mdn* one) and by survey III, the median score had also increased to many times a day (C2 *mdn* five). This increased use, from one placement to the next, would suggest a reliance on desktop machines due to their availability in a school placement classroom. This was an interesting result given the decrease in use of personal desktop machines reported in the first research question. Desktop machines had not featured strongly during the interview phase of the research, and where they were mentioned they were seen as older technology, than a laptop: “one school actually had a PC, I think, it still didn't have a laptop” (C2PE1) and one interviewee seemed to prefer using her own laptop, where a desktop machine would have been more difficult to connect to:

> I tried to bring in my own laptop a few times so it kind of wouldn't become a problem but again I didn't have the software and this and that on my own laptop, so I couldn't just be plugging it in, plugging it out and then sometimes there's only a laptop, so it's fine to plug in your own, but then I had a computer kind of like yours [desktop] the last one, so you couldn't just be plugging it in and out switches (C2 VGE1).

Whether the desktop machine was connected to an interactive whiteboard (IWB) was not clear from the interview data, but interviewees seemed to prefer the mobility a laptop afforded. As participants were on placement for a short block of time, and as reported earlier, they tended to use their own laptops in combination with whatever technology was present in the placement classroom. Thus, the availability of technology, such as desktop machines on school placement was an influence on both survey and interview respondents. This will be explored further in the next chapter related to the barriers impacting on use of technology in a classroom.

Internet.

Internet (C1 SII & SIII *mdn* five, C2 SII & SIII *mdn* five) was used frequently by both cohorts, during school placement, as reported by both cohorts. Cohort ones’ use of

Internet was very frequent (*mdn* five) in survey II but less frequent by survey III (*mdn* four) indicating a lower middle value in the data set. Cohort twos' use of the Internet was also very frequent in survey II (*mdn* four) and had increased by survey III (*mdn* five) where a higher median score indicated a higher middle value in the range of data.

The reason for the difference in median scores between survey II and survey III was not clear from the survey data. It did become apparent that some issues had arisen when using the Internet in schools, but these are discussed in the next chapter. Where interviewees had internet access, they were effusive about its benefits on school placement: "its brilliant when a school has now, when a school has internet, fast internet even" (C1 VGE1), "even if you just Google a random thing like eh, something not working – (click of fingers sound), next thing comes up (click)" (C1 VGE2) and "mostly get it from the web, there's so much on the web" (C1 GE2). Participants did report a variety of problems with the Internet, its availability, or it simply not working at all:

> Yea the Internet went down I think twice maybe (C1 PE1),
>
> Like if you go in in the morning, anything I would use that I'm using the Internet for, I have it loaded beforehand to be honest (C2 PE1) and
>
> I wouldn't be able to do teaching practice without the Internet or without a computer (C2 GE2).

Thus, where the Internet was available it was a valuable asset, but problems were encountered using it, which will be discussed in the next research question.

Interactive whiteboard.

The interactive whiteboard (IWB) also featured as one of the most frequently used technologies on school placement, when it was present in the school classroom. A modal score of five (many times a day) for each cohort and each survey, was reported. A median score (C2 *mdn* four) was present for the second cohort, but this still indicated frequent use of the IWB. The modal score stayed static for each cohorts' survey III results, and the median score increased for cohort two, indicating the presence, and availability, of

IWBs in different school placement classrooms, from one year to the next. Interviewees were asked about the availability of an IWB in schools and the majority of participants had access on at least one of their school placement blocks: "there were interactive whiteboards on my placement I just did" (C1 PE1), "like I had the IWB in November, so I would've used that a lot, that was brilliant" (C1 SGE1) and "in first year there was a promethean board" (C1 SGE2). However, not having access to an IWB was an issue for some interviewees where in "third year it was kind of a step back because there was no IWB, at all" (C2PE1):

> So first school placement there was the whiteboard, the interactive whiteboards, so I had one in first year, and one in second year and then I went into my classroom in 3rd year with my senior infants and I said 'where's the whiteboard' so they don't have one and I was like you're telling me every child in the school has a violin but not whiteboard in the classrooms and I was just baffled (C1 VGE2).

However, as before, the barriers that impacted on use of this particular type of technology in the classroom are discussed in the next chapter, and not analysed here.

PowerPoint.

PowerPoint was used more often by cohort two (SIII *mdn* five) than cohort one (*mdn* four). Equally, cohort ones' usage remained static from one year to the next, whereas cohort twos' usage had increased on their third-year placement (C2 SII *mdn* four to C2 SIII *mdn* five). This was of note in the current research as this software does not form part of the content of the college preparation course. How pre-service teachers were using this software was then explored with interviewees at the end of their final school placement block in third year.

All interviewees (n = 14) had relied on this software on a daily basis. They reported use of it as the norm on school placement: "oh yea, lots of PowerPoints" (C1 PE2), "just PowerPoints, I used lots of PowerPoints" (C1 GE2), I think it's just normally just like straightforward PowerPoints" (C1 PE1) and "I used PowerPoint yea, that was kind of my favourite thing to use, like the normal yea" (C2 VGE2). However, there were comments from their school placement supervisors that some of the interviewees tended to overuse PowerPoint and were relying on it too much. This may also explain the reduction in use of PowerPoint by cohort one, by third year:

> Yea, I've got that on feedback– too much use of the PowerPoint, you should do more like different – like change it up a little - she just felt like it was overuse of them and children were kinda probably getting bored seeing the PowerPoint, just like too much reading off them maybe, I was reading too much off them - off the board, I wasn't really engaging with the children as much maybe (C1 GE2).

One interviewee reported that sometimes children in the classroom were also bored by over-use of PowerPoint: "like, an awful lot of the time when I did PowerPoints, the kids weren't interested" (C2 GE2). Yet, participants continued to use PowerPoint on school placement as it was what they were used to and were comfortable with: "but I suppose that's cause I was probably using stuff, like I wasn't branching out too far, I was using stuff I was comfortable with rather than cause that's just added stress you really don't need" (C1 SGE2). This added stress referred to the nature of school placement being an examination of their teaching ability, in a classroom environment. Thus, PowerPoint was one of the most frequently reported technologies in use by survey and interview participants, from both cohorts. However, comments about how PowerPoint was used generally (during their college preparation course) also arose at interview, these comments will be explored subsequently.

Video.

Video and video sharing sites were used between sometimes and often by members of each cohort, where cohort twos' use of video had increased from one survey to the next (C2 SII *mdn* three, C2 SIII *mdn* four), whereas cohort ones' usage had remained static (C1 SII *mdn* three, C1 SIII *mdn* three). However, access to video sharing sites was an issue for some respondents, in a classroom. Where video was used, it was used to demonstrate a point, or process, that a pre-service teacher was trying to make to the children:

> I used loads of YouTube, YouTube has so many songs if you look for the right channels, that cover everything from how to brush your teeth, to a song about, what was there a song about, oh there was a song about particular sounds that literally just all these words that had the e sound in it, and junior infants loved those (C2 VGE2).

Videos were also used to add a fun element to a lesson, and to enhance a lesson:

> Well videos I'd use videos for everything nearly - I always just put like video, like I would have - this time I would've done a lot of YouTube like dance videos like just dance on that, to get them up dancing – so just songs (C1 SGE1),
>
> Yea, video's great - I used it for a dance party on the final day I just played The Wiggles channel (C2 VGE2),
>
> Just to really enhance the lesson – I wouldn't use it just solely for a lesson, but just to enhance and bring it all together (C1 PE2).

One participant (C2 VGE1) described trying to make her own videos but was mindful of not being able to video any of the children in the classroom, as she did not have explicit permission to do so, from their parents.

Interview participants also reported they would have liked to use video more frequently but faced problems with school firewalls and more generally with YouTube as it was blocked in the schools they had visited on school placement: "I found every school apart from the last one, You Tube has been blocked" (C2 PE1) and "YouTube was blocked yea" (C2 GE1). However, one student had managed to figure out a workaround so she could use video on school placement: "like that for videos, different videos, I'd have to download from Clip Converter" (C1 VGE2). Generally, interview participants favoured use of YouTube, but they had to consider alternatives as it was blocked in the schools, they had attended for school placement. Interviewees in both cohorts also mentioned Vimeo, an alternative web-based video platform, which was used less frequently. Thus, as before, when using technology, there were barriers that impacted on use, which will be explored presently in research question three, in the next chapter.

iPads.

Tablet devices did not feature as a technology used with any frequency in either survey instrument, for either cohort (C1 SII *mdn* one & SIII *mdn* one, C2 SII *mdn* one and SIII *mdn* one). Indeed, the low median scores may have also been indicative of the technology not being available in the classroom (scored as 0 in SPSS). However, 11 out of 14 interviewees mentioned iPads in the classroom where often these interviewees were in schools that had iPads but had not had a chance to use them: "I think the school had a batch of iPads I didn't get a chance to use them" (C1 VGE2) and "I never really got, I know in first year the principal had the iPads, but I've never really got to work with the iPads, and I would like an opportunity to do that with the kids because I don't have an iPad myself" (C2 VGE2). When questioned further, interviewees were not specific about what to do with the iPads, rather they just held the general view that iPads were a good idea: "well, I suppose having iPads would be brilliant" (C1 GE1), "no school I'd been in have had iPads, but I haven't been lucky enough now yet, but I would love to do that now"(C2 PE1), "I think there should be iPads and stuff like that, in schools" (C2 GE1) and "no I don't own an iPad myself but it's something that I think will be huge coming into schools in the next few years" (C2 VGE1).

Technologies Not Used in the Classroom

There was a similar lack of use of a variety of other technologies by survey participants from both cohorts. For example, a median score of one was reported for each of the following technologies, in each cohort: professional websites, Google drive, mp3 players, digital cameras, email, mobile/smart phones, attendance management systems, MS excel, online music sites, virtual learning environments, curriculum software packages, visualisers, WhatsApp/Viber, Facetime and Skype, digital books and social media sites amongst other items listed in the survey instruments. Survey participants had used some of these technologies (Facebook, WhatsApp and Skype) to communicate with each other during school placement and it was noted that these communication technologies tended to be used in a personal capacity only, as reported earlier. As such, an interesting delineation existed between personal and professional use of these communication tools.

Prezi had been mentioned by some interview participants and had only been used sometimes by cohort one (C1 *mdn* three). Those few that did use Prezi had mixed views: "prezi's great, you can download it" (C1 VGE1), "I love making prezis but they are so frustrating sometimes" (C1 VGE2) to being unsure about it entirely: "Prezi I prefer em, but even still I don't really like, I don't like it" (C2 PE1). Online games, such as Minecraft, were also mentioned at interview, but it was in the context of what the children in their classes were using at home, rather than being used by the pre-service teachers themselves. Those interviewees that had mentioned Minecraft did think it was a good idea:

> Kids love it, there's this whole range, there's books for doing it, these people show you how to cheat these things, and you can build your houses, they show you how to build your like castles, and stuff it's really really good (C1 VGE2)

and "junior infants they all talk about Minecraft, which is good" (C1 GE1). Use of a digital camera was also mentioned specifically by one interview participant: "the camera is a big thing actually – that I've used a good bit" (C1 GE1) and not mentioned at all by other survey or interview participants in either cohort. Yet use of images, and image sharing websites such as Pinterest and Instagram, had also arisen for the majority of interviewees, as outlined earlier. The other rarely used technology, that was mentioned by interviewees, was the visualiser. Participants reported that they had not seen visualisers before, and were impressed by how they could be used, in the classroom. Two quotes exemplified the experiences of using a visualiser: "yes, they had a visualiser – it was great – I've never, this was my first placement working with them, unreal like, so good" (C1 GE2) and,

> So that was (the visualiser) I'd never seen that before - it looks like a little lamp and it just picks up whatever is underneath it and it just, it's just up there, so if I had a printout or you know, anything I could just literally slide it under and the kids would be able to see it, huge in front of them, they were tiny, they were only first class, so they were like oh look, like anything and it would go up in colour and everything. so that was the first time I'd ever seen that, I thought that was brilliant (C2 VGE2).

Of note, however, was how interviewees were using the visualisers mentioned, and the teaching strategies employed by participants during school placement are explored shortly.

Interviewees from both cohorts mentioned other professional technologies they had used while on school placement, that were not listed in the survey instruments. These included technologies such as Weebly (a drag & drop website builder), regular dry-wipe whiteboards (akin to a blackboard), their own iPods (to play music) and Playdough (modelling clay). The term technology being applied to whiteboards and Playdough was interesting to note, and that the interviewees defined technology use in the classroom as not being limited to the lists supplied in the survey instruments.

Cohorts' Usage Patterns

Composite professional use scores were calculated for each respondent, by calculating composite use scores for the fifteen most frequently used technologies for each survey instrument, using the compute variable function in SPSS. These composite professional use scores were then compared, using paired sample t-tests. These paired sample t-tests were also used to check for any progression in use of technology, from one placement to the next, for those participants that had answered both survey II and survey III, from each cohort. The results of the paired t-tests are reported in Table 16.

Table 16 *Differences between cohorts' usage patterns paired t-test results*

Paired samples t-test	*T*	*df*	*p value*
Cohort 1 Prof Use SII & Prof Use SIII	2.81	38	0.01*
Cohort 2 Prof Use SII & Prof Use SIII	-2.75	19	0.01*

* *significance value <.01*

The results of the paired t-tests were interesting, as cohort ones' use of technology had significantly *decreased* from one placement to the next. For example, cohort ones' composite score for use of technology in survey II was *M* 3.21 *SD* .63 and for survey III *M* 2.91 *SD* .59; $t(38)=2.81$ $p<.001$. Cohort two, however, reported a marginal *increase* in their use of technology from one placement to the next (SII *M* 3.03 *SD* .57 SIII *M* 3.34 *SD* .52; $t(19)= -2.75$ $p<.001$). Given the small number of respondents (n=20), this result while significant may not be important where the mean score of three was still indicative of infrequent use (three represented 'sometimes used' on the survey instruments). Thus, these results suggest that a school placement environment had a statistically significant impact (both positive and negative) on professional use of technology for participants from both cohorts. These results had been evident in the frequency counts, median and modal scores for use of professional technologies in each cohort, reported earlier in this chapter, and the paired t-tests confirmed the previous results.

Expertise Levels & Professional Technologies

When expertise levels were cross-tabulated with use of professional technologies in SPSS, similar patterns of use emerged, across both cohorts. This cross-tabulation of expertise levels with what technologies each cohort used are displayed in the following four tables (Tables 15 to 18). These tables are then analysed and discussed.

Table 17 *Cohort one survey II frequency of use of professional technologies > 4 (often or very often) by expertise levels*

Professional Technology	**Poor Expert [5]**	**Somewhat Good Expert [11]**	**Good Expert [22]**	**Very Good Expert [9]**	**n = 46**
Laptop	4	10	20	6	40
Data projector	4	7	19	9	39
Internet	5	7	19	8	39
Interactive Whiteboard	4	7	19	8	38
MS PowerPoint	4	6	16	9	35
Search Engines	2	6	18	8	34
Online Games	3	2	11	5	21
Video sharing sites	3	3	11	4	21
MS Word	1	3	11	5	20
Professional websites	1	3	8	5	17
Prezi	1	2	5	2	10
Mp3/iPod music player	1	3	5	0	9
Desktop machine	1	1	5	2	9
Storing Information	0	2	5	1	8
Attendance management	0	2	4	2	8
Digital camera	1	1	4	1	7
MS Excel	0	3	2	2	7
Blogging site	0	2	3	1	6
Curriculum software	0	2	2	2	6
VLE	0	2	1	1	4
Visualiser	0	1	1	2	4
Classroom 'clicker' system	0	0	1	2	3
Online news sites	0	1	0	1	2
Online music site	1	0	1	0	2
Smart phone	0	0	0	2	2
Accessing digital books	0	1	0	1	2
Blogging site (creating)	0	0	1	1	2
Tape-recorder	1	0	1	0	2
iPad/Tablet Device	0	1	1	0	2
Online Discussion Group	0	1	0	1	2
Video Camera	0	0	1	0	1
Email	0	0	0	1	1
Mobile phone	0	0	0	1	1
Photo Sharing Sites	0	0	0	1	1

Table 18 *Cohort one survey III frequency of use of professional technologies >4 (often or very often) by expertise level*

Professional Technology	**Poor Expert [5]**	**Somewhat Good Expert [11]**	**Good Expert [22]**	**Very Good Expert [9]**	**n = 38**
Data projector	4	9	18	7	38
Interactive Whiteboard	2	10	18	5	35
Internet	4	7	17	3	31
Laptop	2	7	12	5	26
MS PowerPoint	2	7	13	4	26
Desktop machine	2	6	11	3	22
Search Engines	4	6	9	2	21
MS Word	2	6	8	5	21
Video sharing sites	3	3	4	3	13
Online Games	2	1	5	4	12
Storing Information	1	2	4	3	10
Prezi	1	2	4	2	9
Attendance management	1	2	2	3	8
Digital camera	1	2	3	1	7
Email	1	3	3	0	7
Professional websites	0	1	3	2	6
Mp3/iPod music player	1	3	1	1	6
VLE	0	1	2	1	4
Curriculum software	1	0	1	1	3
Visualiser	0	0	2	1	3
Online music site	0	1	2	0	3
Smart phone	0	0	1	2	3
Accessing digital books	1	1	1	0	3
Online news sites	0	0	1	0	1
Tape-recorder	0	0	1	0	1
Online Discussion Group	0	0	0	1	1
Mobile phone	0	0	1	0	1
Social Networks	0	0	1	0	1
Instant Messages	0	0	1	0	1
What's App	0	0	1	0	1
Viber	0	0	1	0	1

**Note – not all survey respondents answered this question*

Table 19 *Cohort two survey II frequency of use of professional technologies >4 (often or very often) by expertise level*

Professional Technology	**Poor Expert [2]**	**Somewhat Good Expert [11]**	**Good Expert [13]**	**Very Good Expert [7]**	**n =33***
Data projector	1	11	12	6	30
Laptop	1	7	11	7	26
MS PowerPoint	1	7	11	5	24
Internet	1	8	7	6	22
Search Engines	1	7	9	5	22
Interactive Whiteboard	1	8	8	2	19
MS Word	0	3	8	4	15
Video sharing sites	1	4	7	1	13
Online Games	0	6	4	2	12
Professional websites	1	1	6	3	11
Storing Information	1	4	2	3	10
Attendance management	1	3	2	1	7
Desktop machine	0	4	1	0	5
Online music site	1	0	2	1	4
iPad/Tablet Device	0	2	2	0	4
Mp3/iPod music player	1	1	1	0	3
Prezi	0	1	1	0	2
Curriculum software	0	0	2	0	2
VLE	0	0	1	1	2
Online news sites	0	0	1	1	2
Visualiser	0	1	0	0	1
Classroom 'clicker' system	0	0	1	0	1
Email	0	1	0	0	1
Grade Management	0	1	0	0	1

**Note – not all survey respondents answered this question*

Table 20 *Cohort two survey III frequency of use of professional technologies >4 (often or very often) by expertise level*

Professional Technology	Poor Expert [0]	Somewhat Good Expert [13]	Good Expert [17]	Very Good Expert [6]	n= 36
Internet	0	12	15	6	33
Data projector	0	12	14	6	32
Interactive Whiteboard	0	12	16	4	32
MS PowerPoint	0	10	17	4	31
Laptop	0	9	15	6	30
Online Games	0	8	14	6	28
Search Engines	0	6	13	4	23
MS Word	0	3	11	5	19
Video sharing sites	0	5	8	4	17
Attendance management	0	5	9	1	15
Desktop machine	0	6	6	1	13
Storing Information	0	4	4	1	9
Professional websites	0	1	5	1	7
Prezi	0	2	1	2	5
Mp3/iPod music player	0	2	3	0	5
iPad/Tablet Device	0	2	3	0	5
VLE	0	1	1	1	3
Curriculum software	0	0	2	1	3
Online music site	0	0	3	0	3
Classroom 'clicker' system	0	2	1	0	3
Wiki	0	1	2	0	3
Visualiser	0	2	0	0	2
Grade Management	0	1	1	0	2
Digital camera	0	0	1	0	1
Email	0	1	0	0	1
Smart phone	0	0	1	0	1
Accessing digital books	0	0	1	0	1
Online news sites	0	0	1	0	1
Blogging site	0	1	0	0	1
Photo Sharing Sites	0	0	0	1	1

Of note in the previous tables was that for each cohort, the most frequently used technologies on school placement did not seem to differ across expertise levels. Cohort ones' most frequently used technologies (*mdn* five) on school placement included Internet, data projectors, MS PowerPoint, IWBs and laptops across all expertise levels, where four out of five PEs and nine out of nine VGEs had similar frequencies of use. Equally, cohort two reported similar results, where the same five technologies were used most frequently equally across all expertise levels. For example, 12 out of 13 SGEs used the Internet as frequently as all six VGEs.

There were however, small differences between the cohorts, amongst the lesser-used technologies by the different expertise levels in each cohort. For example, frequency of use of online games was reported across the different expertise levels in cohort two (n= 36), where eight of 13 SGEs and all six VGEs used these often or very often on school placement. Usage by cohort one differed in that only two PEs and four VGEs reported using online games, out of a total sample of 47 participants. Similarly, cohort two only used attendance management systems during their third-year school placement, where five (of 13) SGEs and nine (of 17) GEs had used them with any frequency. However, cohort one had very little reported use of attendance management systems, across all expertise levels (one PE of five, two of 11 SGEs, two of 22 GEs and three out of nine VGEs), this was perhaps expected, given they were in another teacher's classroom.

Chi-square & Spearman rank-order correlation.

When chi-square analysis was conducted on self-rated expertise with professional technologies used, results proved unproductive as often the reported frequencies in the cross-tabulations were too small (less than five) for the test to be applicable.

As chi-square analysis proved unproductive and as the data was ordinal in nature, non-parametric Spearman rho (r_s) rank-order correlation statistical tests were conducted on the survey data, for each cohort. Self-reported expertise levels were correlated against professional uses of various technologies, which demonstrated the strength of a relationship, if any, between expertise levels and what technologies were used. Some significant results were obtained. In cohort one self-reported expertise correlated highly significantly with internet (C1 r_s=*.416 p<.001*), search engines (C1 r_s=*.381 p<.001*) and smartphones (C1 r_s=*.497 p<.001*) and significantly with data projectors (C1 r_s=*.312 p=.05*) and email (C1 r_s=*.342 p=.05*). In cohort two self-reported expertise correlated significantly with smartphones (C2 r_s=*.370 p=.05*) and highly significantly with MS Word (C2 r_s=*.543 p<.001*) only. Thus, these pre-service teachers demonstrated levels of expertise when using the Internet, Google search engines, MS word and their own smartphones. As such, while these results were interesting, they were also quite similar to the personal technologies used by participants, as reported earlier.

Other associations were present in each cohort for various combinations of use of the professional technologies listed, but the results were outside the remit of the current research question. They were, however, interesting where professional use of a digital projector correlated significantly with using MS PowerPoint (C1 r_s=*.465 p<.001* and C2 r_s=*.558 p<.001*) and laptop (C1 r_s=*.447 p<.001*, C2 r_s=*.436 p<.001*) for both cohorts. Similar to the frequent personal use of social media reported earlier, use of social media showed highly significant associations with smartphone usage (C1 r_s=*.396 p<.001*, C2 r_s=*.527 p=.05*) and online discussion groups (C1 r_s=*.471 p<.001*, C2 r_s=*.640 p<.001*) for both cohorts. These results were similar to the reported reliance on Facebook discussion groups reported earlier, where such discussion groups were used as a peer support mechanism during school placement, most likely being accessed using their smartphone devices. Other highly significant correlations were present for social media and photo sharing (C1 r_s=.633 *p<.001*) and social media and online games (C2 r_s=.615 *p <.001*) but again these were symptomatic of the prevalence of photo sharing websites such as Pinterest (C1) and Snapchat (C2) for survey participants, as reported earlier, in the first research question.

How Professional Technologies Were Used on School Placement

While *what* professional technologies each cohort reported were of interest, this research question also investigated *how* the pre-service teachers were using those reported technologies. Table 21 outlines how the pre-service teachers used technology while on the various school placement blocks, as reported in the survey instruments (survey II & III). The survey items were based on statements presented in previous literature (EU Commission, 2013). Hence, this is acknowledged as a limitation of this particular section of this survey instrument where providing a list of statements to survey participants may have curtailed their responses. As such, the interview responses provided a broader sense of how technologies were used in the primary school classroom, by these pre-service teachers, while on school placement.

Non-parametric analysis.

Respondents were asked to choose from eighteen ways of using technology in the classroom in section three of survey II (and III). Table 21 outlined the most frequently reported uses of technology, where these eight items were the only ones chosen with any frequency, by survey respondents in either cohort. These items are now reported, in conjunction with the interview data of relevance to those methods.

Table 21 *How technologies were used on school placement frequency counts*

	Cohort one survey II - March 2014			Cohort one survey III - December 2014			Cohort two survey II - March 2015			Cohort two survey III - December 2015		
	n	**Mode**	**Median**	**n**	**Mode**	**Median**	**n**	**Mode**	**Median**	**n**	**Mode**	**Median**
Looked for material online to prepare lesson plans	49	5	5	51	5	5	33	5	5	32	5	5
Prepared exercises/tasks (handouts) for children	49	5	5	50	5	5	33	5	5	32	5	5
Used applications (MS Word/PPT) to prepare presentations for lessons	49	5	4	52	4	5	33	5	5	32	5	5
Used social networking (Facebook) to exchange ideas with my class colleagues during SP	48	5	1	50	3	3	33	4	5	32	5	4
Demonstrated science experiments	49	3	3	50	3	1	33	3	3	31	3	3
Downloaded material from College virtual learning environment	48	1	3	49	3	1	32	1	1.5	31	4	3
Used social networking (WhatsApp) to exchange ideas with my class colleagues during SP	48	1	3	50	2	1	33	1	3	32	1	3
Used Digital Textbooks (e.g. Folens, Ed.Co)	48	2	1	50	1	2.5	33	2	1	31	4	3

Lesson planning.

'Looking for material online to prepare lessons' was the primary use of technology while on school placement in order to prepare for lessons. For example, survey participants 'looked for material online to prepare lessons' (C1 *mdn* five, C2 *mdn* five) and 'prepared exercises/handouts for students' (C1 *mdn* five, C2 *mdn* five) most frequently, during both cohort's first school placement block (survey II). Further, 'use of PowerPoint or Word to prepare material for lessons' was similar across both cohorts' first school placement (survey II), where cohort ones' use of this technology was very often (mdn five) and cohort twos' frequency of use scores were similarly, very often (mdn five).

Yet, interview data had not mentioned using technology to prepare for school placement generally. Indeed, only one interviewee mentioned using technology to prepare for school placement at all: "for first year - only in my laptop at home to do my lesson plans and all the Internet obviously, at home, but nothing in school" (C2 SGE1). Other interviewees had not commented on this use of technology at all; this could be linked to the focus of the interview being on use of technology while in the classroom or indeed, a feature of the timing of the interviews with both cohorts. Interviews were conducted after the final school placement, and the pressure of preparation may not have been in the forefront of interviewees' minds at that time.

Social media.

Of note in the survey data, was the reliance by both cohorts, on 'social networking to exchange ideas with their classmates, during school placement'. Cohort one used this technology with similar frequency (C1 *mdn* five) to cohort two (C2 *mdn* four) [very often and often] during their first school placement block, however, cohort ones' usage had reduced by their third-year block (C1 SIII *mdn* three). Cohort two still continued to rely on Facebook during their final school placement in third year (C2 SIII *mdn* four). This was similar to the personal reliance on Facebook expressed during interviews, by C2 participants, as outlined earlier. However, similar to the lack of use of WhatsApp, and other free communication platforms in a personal capacity, both cohorts had only used these communication tools sometimes in the classroom (C1 SII *mdn* three, C1 SIII *mdn* one and C2 SII *mdn* three, SIII *mdn* three).

College virtual learning environment.

By the time both cohorts had reached school placement in their third year of study, there were differences between how they were using the college virtual learning environment (VLE). In second year, cohort one had used the virtual learning environment at least sometimes, but cohort two had never used it (C1 SII *mdn* three, C2 SII *mdn* one). By third year usage of this facility had decreased for cohort one and increased for cohort two (C1 SIII *mdn* one, C2 SIII *mdn* three). However, a median score of three still only indicated that the virtual learning environment was used sometimes. Both cohorts' use of VLE was significantly associated with 'preparation of handouts' (C1 r_s=.332 $p=.05$ and C2 r_s=.461 $p<.001$) but only in their survey III responses (third year). This then became apparent with interviewees from both cohorts after their final school placement block as noted by two participants:

> There's actually a part on Moodle and I don't think people know this on school placement, it's actually an uploading thing (C1 VGE2),
>
> Moodle is very good especially coming up to placement where all - I don't know, nobody seems to save a template of a lesson plan. I'd go on every night and I'd download one (C1 PE1).

Curriculum software packages.

There was limited use of publisher content by survey participants, where for cohort one usage had increased marginally between second and third year (C1 SII *mdn* one, SIII *mdn* two). Usage had increased for members of the second cohort (C2 SII *mdn* one, SIII *mdn* three) from one placement to the next. Interview participants had also mentioned curriculum software packages such as ‘Ready Set Go Maths’, ‘Buaine Cainte’ (an Irish software package) and ‘Jolly Phonics’. These curriculum software packages were created by the various educational publishers and provided multi-media content for teachers to use in the classroom, accompanied by a book for children. However, interviewees had mixed views on the use of these curriculum packages and were generally worried about the over-reliance on these packages by the schools they had seen them in:

> You load it on and then it basically like all the teachers were like- it does the teaching for you and I’m like – eh, no it doesn’t, it supports your teaching (C1 VGE2),
>
> but I do find Buaine Cainte like a lot of the teachers love it because it’s kind of the lazy way out - they just turn on the thing, and I don’t think it’s that good (C2 SGE1).

Overall however, there was general consensus that children enjoyed the interactive elements of these curriculum packages, and that they were learning from them:

> Even with the new Buaine Cainte software its fantastic and a lot of people think that people are going to become reliant on it and let it do the teaching, but the kids are like oh there’s the teddy bear, you know they just become more familiar with things and they’re like oh, they might then add another little bit of Gaeilge (C2 VGE1).

Other teaching methods mentioned at interview.

Generally, teaching methods associated with technology tended to reflect instructor led, traditional, uses of technology in the classroom where the majority of interviewees reported using technology ‘to enhance or augment a lesson’. While this phrase was non-specific, it was a frequent response from interview participants:

> Em…yea no I just kind of use it to enhance the lessons (C1 PE2),
>
> Ideally, technology would be used to enhance or augment a lesson but not to be the entire lesson - definitely but just to enhance the lesson, not to teach a lesson, just not the whole thing (C2 PE1).

These enhancements included using technology as a stimulus, to introduce or conclude a lesson and using technology in conjunction with more traditional teaching methodologies, such as concrete materials, or working in a copybook:

> But I think as a stimulus because it's what they're into, they love it themselves and as stimulus for any lesson, a conclusion to any lesson, oh god yea, they would know the minute I have it on, they kind of know (C2 PE1),

> Just to kind of to do it like that, kind of looking for something different to do, looking for ways to make it more interesting, and a little break in the lesson, because I feel like your intro, your development, your conclusion they have to be very separate, so you might have a really active intro and a really active conclusion, and a very maybe text based or very just discussion based opening, or you might do it separately, where the action is might be somewhere here in the middle (C1 VGE2),

> Yea, so (Buaine Cainte) so you basically click into it, it gives you like ten lessons and they're all done out, there's like a conversation part of the lesson, there's a game, there's a song and it's all done out, now it's basic, but there's such good bits in it, that you can add into your lesson. So what I did was I'd introduce the lesson myself like with real things, so like with say I was doing clothes, so I had a big bag and we took out the bag and we hung them up on this line (C2 GE2),

> I do tend to use it as kind of an introduction because it has to be a whole class thing so for them to see yea, that's working, so now I can do it in my workbook or my copybook with this – with these materials (C1 SGE2).

Technology was also useful for lesson transitions and as a prompt for the children to recognise when a new topic was going to be covered: "playing videos for 'transitions' and songs and it really got their attention em, you know just to give them little breaks in between" (C1 PE1).

Overall, these uses of technology tended to support instructor-led approaches and all interviewees reported using technologies such as YouTube (where available), PowerPoint with the IWB to demonstrate or display a topic, image or worksheet relevant to the lesson being conducted:

> Pure display really, yea, pure display (C2 GE1),

> So I did use that (IWB) for kind of displays and I think the main thing was to get their attention (C2 GE2),

> Then I also took a lot of pictures then to put up on display (on IWB) (C2 GE1),

> Videos online showing them pictures online, its brilliant when a school has now, when has a school has internet, fast internet even – having a discussion being able to turn around and go you don't know what I'm

> taking, you do, but I'm going to get a picture and you can bring it up, or I would get a video – it's very great visually (C1 VGE1),
>
> Or if then I just had the projector I used to do Story, and I just find that if you can get a story book books are great, but sometimes they're not practical – you have too many kids in a class it's gonna take double your time to move that book around, to show them – I didn't see that, I didn't see that (child's voice) – if you have a whiteboard and you have the book – it's still a book and it's still a story, and it's still literature, there's still words -they're just reading it away, and everyone can see it (C1 VGE2).

Yet, the software that came with the IWB tended not to be utilised, as the pre-service teachers felt they did not know how to use it. Furthermore, there were problems with the IWBs not functioning in some of the school placement classrooms. These challenges using technology will be discussed in the next chapter. Other reported uses of technology included 'demonstrated science experiments', which had been mentioned in both cohort's survey responses (C1SII *mdn* three, C2SIII *mdn* one, C2SII *mdn* three, C2 SIII *mdn* three - either never or sometimes). However, these particular uses of technology had not arisen during any of the interviews conducted. Nonetheless, when interviewees described using videos to demonstrate a point, science may have been one of the topics covered.

Getting children involved.

Other reported uses of technology that were mentioned by all interview participants concentrated on getting children involved in various activities that were going on, in the school placement classroom: "so they all got their go and they loved coming up and that was really good actually for the kids" (C1 VGE2) using the IWB. Generally, getting children involved was seen as a good thing and specific uses of technology mentioned included getting children to do project work: "they were for like for research projects - the kids want to go look up things"(C2 GE1), "I think kids remember information a little bit more, when they look it up themselves, rather than you just feeding it to them" (C2 SGE1), using computers in a classroom to type up reports or stories: "there was 30, over 30 computers in the room so like you can't replace them every other year, but it was (computer room) it was being used for typing up projects and stuff from what I could see" (C1 SGE2), allowing children to explore new things (on these computers): "their engagement more than anything, especially with 4th, 5th and 6th classes I find they liked looking up things on a computer" (C2 SGE1), letting children create their own podcasts (using microphones and software such as Audio boo): "let's download it and see, make a video, or make music - you can put different sounds on something - and merge them together" (C2 VGE2), using technology to create quizzes for the children: "then in the class I made quizzes about it, so they would watch the video and then we , to make sure they were watching it, I did like little quizzes and stuff, this was 5th and 6th class" (C2 VGE2) and creation of stop animation videos (where clay was used to create characters, and then pictures were taken of the clay characters in various poses, then merged together into a video clip) by the children, using iPads as camera devices: "we did an App an animation, using an App, and we had …say you made something out of clay and then you could do it" (C2 SGE1). However, getting children involved did not appeal to everyone, as a cohort one interviewee commented in relation to children at the IWB: "no I don't want to get them to come up at all" (C1 PE2). Whether this was down to a classroom management concern or not, is explored in research question three in the next chapter.

The teaching methods not employed when using technology (seldom/never) by either cohort, were also informative and had a tendency to be more constructive in nature (not shown in Table 21). Use of data logging tools (C1 *mdn* one and C2 *mdn* one on both surveys), multimedia production tools (C1 *mdn* one and C2 *mdn* one on both surveys), use of twitter to exchange ideas (C1 *mdn* one and C2 *mdn* one on both surveys) and teacher/parent communication (C1 *mdn* one and C2 *mdn* one on both surveys) did not feature, on either school placement block, for either cohort. The teacher/parent communication low mode scores would be expected given these pre-service teachers were on school placement, and as such were likely not in a position to communicate with parents using technologies available in the classroom.

Expertise Levels and Teaching with Technology

Given the self-reported expertise levels on the survey respondents, in each cohort, how different expertise levels used technology, in the classroom, was also of interest, to the current research. Cross-tabulations were conducted in SPSS, and any significant associations between expertise levels and how technology was used were calculated by performing chi-square tests on the data. The results of these tests were inconclusive where 'use of MS Word & MS PowerPoint' was associated with all levels of expertise, but not strongly (C2 r_s=.372 *p=.04*) and 'used broadcasting tools, uploaded to YouTube' had a similar weak association (C2 r_s =.282 *p=.13)* and then only for cohort two participants.

Spearman rank order correlation tests which were used to test for any significant associations between expertise levels and professional technologies used by respondents, also proved unproductive. For example, good and very good expertise levels for cohort one demonstrated some weak association with 'use of MS Word and MS PowerPoint' (C1 r_s=.372 *p=.04*) and 'using Google Scholar' (C1 r_s=.301 *p=.042*). There were no strong or weak associations present for any teaching methods listed with any expertise levels for cohort two. Therefore, GE and VGE cohort one pre-service teachers felt they were experts using MS Word, PowerPoint and Google Scholar, but it was not clear from the survey data whether these particular pre-service teachers had differentiated between their own preparation of lesson plans and content for school placement or using these particular teaching methods with technologies in the school placement classroom. Hence, interviewees were asked how they used technology on school placement, and probed for specific examples, lesson types and particular teaching methods they had used with the children specifically, rather than in their own preparation for classes, the night before. The results of these interviews have been reported in the previous section.

Table 22 and Table 23 demonstrated that across all levels of expertise, there were similar teaching methods used with technology. There was little change in the frequency of use of these particular teaching methods, either between cohorts or from one survey to the next. For example, all nine VGEs in cohort one ‘looked for materials online to prepare a lesson plan’, as frequently as all four PEs in that same cohort. ‘Use of applications to prepare lessons’ was as frequent for the PE user as the VGE user, accounting for 90% of the responses to that statement, in survey II. These three teaching methods were then reported, as frequently in survey III, by cohort one respondents (Table 22).

Cohort two reported similar results, where six VGEs looked for ‘materials online’, as frequently as two PEs in survey II and survey III (Table 23). As such, despite the self-reported expertise level of the respondents, how they were using technology on school placement tended to be similar, where the traditional methods associated with using technology were as valid for the PE as the VGE pre-service teacher, from one placement to the next, for survey respondents in each cohort.

Table 22 *Teaching methods most and least used by different expertise levels, cohort one, survey II and survey III*

Survey II Most Used Teaching Methods - (Often or Very Often)	**Mode**	**Median**	**Very Good Expert (9)**	**Good Expert (22)**	**Somewhat Good Expert (11)**	**Poor Expert (6)**	**Total - 48**	**% of Total**
Looked for Material online for Lesson Plans	5	5	9	20	8	4	41	85
Prepared exercised and tasks for students (handouts)	5	5	9	18	9	4	40	83
Used applications to prepare presentations for lessons	5	5	9	20	10	4	43	90
Least Used Teaching Methods								
Used data logging tools (e.g. temperature rise)	1	1	1	0	2	0	3	6
Used multimedia production tools (video editing/digital recording)	1	1	0	0	0	1	1	2
Downloaded/uploaded/browsed material from the school's website or VLE	2	1	0	0	0	0	0	0
Teacher- parent communication (email, class webpage)	1	1	0	0	0	0	0	0

Survey III Most Used Teaching Methods - (Often or Very Often)	**Mode**	**Median**	**Very Good Expert (9)**	**Good Expert (22)**	**Somewhat Good Expert (11)**	**Poor Expert (6)**	**Total - 48**	**% of Total**
Looked for Material online for Lesson Plans	5	5	9	19	9	4	41	85
Prepared exercised and tasks for students (handouts)	5	5	9	20	9	2	40	83
Used applications to prepare presentations for lessons	5	5	9	20	8	3	40	83
Least Used Teaching Methods								
Used data logging tools (e.g. temperature rise)	1	1	0	0	0	0	0	0
Used multimedia production tools (video editing/digital recording)	1	1	0	2	0	0	2	4
Downloaded/uploaded/browsed material from the school's website or VLE	1	2	0	0	1	0	1	2
Teacher- parent communication (email, class webpage)	1	1	0	1	0	0	1	2

Table 23 *Teaching methods most and least used by different expertise levels, cohort two, survey II and survey III*

Survey II Most Used Teaching Methods - (Often or Very Often)	**Mode**	**Median**	**Very Good Expert (6)**	**Good Expert (11)**	**Somewhat Good Expert (11)**	**Poor Expert (6)**	**Total - 34**	**% of Total**
Looked for Material online for Lesson Plans	5	5	6	11	11	2	30	63
Prepared exercised and tasks for students (handouts)	5	5	6	11	10	2	29	60
Used applications to prepare presentations for lessons	5	5	6	11	11	2	30	63
Least Used Teaching Methods								
Used data logging tools (e.g. temperature rise)	1	1	0	0	1	0	1	2
Used multimedia production tools (video editing/digital recording)	1	1	0	0	0	1	1	2
Downloaded/uploaded/browsed material from the school's website or VLE	1	1	1	1	0	0	2	4
Teacher- parent communication (email, class webpage)	1	1	0	0	0	0	0	0

Survey III Most Used Teaching Methods - (Often or Very Often)	**Mode**	**Median**	**Very Good Expert (5)**	**Good Expert (16)**	**Somewhat Good Expert (9)**	**Poor Expert (none)**	**Total - 33**	**% of Total**
Looked for Material online for Lesson Plans	5	5	5	16	9	0	30	63
Prepared exercised and tasks for students (handouts)	5	5	5	14	8	0	27	56
Used applications to prepare presentations for lessons	5	5	5	16	7	0	28	58
Least Used Teaching Methods								
Used data logging tools (e.g. temperature rise)	1	1	0	1	1	0	2	4
Used multimedia production tools (video editing/digital recording)	1	1	1	1	1	0	3	6
Downloaded/uploaded/browsed material from the school's website or VLE	2	1	0	4	1	0	5	10
Teacher- parent communication (email, class webpage)	1	1	0	1	0	0	1	2

Perspectives on Use of Technology

The third sub-section of this research question asked these pre-service teachers about their own perspectives on technology use during their pre-service teacher education classes. This was not queried with survey participants and arose only during semi-structured interviews. Tondeur et al. (2012) had established that a gap tended to exist between what technology pre-service teachers had seen used during their college preparation course, and what technologies they then used while out on school placement. Interviewees were also asked about models of good technological practice they may have seen during their college preparation course and the influence these models may have had on their actual use of technology in the school placement classroom.

Interviewees detailed mixed views in relation to their college preparation course to use technology whilst on school placement. There were two main views that arose: that during their college preparation course they had really only seen PowerPoint and video being used by their lecturers, and that they felt their specific technology preparation course was too short. All participants mentioned the use of PowerPoint, and most found it boring and one deemed it was "using technology badly" (C1 SGE1):

> I don't think I've ever really had a lecturer that hasn't used PowerPoint cause if the PowerPoint can't work, we stop, and we get the tech guy in, and we wait ten minutes (laughter) and then we try to continue on and then it starts working again… because it's the same, here's the slides, I'm going to read out from the slides, I might elaborate a little bit, and you just find yourself disengaged from it… some lecturers just no – you're getting what you got 20 years ago (C1 VGE1),
>
> Like lecturers that stick up PowerPoints that are fifty pages long and you're like, oh god and they've text, and you're like here what am I looking at – it's very boring, you just think I'd never do that (C1 PE 2)
>
> Most of the lecturers just use PowerPoint, which is fine, it's just like reading off sheets (C2 SGE1),
>
> This year a lot of our lectures tended to be just PowerPoints so I mean they were good, but I'm kind of used to them at this stage (C2 VGE2),
>
> I think it's just normally just like straightforward PowerPoints (C1 PE1)

Other interview participants mentioned that video had been used very well by some lecturers: “so lecturer would use her child (in the video) showing, like she’d be really young and she’d be writing” (C2 SGE1), or to explain difficult concepts to students:

> Like psychology and that kind of thing, there’s loads of videos out there and that’s what really ties you in, because for those heavy subjects, you need, you obviously need to listen and you need that, but you also need something that’s actually going to draw you in. I remember like we were looking at feral children and those kind of issues, and that really got people into it (C1 VGE2).

Another lecturer had made her own videos, “we see her actually there modelling, doing the work” (C1 VGE1) so pre-service teachers could see this lecturer, in action, demonstrating how a lesson should be conducted. Yet, this reliance on a traditional, transmissionist approach to delivery was consistent with the literature on the topic and was generally seen as not useful by interview participants: “well I think half the time we only show up to lectures because we get you know, marked in” (C1 VGE1).

Participants also mentioned their college-based technology preparation course specifically, and the majority of interviewees were positive about the content covered therein. Interviewees drew attention to the role played by that particular lecturer in raising awareness regarding the availability of a wide variety of resources and the construction of a website as a worthwhile assessment exercise. This course was an opportunity to try something new, and most said it was the only lecture where the lecturer used technology well: “she was the only one that I’ve seen use it well” (C2 SGE1), “like using the wide range of resources that lecturer has kind of shown us” (C1 PE1) and “I find that you know the course that we did, was brilliant and it was mostly geared towards you know explorative work” (C1 VGE1). The innovative topics covered during the college preparation course were mentioned by all interviewees and included creating their own websites using Weebly (C1 PE2, C1 VGE2, C2 VGE1), making animation type videos using iPads (C2 GE2) and use of coding software, such as Scratch (C1 GE1). There was concern, however, that the course was too rushed: "we really didn't get much during the year like because it was just rushed, you know, at our course and that" (C1 GE2) and that the reality of school placement meant they would not try out technologies they had seen, on that course:

> Some of the stuff that lecturer was doing the really making movies out of stuff and stuff like that, I wouldn't be that confident in doing it, like I wouldn't be I don't, I think school placement isn't the time where you test IT (C2 GE2).

Furthermore, there was concern that a limited time had been spent on using an IWB during their college preparation course. As a result, some interviewees felt they were not able to use IWBs properly: "but I'd still say from a school placement point of view I'm not very up to par – I can't use, I don't know how to use an IWB" (C1 VGE1), "if there was an IWB somewhere here, so we could practice on it and stuff I want to be able to do that …so, like that would be really helpful to have one of them" (C2 SGE1) and "if anything like maybe at an earlier stage in college, being like this is the IWB you know like been shown a few different things, I know it's so hard but again some people wouldn't be, or have had so much experience with computers or something so it could be a little bit more difficult" (C2 VGE1). Another perceived limitation identified by participants related to the availability of only one type of IWB in their pre-service education course; this became an issue for one interviewee when a different type of board was available in their placement school: "this placement I've been using the smart board it is different, yea, I've never experienced it" (C1 GE2).

Thus, while pre-service teachers were positive about their college preparation course, generally, they felt there was a gap between what technology they had seen used in college and what was available to them, while out on school placement. Furthermore, there were few models of good practice using technology in evidence in the college, where most of the lecturers were limited to using PowerPoint, or video, in their lecturing. However, one participant articulated the difference between lecturing and teaching in a classroom and commented that "lecturing is different to teaching in the sense that you don't go in there like 'learn this, this is what you need' and (in teaching) you're not delivering, you're exploring – that's the difference at that level, it's exploring it" (C1 VGE2) and perhaps, as such, the gap was justified.

Conclusion

This research question investigated what technologies pre-service teachers used while on school placement, and how these technologies were used, in a professional context. It also probed their perspectives on their college preparation course, and the influence this had on their subsequent use of technology in classrooms. The most frequently used professional technologies were data projectors, laptops, IWBs, Internet, MS Word and PowerPoint. These technologies were reported by survey and interview respondents in equal measure. Desktop machines were also mentioned by interviewees, as being present in classrooms, but they would have preferred to bring their own personal laptops with them. However, this was not always feasible where the technology available in a school placement classroom exerted an influence over a pre-service teacher's decision and ability to technology. The results of the surveys had demonstrated some reliance on the Internet and video sharing sites, but interviewees noted these were not always available or reliable, in various schools they had attended. Tablet devices featured at interview as something aspirational for a future classroom, and typically pre-service teachers may have seen them in the schools they attended, but were not allowed access to them. However, an interesting result of this second research question was the *reduction* in use of technology, by cohort one, and the increase in use by cohort two, from the second year to third year school placement block.

Research participants were also asked about how they had used technology on placement, and the results tended to focus on lesson preparation by the pre-service teachers themselves. A reliance on social media was, again, noted in this second research question, where interviewees from both cohorts mentioned the peer Facebook support page. Interviewees outlined specific instances of how they used technology such as music and videos for lesson transitions, as prompts or audio cues and generally to get children involved, by getting them up to the IWB or getting them moving around a room. Interviewees were also asked for their perspectives on their college preparation course, and whether they felt they could now (after three years) use technology effectively in a classroom. The interviewees reported mixed opinions where they were generally pleased with their exposure to a wide range of technologies, but others had noted their college preparation course had felt rushed. Interviewees also expressed concerns that there were few models of good technology practice in the college where most of the lecturers used PowerPoint. However, they were mindful that some lecturers used technology well, and appropriately, where video demonstrations of more abstract concepts aided their comprehension of those topics. Thus, the second research question had asked for details of what technologies pre-service teachers used while on school placement, and how these technologies were being used while there. The results were interesting and the influence of a school environment and availability of technology in a classroom, noteworthy.

Chapter Four Conclusion

This first findings chapter has outlined the technologies the pre-service teacher participants used in their personal and professional lives and provided some examples on how these technologies were used. This first research question investigated if the pre-service teachers in both cohorts could be considered members of the net generation, based on their age profiles and personal usage of technology, and the results indicated they could. At least 90% of participants from both cohorts were within the age criteria for a millennial as defined in the literature section earlier (Albion, 2007; Dede, 2005; Howe & Strauss, 2000). Their current personal uses of technology tended to their own smartphones and laptops, typically purchased by their parents to support their college work. Of note in the findings was the peer support community, akin to a community of practice (Lave & Wenger, 1991), mediated on social media. Further, despite the expectations surrounding iPad and tablet adoption, these newer technologies had not been used by members of either cohort, yet interviewees did aspire to use them in their near future.

The second research question had investigated what technologies pre-service teachers used while on school placement, and how these technologies were used, in those classrooms. The most frequently used professional technologies were data projectors, laptops, IWBs, Internet, MS Word and PowerPoint. Research participants were also asked about how they had used with technology on placement, and these results tended to focus on lesson preparation by the pre-service teachers themselves. A reliance on social media was, again, noted in this second research question, where interviewees from both cohorts mentioned the peer Facebook community of practice page. Interviewees were then asked for their perspectives on their college preparation course, and whether they felt they could now (after three years) use technology effectively in a classroom. The results of this second research question were interesting and the influence of a school environment and availability of technology in a classroom and their impact on use of technology were of note.

The next chapter will outline the results of parametric and thematic analyses conducted on the data for the final three research questions. This chapter had focused on non-parametric analysis, where the data was ordinal and non-normally distributed. The interview data was analysed thematically and the interview data expanded the interpretation of professional use of technology, for the current research study. Themes that arose in this first data chapter will be discussed in chapter six shortly, after analysis of the final three research questions is completed in the next chapter (five).

Chapter Five Findings Part Two

This second findings chapter outlines the results of the parametric analyses of the final three research questions. The chapter will also provide reliability and validity statistics for the methods used with each cohort, and the instruments therein. The chapter will outline the specific types of parametric analysis conducted on each of the relevant data sets as required for each research question. This second findings chapter is focused on barriers to technology integration experienced by the research participants, the influence technological self-efficacy had on the participants, and finally, how the TAM model applied to members of each cohort. Each section will examine the survey responses of relevance for each research question and then review the interview data pertinent to each section. Each research question is considered in turn.

Parametric Analysis

As described in the methodology chapter, before any statistical tests were conducted on the relevant survey data, they needed to be checked to see if the data in those sections followed a normal distribution. If the data did follow this normal distribution, parametric statistical tests could be conducted on the data. To check for normality the nominal data relevant to these, final, three research questions were calculated using a Shapiro-Wilk test conducted in SPSS. Further visual analysis of histogram and scatter plots for each research question demonstrated the normality of the distribution of the cohorts' responses, for each dataset, as appropriate.

Research Question Three

The third research question investigated what barriers, if any, pre-service teachers perceived as impacting on their use of technology in the classroom (Ertmer, 1999; Ertmer, Ottenbreit – Leftwich, Sadik, Sendurur & Sendurur, 2012). The responses from survey II (& III), section IV were used to answer the quantitative elements of this research question. Thus, there were four data sets from the survey instruments, relevant to this third research question (cohort one, surveys II and III and cohort two, surveys II and III). Data from the semi-structured interviews added to the survey findings and gave a broader view of the barriers that impacted on technology use by these pre-service teachers on school placement, therefore, they are presented together. Survey and interview respondents to the research claimed there were barriers to using technology present, in varying degrees, in a school placement classroom and thus constituted both positive and negative responses to this third research question.

Normal Distribution of Data

The data in this third research question was sufficiently normally distributed, based on the results of a Shapiro-Wilk test conducted in SPSS. Figure 25, Figure 26, Figure 27 and Figure 28 give an example of this normal distribution for a sample of each of the 21 barrier statements used. The observed values did not diverge greatly from the expected values, for responses for each cohort for each data set. The histogram curve was also normally distributed, and thus parametric statistical analysis was the appropriate method of analysis for the survey data for this third research question.

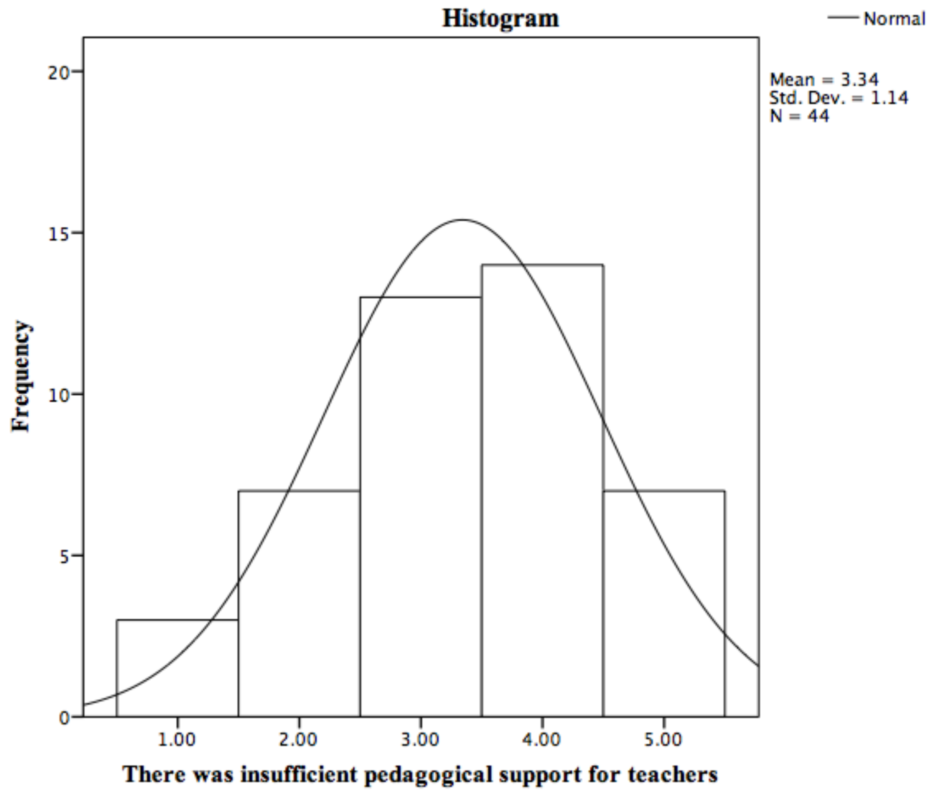


Figure 25 Example of normal distribution of one barrier statement for cohort one

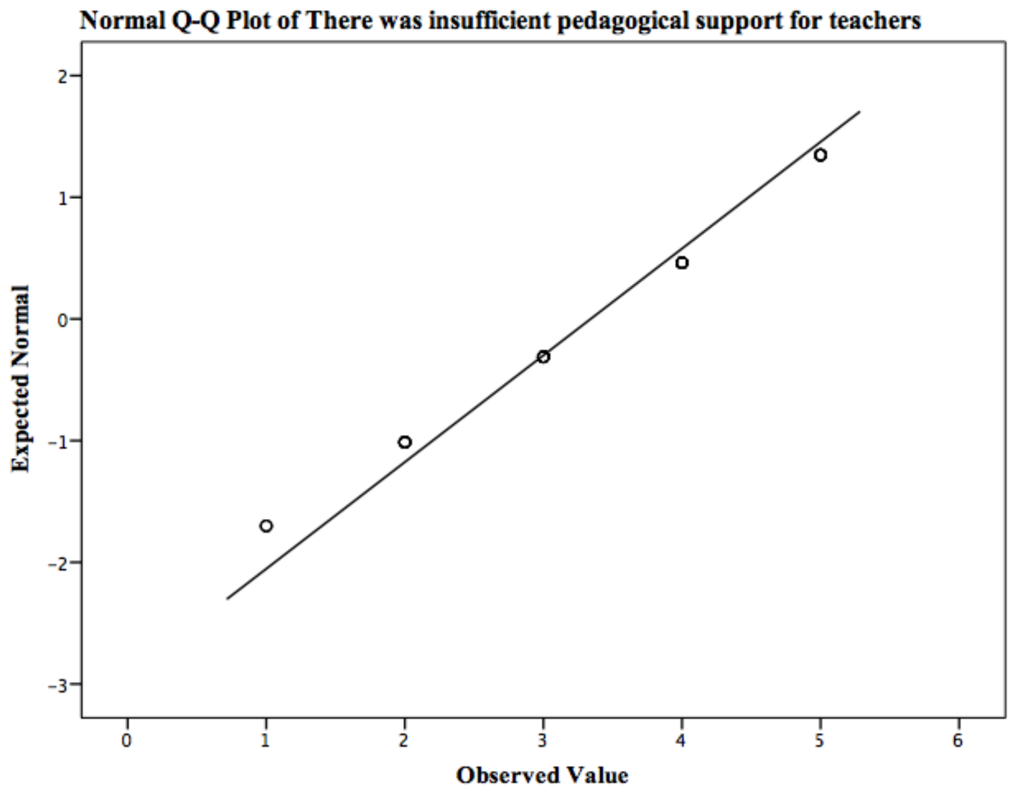


Figure 26 Example of Quartile-Quartile plot of one barrier statement for cohort one

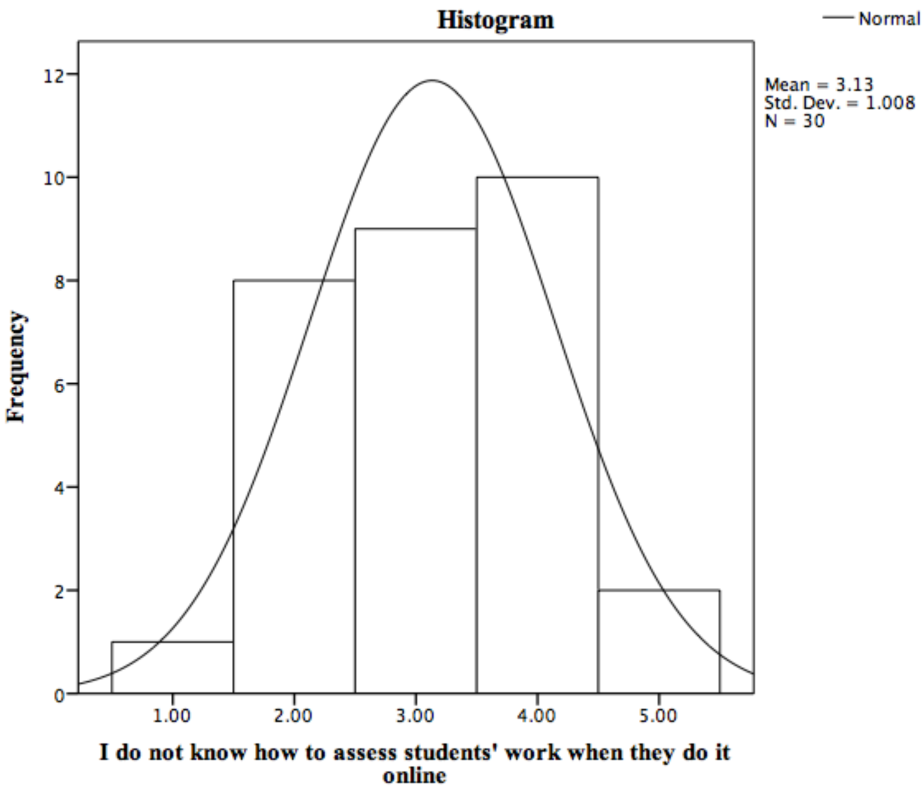


Figure 27 Example of normal distribution of one barrier statement for cohort two

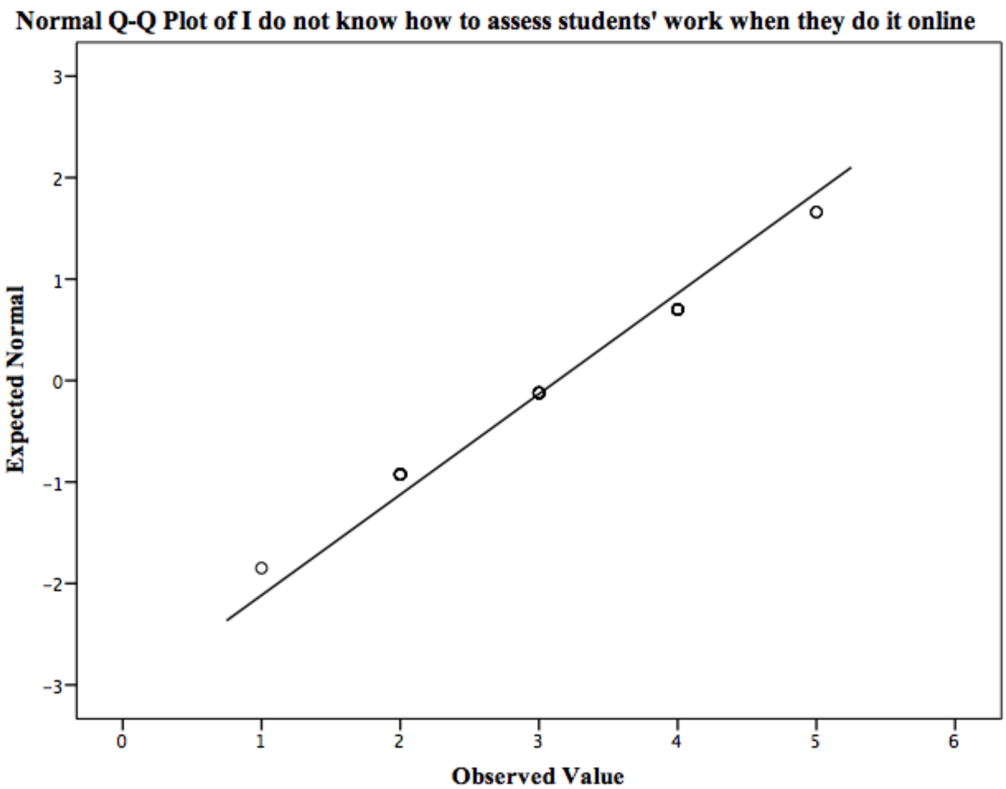


Figure 28 Example of Quartile-Quartile plot of one barrier statement for cohort two

Reliability and validity.

The barrier scores from survey II, section IV for each cohort, were then checked for reliability using the Cronbach alpha statistic. This was defined by Cronbach (1951) as a test of homogeneity to check that the items used in the survey instrument did measure the same things, in this case barriers. Therefore, in the current research, Cronbach alpha scores were calculated for each set of barrier statements relevant to the third research question, for each cohort. A Cronbach alpha score over .70 is an "acceptable score in social science research" (Cronbach, 1951; Gray & Kinnear, 2012; Hinton, 2001) and meant that the statements used were a reliable measurement of what barriers to using technology pre-service teachers faced when in a school placement classroom, as demonstrated in Table 24.

Table 24 *Survey II (& III) reliability scores*

	n	Cronbach's alpha α
Cohort 1 Survey II - Barrier Statements	21	0.888
Cohort 1 Survey III - Barrier Statements	21	0.853
Cohort 2 Survey II - Barrier Statements	21	0.885
Cohort 2 Survey III - Barrier Statements	21	0.828

Descriptive Statistics

The research question investigated the barriers that pre-service teachers perceived as impacting on their use of technology while on school placement. To answer this the following statistical tests were performed on the data collected for each cohort:

- frequency counts, mean and standard deviation calculations
- factor analysis
- Pearson's product moment correlation co-efficient and
- paired sample t-tests

The highest mean score across both surveys, for both cohorts, was that 'nothing prevented me using technology' (C1 SII *M* 3.35 *SD* 1.30, C1 SIII *M* 3.06 *SD* 1.29 and C2 SII *M* 3.12 *SD* 1.24, C2 SIII *M* 3.68 *SD* 1.33). In Egan et al. (2012) respondents had reported that nothing had blocked their use of technology, in a free format response area, so this statement was added to future iterations of the barrier items used, to allow for such a positive response. As such, it was removed from subsequent factor analysis, and composite score calculations. The other 21 items in this section of the survey instrument were sourced from relevant literature (Ertmer, 1999; Kurt & Ciftci, 2012; Prestridge, 2012; Teo & Noyes, 2012; Weber et al., 2004), as outlined in chapters two and three. Generally, while a mean score greater than 3.5 did indicate some level of agreement (where three meant neutral and four was agree) these were not strong levels of agreement. As such, the standard deviation scores (C1 SII *SD* 1.30, C1 SIII *SD* 1.29, C2 SII *SD* 1.24 and C2 SIII *SD* 1.33) had suggested some levels of disagreement. This then became apparent when, despite indicating they did not experience any factors that impeded use of technology on school placement, existence of some barriers to using technology were endorsed by all participants, in both cohorts. The results of the frequency counts, mean and standard deviation scores for all barrier statements are reported in Table 25.

Table 25 *Barriers to using technology for each cohort descriptive statistics*

Levels of Agreement [1 strongly disagree to 5 strongly agree]	**Cohort one survey II - March 2014**			**Cohort one survey III - December 2014**			**Cohort two survey II - March 2015**			**Cohort two survey III - December 2015**		
	n	***Mean***	***SD***	**n**	***Mean***	***SD***	**n**	***Mean***	***SD***	**n**	***Mean***	***SD***
*Nothing prevented me using technology during school placement**	49	3.35	1.30	52	3.06	1.29	33	3.12	1.24	32	3.68	1.33
There was insufficient pedagogical support for teachers	48	3.31	1.11	52	2.84	0.91	33	3.09	1.04	32	2.66	1.00
I do not think technology is reliable	49	3.27	0.86	52	3.20	0.87	33	3.36	0.96	32	3.28	0.92
I do not know how to assess students' work when they do it online	48	3.17	1.08	52	2.90	1.01	33	3.09	1.24	32	2.94	0.84
The school computers were out of date/in need of repair	49	3.16	1.46	52	2.61	1.17	33	3.27	1.31	32	2.94	1.09
There was a lack of technical support in the school	48	3.08	1.13	52	2.96	1.11	33	3.45	1.35	32	2.94	1.13
There was a lack of access to technology in classrooms	49	2.94	1.27	52	2.75	1.25	33	3.53	1.14	32	2.61	1.09
There are a lack of pedagogical models on how to use ICT for teaching	49	2.76	1.09	52	2.73	0.94	33	2.85	1.15	32	2.75	0.98
The school did not expect me to use technology	49	2.73	1.06	52	2.77	1.04	33	2.82	0.95	32	2.53	0.92
I had difficulty controlling what information students accessed online	49	2.71	1.00	52	2.61	0.94	33	2.45	0.75	32	2.47	0.92
There was a lack of adequate material/content for teaching available online	48	2.67	1.23	52	2.45	1.10	33	2.79	1.17	32	2.25	0.84
I have difficulty managing the classroom when students are on computers	48	2.54	0.74	52	2.57	0.76	33	2.66	0.97	32	2.53	1.02
Most parents were not in favour of the use of ICT at school	48	2.38	0.91	52	2.40	0.66	33	2.45	0.79	32	2.50	0.67
I do not know how to use technology effectively	49	2.31	0.89	52	2.27	0.80	33	2.18	0.98	32	2.28	1.08
I do not know how to incorporate technology into curriculum subjects	49	2.24	0.78	52	2.18	0.77	33	2.24	0.97	32	2.19	0.87
Most supervisors were not in favour of the use of ICT during school placement	48	2.23	1.04	52	2.12	0.78	33	2.30	1.07	32	2.37	0.87
There were no incentives to use technology	49	2.18	0.93	52	2.22	0.76	33	2.72	1.13	32	2.59	0.80
I do not have time to integrate technology into my teaching, while on school placement	49	2.12	1.07	52	2.12	0.89	33	2.61	0.97	32	2.47	1.02
Most teachers were not in favour of the use of ICT at school	49	2.12	0.93	52	2.25	0.79	33	2.30	0.95	32	2.19	0.74
It was too difficult to integrate ICT into the curriculum	49	1.92	0.70	52	2.08	0.76	33	2.52	0.97	32	1.97	0.54
I do not believe technology integration is useful in the primary classroom	47	1.83	1.01	52	1.61	0.57	33	1.56	0.56	32	1.66	0.94
I do not think technology fits my beliefs about teaching & learning	49	1.82	0.70	52	1.78	0.70	33	1.58	0.50	32	1.63	0.87

** This statement was used to allow for 'no barriers' being experienced by members of each cohort*

Lack of technology.

The technology available to the pre-service teachers on their school placement varied in terms of quantity and quality. The first external barrier encompassed three items from the survey instrument. These were ‘there was lack of access to technology’, ‘the school computers were out of date and in need of repair’ and ‘there was a lack of technical support in the school’. These are discussed sequentially.

There was a neutral response to the statement that ‘there was a lack of access to technology’. The standard deviation scores indicated a range of agreement and disagreement with this survey item (C1 SII *M* 2.94 *SD* 1.27, C1 SIII *M* 2.75 *SD* 1.25 and C2 SII *M* 3.53 *SD* 1.14, C2 SIII *M* 2.61 *SD* 1.09). However, a lack of technology was prevalent in the interview responses, and tended to focus on the lack of provision of an IWB:

> If I was to go back to the first school now – like there would be nothing there (C1 GE1),
>
> I went into my classroom in 3rd year with my senior infants and I said ‘where’s the whiteboard’ so they don’t have one and I was like you’re telling me every child in the school has a violin (C1 VGE1),
>
> yea the first school I was in didn’t have a IWB – that’s the only thing (C1 GE1),
>
> third year it was kind of a step back because there was no IWB, at all (C2 PE1),
>
> whereas in the school I was in, just in April, there was no white board whatsoever, which I didn’t like either now (C2 PE2) and
>
> there was no IWB there, there was no, I don’t think there was even a computer there- no, there wasn’t, there was no computer (C2 SGE1).

Where an IWB was present in a classroom, specific IWB problems also proved challenging for interviewees, where a different brand of IWB being present, or inability to replace peripherals were evident in the interview data:

> Now the only problem was we each had to share a pen, whatever I couldn’t believe - whatever company made these Smart Boards in the school, had gone bust so they couldn’t order another pen so the 5th and

> 6th class teacher, and the 4th and 3rd class teacher were sharing a pen (C2 PE1).

Some interviewees did try and circumvent this 'lack of technology', by bringing their own laptops into the classroom. However, when they did this, often they were not able to configure the laptop to the available technology, without support:

> My laptop I think, I don't know if I said this, the cords going inside, part of the let's say the cable that would connect the laptop to the screen, it was broken so we had to balance it on a piece of blu-tack to make it work (C2 VGE1),
>
> I was always very worried if my laptop didn't work, so I brought it in and made sure I had the right connections and I got the teachers to show me how to hook up the laptop (C2 VGE2).

When technology was available in the classroom, the majority of interview participants encountered technical problems when using the technology. Configuration of the IWB and pen proved especially difficult "on the IWB and, or if I was drawing on it, the line would come down here, I don't know it was just all over the place" (C1 PE1), "that's the only thing with the whiteboards, sometimes if it's not calibrated" (C1 VGE2), "the pen, the pen was the problem, the pen was the main problem, the only other thing was like you know the pen not calibrating" (C2 GE2). Other problems included not having access to YouTube in schools generally, "and then there's a YouTube block (in school) I'm in now" (C1 PE2) to unreliable internet connections, "and it was just like really hit and miss – yea the internet went down I think twice maybe" (C1 PE1) and "there was one (placement) where the internet was kind of dodgy" (C2 VGE2). These problems were also evident in the survey data.

Thus, lack of technology, as an overall factor impeding use of technology on school placement, was evident in other survey statements, related to this first extrinsic barrier. The statement that 'technology was out of date, or in need of repair' was answered neutrally. Again, however, there was a wide deviation in the range of responses for both cohorts (C1 SII *M* 3.15 *SD* 1.46, C1 SIII *M* 2.61 *SD* 1.17 and C2 SII *M* 3.27 *SD* 1.31, C2 SIII *M* 2.94 *SD* 1.09). Furthermore, both cohorts had seen an improvement in technology available in schools, where by survey III there was less agreement with this statement (C1 SII *M* 3.15 C1 SIII *M* 2.61 and C2 SII *M* 3.27 C2 SIII *M* 2.94). Indeed, cohort one reported a highly significant improvement in availability of technology, from one placement to the next (C1 SII *M* 3.43 and C1 SIII *M* 2.40; $t(36)=4.165$ $p<.001$). Interviewees mentioned specific instances of technology being in need of repair, from one placement to the next, where there was no improvement in the technology available. In one instance a broken piece of equipment stayed like that for months on end, "but considering the IWB was sitting stagnant from - I mean they didn't work in my observation in November and still didn't work in my placement in April" (C2 VGE2) and had therefore not been operational during either school placement block.

The final statement related to this first external barrier was that when equipment was often not working, 'lack of technical support' was then reported as a barrier to use (C1 SII *M* 3.08 *SD* 1.13, C1 SIII *M* 2.96 *SD* 1.11 and C2 SII *M* 3.45 *SD* 1.35, C2 SIII *M* 2.94 *SD* 1.13). Interviewees tended to report more negative experiences of there being no support available to them, while on placement, where "they didn't have support, they couldn't afford it, or a new cable and the laptop had to fully break before they were able to replace it" (C2 VGE1). Generally, where a school teacher had a post of responsibility "one of the teachers in the school he'd done a degree in technology before, so he was their kind of consultant" (C1 SGE1) and was in charge of the IT equipment, the problem was "you had to wait until they were finished teaching" (C2 VGE1). Lack of technical support did have an impact on interviewees' willingness to use technology, best exemplified by one interviewee who was sympathetic to the school's predicament "if anything breaks there's panic and fear, and fear of expense, because schools don't have money to repair, or replace or replenish" (C1 VGE 2). This external barrier did therefore impact on a pre-service teachers' use of technology in the school placement classroom.

Influence of school placement environment.

Four items from the survey instrument loaded to this second external factor as outlined in Table 29. These items are considered individually. Survey participants disagreed generally that the supervising 'teachers were not in favour of use of ICT in the school' (C1 SII *M* 2.12 *SD* 0.93, C1 SIII *M* 2.25 *SD* 0.79 and C2 SII *M* 2.30 *SD* 0.95, C2 SIII *M* 2.19 *SD* 0.74) and that 'supervisors were not in favour of the use of ICT' (C1 SII *M* 2.23 *SD* 1.04, C1 SIII *M* 2.12 *SD*.78 and C2 SII *M* 2.30 *SD* 1.07, C2 SIII *M* 2.37 *SD*.87) either. As such, this data meant that survey participants reported that school placement supervisors, and their supervising teachers, did expect, and were in favour of their use of technology in the classroom.

However, conflicting perspectives emerged at interview. Interviewees reported an element of 'playing to the gallery' where they would use technology if they felt their school placement supervisor, expected them to use it, and was in favour of technology use. However, if the supervisor was not in favour of technology, they would not use it, as it may affect the grade achieved, during this examined process:

> Yea you're always worried about them, you're always thinking what are they going to like, you know you're kind of god I'd love to do it this way but she doesn't like it this way, and I need to get my good grade so I'm going to do it this way (C1 SGE1).

Interviewees also commented that some supervisors were more in favour of traditional content, and concrete materials, being used during lessons. Thus, if an interviewee knew in advance who their supervisor was going to be, they would tailor their lesson plans accordingly, using flash cards as outlined by a cohort two interviewee, rather than any form of technology:

> My supervisor hated technology, he didn't want me to use technology at all, yea, he said I was using too much of it, but to be honest I wouldn't ever rely on technology because I just don't think you can and then he told me to go back to using Flash Cards because they're the way to go, so the next visit when he came around I used the Flash Cards and you know, he was delighted then (C2 VGE1).

In addition, some supervisors had indicated to interviewees that they did not want to see them over-reliant on technology:

> I think there's definitely a lot of supervisors out there who just have no time for technology, because they don't use it themselves, like email you know, they might google the odd thing but definitely, it's just a different generation that it wasn't used in their time, and they didn't have to use it, so they're probably thinking why should they, you shouldn't have to rely on it, and maybe it's just their attitude towards it that they don't want to see us become reliant on technology or whatever, to know that as I said, they didn't have to use it, so why should we (C1 VGE1).

Yet, others reported that often the supervisor was very much in favour of technology use in the classroom, "yes, I had one inspector where she said don't bother making any resources, just do it all on the Interactive Whiteboard" (C1 PE1) and

> the majority, yea they've been really open to it, a lot of them actually comment on it and say oh that's actually really cool I never knew you could do that or one of them, especially my most recent tutor for junior infants absolutely loved all the songs that we'd found and was asking us how we went about finding them (C2 VGE2).

As such there were inconsistencies evident in the attitudes to use of technology by the supervisors, and this then had an effect on an interviewee's use of technology while on school placement.

The role of the supervising teacher was also a factor that influenced an interviewee's decision to use technology in the classroom. There were mixed opinions from supervising teachers about the use of technology in the classroom and, similar to the opinions of a supervisor, if the supervising teacher was not in favour of using technology, then this also had an influence on the pre-service teachers' use of technology:

> She just wasn't one for using technology (C2 VGE2),
>
> Like I've heard some teachers say before Oh I think they get enough of it, screens at home (C1 PE1)
>
> Even one teacher I had, she wanted me to use it because she wasn't that au fait with it (C1 GE1).

The school expectations about technology use were also influential. The survey data for statements such as 'the school did not expect me to use technology' (C1 SII *M* 2.73 *SD*

1.06, C1 SIII *M* 2.77 *SD* 1.04 and C2 SII *M* 2.82 *SD* .95, C2 SIII *M* 2.53 *SD*.92) were similar for each cohort, and each survey, where there was general disagreement with this statement. This meant that survey respondents felt that the schools did expect them to use technology in the classroom.

Interviewees reported similar results, where the majority understood that the school expected, and were supportive of their technology use "one of the teachers in the school was mad into like blogging and stuff, and he had a really good blog as well" (C1 SGE1), "so it would be you know teachers from different year groups would work together and they would be like ok, so we'll base our stuff around this lesson and around these, the stuff that's on the IWB and you know" (C2 GE2) and that such a positive environment, made a difference. It was interesting to note that the age of teachers in the school was remarked upon by two interviewees, and had both a positive and negative influence on participants, "but the school I'm in now em, the, my teacher she's in charge of all computers and the IT and she's brilliant and she's in her like 60s" (C1 PE2) to "yea, I've seen different ways teachers have used technology from very little, avoiding it as best possible, to completely 100% incorporating everything is online nowadays. And it, sadly it can depend on the age of the teacher, you know what they're used to" (C1 VGE1).

However, school placement was also seen as an artificial process, perhaps best expressed by one interviewee who said "especially when you're on placement, it's such an artificial process – it's just – it's not real – it's intense, there's no way you'd go in everyday and you teach that way" (C1 VGE2). Moreover, school placement was not the time to go in and change what the norm was in the school "I'm not going to go in there and say right, we're not using any of these so I'm going to introduce a whole other system" (C2 VGE2) or try to use technology where it was not encouraged "now I have been in a situation where in one school, I wasn't allowed access to the technology at all, I wasn't allowed use the computer" (C1 VGE1). Thus, the school environment had an influence on the participants and mixed messages about use of technology proved problematic for the research participants.

Lack of pedagogical models.

The final external barrier related to a general lack of either pedagogical support, or models to integrate technology in a classroom. These are reported separately. Both cohorts had given neutral responses to the statement about ‘there was insufficient pedagogical support’ (C1 SII *M* 3.31 *SD* 1.11, C1 SIII *M* 2.84 *SD*.91 and C2 SII *M* 3.09 *SD* 1.04, C2 SIII *M* 2.66 *SD* 1.00) where the range of results showed at least some levels of agreement, and some levels of disagreement to this barrier. Further, there was some improvement from one placement to the next where both cohorts tended to disagree that pedagogical support was lacking by the time they got to third year. However, these improved scores were checked for significance, using a t-test, and the improvement reported was not significant (C1 *M* 2.78; $t(36)=.00$ $p=1.00$ and C2 *M* 2.75; $t(16)=-.808$ $p=.432$). Equally, the statement that ‘there were a lack of pedagogical models to use ICT for teaching’ (C1 SII *M* 2.76 *SD* 1.09, C1 SIII *M* 2.73 *SD* .94 and C2 SII *M* 2.85 *SD* 1.15, C2 SIII *M* 2.75 *SD*.98) had a similar wide range of responses where again, there were some levels of agreement, and some levels of disagreement reported. The standard deviation scores also demonstrated this wide range of responses. However, there was some reported improvement in pedagogical models available for members of cohort one where there was a significant improvement from one year to the next (C1 SII *M* 2.88; $t(34)=-2.44$ $p=0.02$) but this did not apply to members of cohort two.

This external factor III was endorsed by two interviewees, where they commented “like it’s hard to know what to use it (technology) for, kind of meaningfully” (C1 SGE1) and “you’re kind of brought into it you’re not given formal classes on how to use things” (C2 SGE1). Lack of pedagogical models it was noted, by one interviewee, also applied to the teachers in the schools, where she remarked - “yea, so they don't I don't know if they really know how to use technology properly” (C2 GE1).

Personal beliefs.

Personal beliefs about using technology in the classroom were an influential factor impacting on use for both cohorts. There were two items related to this intrinsic barrier presented in the survey instruments. Survey participants consistently disagreed (where a score of 1 meant strongly disagree) with both personal belief items ‘I do not believe technology integration is useful in the primary classroom’ (C1 SII *M* 1.83 *SD* 1.01, C1 SIII *M* 1.61 *SD* .57 and C2 SII *M* 1.56 *SD*.56, C2 SIII *M* 1.66 *SD* .94) and ‘I do not think technology fits my beliefs about teaching and learning’ (C1 SII *M* 1.82 *SD*.70, C1 SIII *M* 1.78 *SD* .70 and C2 SII *M* 1.58 *SD*.50, C2 SIII *M* 1.63 *SD*.87). The frequency counts of these personal belief statements had a low standard deviation score (less than 1.0) and, therefore, survey participants reported that technology integration *was* useful and that technology use *did* fit their beliefs about teaching.

Generally, interviewees’ responses tended to contradict the survey findings. However, a reminder that interviewees were a sub-set of survey participants in each cohort is salient here. The majority of interviewees reported a wariness about using technology “like, I’d be kind of wary of using it” (C1 SGE1), a prevalence of privacy and bullying concerns, “it’s so scary when you hear those stories (about cyber bullying) and that’s why I don’t want kids in my class to have to go through that sort of thing” (C2 VGE2), “that’s what I don’t like about it (technology) and even the iPhone itself can track you” (C1 PE2) and they expressed general misgivings about over-use of technology by the school children: “but they get so much of it at home, you’d be worried its nearly overload then” (C1 SGE1). Often interviewees simply stated they were not “that into technology” (C1 SGE1) and were more in favour of “offline technology” (C1 VGE1). Some interviewees expressed a view that technology should not replace traditional methodologies "I don't think it should ever take over 'teacher role' as teacher" (C1 VGE2), "I just hope, like it's so sad, like I just hope it doesn't come to when I'm 26 or 27 and I'm teaching, and it's not all technology" (C2 SGE1). These traditional beliefs tended to influence a decision to use technology in a classroom and these, and other factors, were also prevalent when the TAM model was explored (research question five) in relation to the subjective norm variable.

Lack of skills.

All interviewees reported a general lack of ability to use technology on school placement, but these findings were not mirrored in the survey data. This internal factor had three related items in the survey instruments. Generally, survey respondents tended to disagree with these barrier items where 'I do not know how to use technology effectively' (C1 SII *M* 2.31 *SD* .89, C1 SIII *M* 2.27 *SD* .80 and C2 SII *M* 2.18 *SD* .98, C2 SIII *M* 2.28 *SD* 1.08), 'I do not know how to include technology in their curriculum subjects' (C1 SII *M* 2.24 *SD* .78, C1 SIII *M* 2.18 *SD* .77 and C2 SII *M* 2.24 *SD* .97, C2 SIII *M* 2.19 *SD* .87) and 'there was a lack of adequate materials for teaching available online' (C1 SII *M* 2.67 *SD* 1.23, C1 SIII *M* 2.45 *SD* 1.1 and C2 SII *M* 2.71 *SD* 1.17, C2 SIII *M* 2.25 *SD* .84) were marked by the small standard deviation from the mean. Thus, the survey data demonstrated a level of confidence in respondent's ability to integrate technology effectively in the classroom. There was a small (but not significant) increase in reported levels of disagreement, between survey II and survey III for each cohort. This suggested that the survey respondents felt *increased* confidence in their use of technology from their second to third year placement.

Interviewees reported a skills gap and outlined their own inability to deal with the technological issues that arose while on school placement. Generally, interviewees did not feel able to fix any problems they faced "oh no no, I wouldn't have had a clue" (C1 PE1), "em but I'd still say from a school placement point of view I'm not very up to par"

(C1 VGE1), "I'd be like pressing the back button going why is this not working" (C1 GE1), "I would say, that's the only downside I've experienced with technology- things like that and not working and you know" (C2 PE1) and "exactly, if something goes wrong we just leave it until you know, we need to call an IT guy to come and fix it" (C2 GE2). Interviewees then reported on the nature of the problems they faced, while on school placement, and these tended to differentiate between hardware and software issues.

The hardware problems encountered by interviewees were generally focused on the IWB not working, "yea the calibration on the IWB it was a bit off today, so it didn't work when we tried to press calibrate or whatever, so I dunno" (C1 GE1), computers not connecting, "it said it was connected but it said no, it could find the internet but it couldn't connect to it" (C1 GE2), or problems with the school computer/laptop not functioning, "the laptop once just died on me – no expectation" (C1 VGE1). Software also proved problematic, but less so, where one interviewee mentioned specific software problems such as "the problem then was transferring the (Buaine Cainte) software over - that took another two days" and software being generally "a bit fiddly" to use (C2 GE2). These hardware problems were the biggest focus of the interviewees' discussions, for each cohort.

To circumvent the reported skills gap, some interviewees expressed a desire to learn more about technology by going "to a few more courses" (C1 PE1) although they did recognise that it was impossible to future proof their own skills, as technology was constantly changing. One interviewee from cohort one best expressed this:

> We're trying to kind of straddle both worlds, we're from we understand, we've gone through this change (with technology) and this evolution but at the same time, we're on that side and we're on the other side, of we have to keep up – we don't have a choice (C1 VGE1).

Thus, while a lack of ability to use the technology available to them was something interviewees had considered, survey respondents had different views.

Beliefs about technology in a classroom.

A third intrinsic barrier evident in the data was related to beliefs about using technology in the classroom. A barrier that demonstrated some impact on use of technology in the classroom, was participants' beliefs that 'technology was not reliable' (C1 SII *M* 3.27 *SD* 1.11, C1 SIII *M* 3.20 *SD* .87 and C2 SII *M* 3.36 *SD* .96, C2 SIII *M* 3.28 *SD* .92), where at least some students agreed and some disagreed with this statement. Generally, the respondents' experiences of school placement had some effect on the results of survey III, where some level of improvement in their beliefs was apparent, but not significantly so. Survey III response patterns were marked generally by an increase in confidence using technology, where an 'inability to control what the children accessed online' (C1 SII *M* 2.71 *SD* 1.00, C1 SIII *M* 2.61 *SD* .94 and C2 SII *M* 2.45 *SD* .75, C2 SIII *M* 2.47 *SD* .92), 'lack of incentives to use technology' (C1 SII *M* 2.18 *SD* .93, C1 SIII *M* 2.22 *SD* .76 and C2 SII *M* 2.72 *SD* 1.13, C2 SIII *M* 2.59 *SD* .80) and 'classroom management problems' (C1 SII *M* 2.54 *SD* .74, C1 SIII *M* 2.57 *SD* .76 and C2 SII *M* 2.66 *SD* .97, C2 SIII *M* 2.53 *SD* 1.02) were generally disagreed with. These results indicated that participants had no issues with classroom management, controlling what children accessed online and did feel incentivised to use technology, while on school placement. There were levels of agreement and disagreement with respondents 'inability to assess students work when they completed it online' (C1 SII *M* 3.17 *SD* 1.08, C1 SIII *M* 2.90 *SD* 1.01 and C2 SII *M* 3.09 *SD* 1.24, C2 SIII *M* 2.94 *SD* .84) but the range of scores from the mean indicated a wide variance in responses where there was some non-significant improvement in these skills, by survey III.

Interviewees reported that technology not being reliable was a critical factor in their decision to use technology on school placement, "like when it's unreliable or when it breaks down that we're like - oh god, what will we do" (C2 SGE1). This unreliability was seen by all interviewees as a barrier to using technology in the classroom and did have an influence on their decisions regarding what technology to use, “or like or just get a new internet system that’s more reliable” (C1 PE1) to “sometimes it can be unreliable, but I don’t really, a lot of people say oh it’s unreliable, I’m not going to use it” (C2 PE1). However, the majority of interviewees reported that having a “plan b” or downloading material in advance of a lesson was expedient “oh yea, you always have to have a plan B, you’d have to - yea, you’re being assessed you are, yea” (C2 GE1), “like the different things for school placement, like obviously YouTube isn’t available in lots of schools – so you’re going to have to find different ways to download videos” (C1 VGE1). Again, the nature of school placement being an examination arose for interview participants, and they were unlikely to use technology that may not work, if they were being graded on the associated lesson “because if I was inspected that day I’d be like screwed (sic.) so em I’d always have a handout” (C2 GE2). Thus, the experience of school placement gave interviewees a more realistic view of using technology in the classroom, and they began to realise they needed to plan for using technology, like they would with more traditional resources.

Classroom management issues when using technology were reported by interviewees from both cohorts and the nature of school placement was, again, a factor here. Interviewees were unsure how to use technology so that all children in a classroom were engaged in a lesson “to get everyone up, yea that is difficult yea so you tend to use that (IWB) for a second and then let everyone have a chance to do something in pairs” (C2 GE1) and “even the teacher was like you could use them for your stations (work stations in a classroom) if you want, but sure like I wouldn’t have a clue like” (C1 SGE1). As such effective integration of technology remained an issue for interviewees:

> Yea classroom management and being able to like work it in to the lesson, more so than like, having it – just there and not even yea –just kind of working it into the lesson and working with the children with it (C1 GE2).

Interviewees also reported there were 'few incentives for using technology' in the classroom, where often a school placement supervisor did not refer to what technology they had used where "the biggest probably annoying thing was the preparation you put into it and then you don't really get feedback from your supervisor" (C2 VGE1). As such, preparation when using technology was key for interviewees, and an awareness that their classroom management skills using technology could still be improved upon.

Ability and time to integrate technology.

Across both cohorts, survey participants consistently disagreed with two statements related to the final internal factor namely that 'it was too difficult to integrate technology into the curriculum' (C1 SII *M* 1.92 *SD*.70, C1 SIII *M* 2.08 *SD*.76 and C2 SII *M* 2.52 *SD*.97, C2 SIII *M* 1.97 *SD*.54) and that they 'had no time to integrate technology' (C1 SII *M* 2.12 *SD* 1.07, C1 SIII *M* 2.12 *SD*.89 and C2 SII *M* 2.61 *SD*.97, C2 SIII *M* 2.45 *SD* 1.02) while on school placement. The majority of interviewees also reported few difficulties integrating technology, and when these difficulties were experienced, interviewees reported they were able to overcome them, "you kind of just adapted like, you just kind of dealt with it - like, the IWB wasn't working in any placement until the last placement, so you just forgot about it and did whatever you could - to make it work" (C2 GE1). One interviewee noted that although she had not experienced difficulty, her placement teacher had where "she found, she found it hard to - that she had to take the pictures, digital camera, upload them then try and get them onto the blog, which she found the hardest then, but yea I didn't really see what the issue was" (C2 PE1). Yet, other interviewees had used words like "stressful" (C1 PE1, C1 VGE2) and "frustrating" (C2 PE1, C2 SGE1) when describing using technology in the classroom, but these were cited in the context of the "false reality" (C2 SGE1) of school placement, "so it was pretty difficult, so I spent hours at a time, downloading Active Inspire at home and trying to play around with it, and I was too nervous to use it on placement" (C2 VGE1). Further, they did not think time would be a factor, when they had their own classrooms in the future, "but you see when you're in your own class you have time to test stuff out and you're not going home to do lesson plans you've got time" (C2 GE 2). As such, the pre-service teachers in both cohorts were looking forward to using technology and having the time to use it, in their future classrooms, but were mindful that school placement was not that time.

Barrier Scale Items

Once the Cronbach alpha score showed the items did form a reliable scale (and did measure barriers effectively) then the total mean score of the barrier items were calculated in SPSS, for each respondent. As such, each respondent had a composite internal and external barrier score from each survey instrument from his or her responses to that instrument. Thus, a cohort one respondent had two composite scores, one composite barrier score for survey II and one composite barrier score for survey III. This also applied to survey participants in cohort two. These composite barrier scores could be checked for any progression or difference, from one survey instrument to the next, or for any between cohort differences, between members of cohort one and cohort two. These barrier composite scores were then used to analyse whether different expertise levels had experienced similar barriers to using technology, while on school placement, by calculating the results using paired t-tests, conducted in SPSS.

T-tests.

Paired sample t-tests were calculated on the relevant data sets to check for cohort differences in total composite barrier scores for each survey instrument. The results indicated there were no significant differences in the composite barrier scores between cohort one (Survey II *M* 2.58, *SD* .53, Survey III *M* 2.45, *SD* .45); $t(37)=-1.40$, $p=.17$) and cohort two (Survey II *M* 2.56, *SD* .38, Survey III *M* 2.55 *SD* .38); $t(15)=.077$, $p=.94$)

for survey II or survey III (Table 26). Thus, both cohorts experienced similar levels of barriers to using technology, on school placement blocks, in second and third year of their college preparation course. However, given the small number of participants who responded to the final surveys form each cohort, these results while interesting, may not be representative of the larger cohort.

Table 26 *Paired sample t-tests survey differences*

Paired Sample	**Composite Score**	***t***	***df***	***p***
C1 Survey II & Survey III	Barriers	-1.399	37	.170
C2 Survey II & Survey III	Barriers	0.77	15	.940

Both cohorts also demonstrated similar answering patterns where there were no significant differences calculated between cohorts (Table 27). To check for this cohort one, survey II and cohort two, survey II composite barrier scores were compared using a paired t-test (C1 SII *M* 2.68, *SD* .54, C2 SII *M* 2.66, *SD* .52); $t(15)=.113$, $p=.91$). Then, composite barrier scores from cohort one, survey III and cohort two, survey III were analysed (C1 SIII *M* 2.37, *SD* .48, C2 SIII *M* 2.40 *SD* .41); $t(17)=-.191$, p=.85). These results therefore, demonstrated no significant differences between cohorts' response patterns.

Table 27 *Paired sample t-tests cohort differences*

Paired Sample	**Composite Score**	***t***	***df***	***p***
C1 Survey II & C2 Survey II	Barrier	.113	15	.91
C1 Survey III & C2 Survey III	Barrier	-.191	17	.85

Thus, as the composite barrier score paired t-tests proved unproductive, factor analysis was conducted on the barrier statements. This was used to calculate any underlying latent factors that may have influenced use of technology on school placement, for survey participants. The results of factor analyses are now reported and provided similar results to the descriptive statistics reported earlier.

Factor Analysis

Factor analysis was conducted with data from cohort one, survey II as factor analysis was sensitive to sample size. Cohort one had 52 respondents to survey II, whereas cohort two had 33 respondents, therefore cohort one was more suitable for factor analysis. The subject to variable ratio appropriate for factor analysis was based on results of a study by Osborne and Costello (2005) where three times the number of variables would be an appropriate minimum sample size to ensure the factors uncovered would be generalisable to the population. However, another method to circumvent the small sample size was calculation of the Kaiser-Meyer-Olkin (KMO) statistic, which allowed for factor analysis if the result of the KMO test (in SPSS) was larger than the KMO 0.6 sampling adequacy figure. Table 28 outlines the KMO score for the barrier statements in section IV of surveys II (and III) for cohort one, and thus were appropriate for factor analysis.

Table 28 *KMO score for barrier statements cohort one*

	No. of statements	**KMO**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy S II	21	.683
Kaiser-Meyer-Olkin Measure of Sampling Adequacy S III	21	.667

The barriers section in survey II (& III) had 21 statements – of these 21 statements, when factor analysis was conducted, seven latent barriers to using technology were identified using varimax rotation and 25 iterations in SPSS. These seven latent barriers were both extrinsic and intrinsic barriers that influenced a pre-service teacher's decision to use technology in the classroom. These were similar to recent literature on the subject of barriers experienced using technology in a classroom (Ertmer & Ottenbreit-Leftwich, 2013; Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014; Prestridge, 2012; Sadaf et al., 2015). The seven latent factors calculated through factor analysis were:

External factors

(i) Lack of technology in the classroom

(ii) Influence of school placement environment

(iii) Lack of pedagogical models to use technology

Internal Factors

(i) Personal beliefs about using technology

(ii) Lack of own skills

(iii) Beliefs about using technology in a classroom

(iv) Ability and time to integrate technology.

An outline of the factor loadings is displayed in Table 29 and Table 30. For example, external barrier I 'no technology available in the classroom' had a strong underlying factor load ($r = .759$) with statements about 'computers were out of date' ($r = .852$) and 'there was lack of technical support in the school' ($r = .819$). These factors were subsequently used to create composite scores for internal barriers and external barriers experienced while using technology on school placement.

Table 29 *Factor analysis on barrier statements & factor loadings for each*

Barrier Statements – External Factors	**Ext 1**	**Ext II**	**Ext III**
Lack of technology			
There was a lack of access to technology in classrooms	**.759**	.107	.135
The school computers were out of date/in need of repair	**.852**	-.036	.104
There was a lack of technical support in the school	**.819**	.160	.023
Influence of school placement environment			
Most parents were not in favour of the use of ICT at school	.163	**.793**	.230
Most teachers were not in favour of the use of ICT at school	.290	**.822**	.056
Most supervisors were not in favour of the use of ICT during school placement	-.092	**.727**	.036
The school did not expect me to use technology*	.166	.345*	-.167
Lack of pedagogical models to use ICT			
There are a lack of pedagogical models to use ICT for teaching	.015	.049	**.843**
There was insufficient pedagogical support for teachers	.311	.039	.491*

Principal component analysis, varimax rotation, 9 iterations. low factor loading reported here*

Table 30 *Factor analysis on barrier statements & factor loadings for each*

Barrier Statements – Internal Factors	**Int I**	**Int II**	**Int III**	**Int IV**
Personal beliefs				
I do not believe technology integration is useful in the primary classroom	**.837**	.043	.135	.106
I do not think technology fits my beliefs about teaching & learning	**.611**	.040	.022	.468
Lack of own skills				
I do not know how to use technology effectively	.122	**.704**	.035	.319
I do not know how to incorporate technology into curriculum subjects	.305	**.649**	.137	.151
There was a lack of adequate material/content for teaching available online	.347	**.710**	.160	.219
Beliefs about using technology in a classroom				
I do not think technology is reliable	.230	-.238	**.790**	.030
There were no incentives to use technology	.097	.342	**.628**	.276
I had difficulty controlling what information students accessed online	-.154	.167	**.548**	.052
I do not know how to assess students' work when they do it online	-.336	.309	**.502**	.246
I have difficulty managing the classroom when students are on computers	-.248	-.016	.455*	.316
Ability and time to integrate technology				
It was too difficult to integrate ICT into the curriculum	.206	.197	-.002	**.807**
I do not have time to integrate technology into my teaching, while on school placement	.135	.100	.249	**.732**

Principal component analysis, varimax rotation, 9 iterations. low factor loading reported here*

Latent Factor Composite Scores

The latent internal and external barriers that were calculated during factor analysis were used to create a composite score for **each** of those internal and external factors, in SPSS, named (EXTBARR and INTBARR). These were calculated, using SPSS, by creating a mean score for each of the internal and external barrier items, for each participant. These composite barrier scores were then used to check for any progression or differences between cohorts, and between survey instruments, from one year to the next, using paired sample t-tests.

For the composite *external barrier* scores, cohort one had no significant difference between their survey II and survey III results, where there was no reduction in the external barriers experienced from one placement to the next (C1 SII *M* 2.74 *SD* .72 C1 SIII *M* 2.65 *SD* .56; $t(48)=1.52$ $p=.13$). Similarly, cohort two had no significant differences in their composite external barrier scores between each survey instrument (C2 SII *M* 2.89 *SD* .71 C2 SIII *M* 2.90 *SD* .66; $t(32)=-.151$ $p=.88$). Thus, the experience of external barriers was consistent between survey instruments for both cohorts and had not reduced, or improved, from one school placement to the next.

The results of the comparison of *internal barrier* composite scores demonstrated equivalent results where cohort ones' results did not differ significantly from survey II to survey III (C1 SII *M* 2.39 *SD* .51 C1 SIII *M* 2.37 *SD* .44; $t(48)=.766$ $p=.44$). Cohort two also demonstrated no significant difference in the results of their internal barrier composite scores (C2 SII *M* 2.48 *SD* .51 C2 SIII *M* 2.45 *SD* .48; $t(32)=.56$ $p=.57$). As such, there was no significant decrease in the presence of internal barriers to using technology on school placement, during their college preparation course, for either cohort. Further, when cohort one and cohort twos' composite external barriers scores were compared using a paired sample t-test, for results from each survey, there were no significant differences present. A similar lack of difference also applied to the composite internal scores for each cohort, again, demonstrating no progression or improvement from one year to the next, for respondents to the research.

Expertise Levels and Barriers Experienced on School Placement

The following tables outline the previously reported expertise levels cross-tabulated with the barrier statements, in SPSS, reported by each survey instrument (Table 31, Table 32, Table 33 and Table 34). Each table represents levels of agreement only, where participants either agreed or strongly agreed, with the barrier items. The results of these tables are discussed subsequently and relevant responses noted therein.

Of note in the tables displayed, was that similar barriers impacted on technology use in the classroom, no matter the expertise level, in both cohorts. However, it was also noted that these results were similar to the individual descriptive statistics reported earlier for this research question where, generally, the barrier statements tended to be answered neutrally by survey respondents in both cohorts. This was also evident when the percentage results were reviewed, for the different expertise levels, from each cohort. Yet, across all expertise levels, there was a reduction in reported barriers to using technology in a classroom, by their final survey instrument in third year.

The majority of cohort one respondents (>40%) had reported lack of access to technology, no pedagogical support, old technology, no technical support and technology as not being reliable across all expertise levels, in survey II. By survey III, the only concern of the majority of cohort one participants (42.5%) was that technology was not reliable. Their levels of agreement for all other barrier statements had reduced by survey III – these results were consistent with the individual descriptive statistics reported earlier for cohort one, where there was a significant improvement in the availability of technology in schools these pre-service teachers had attended. The concern that technology was not reliable in survey III perhaps suggested a more realistic view of using technology in a classroom, given their full school placement experience at that stage of their college preparation course.

Cohort two also reported lack of technical support, lack of access to technology, technology not being reliable and old technology across all expertise levels in survey II (>40%). By the time survey III was conducted, a similar reduction in the barriers reported by all expertise levels, was evident for cohort two and their remaining concern was, again, that technology was not reliable (50%). This also suggests that cohort two had more experience of using technology in a classroom and were aware of issues they had experienced trying to use technology in a classroom by the time they reached third year of their college preparation course.

Table 31 *Cohort one survey II barriers impacting on use of technology on school placement [agree & strongly agree]*

Barriers	**Poor Expert [5]**	**Somewhat Good Expert [11]**	**Good Expert [22]**	**Very Good Expert [9]**	**N = 46**	**%**
There was a lack of access to technology in classrooms	1	6	12	2	21	46
There was insufficient pedagogical support for teachers	1	7	6	6	20	43
The school computers were out of date/in need of repair	1	6	8	5	20	43
I do not think technology is reliable	2	4	11	2	19	41
There was a lack of technical support in the school	2	5	10	2	19	41
I do not know how to assess students' work when they do it online	0	7	6	4	17	37
The school did not expect me to use technology	0	4	7	3	14	30
There are a lack of pedagogical models on how to use ICT for teaching	2	4	5	2	13	28
There was a lack of adequate material/content for teaching available online	0	2	6	5	13	28
I had difficulty controlling what information students accessed online	1	2	4	4	11	24
I do not know how to use technology effectively	0	3	3	0	6	13
I do not know how to incorporate technology into curriculum subjects	1	1	2	1	5	11
Most supervisors were not in favour of the use of ICT during school placement	2	1	0	2	5	11
I do not have time to integrate technology into my teaching, while on school placement	0	1	3	1	5	11
There were no incentives to use technology	0	2	1	1	4	9
Most parents were not in favour of the use of ICT at school	1	0	1	1	3	7
Most teachers were not in favour of the use of ICT at school	1	1	0	1	3	7
I have difficulty managing the classroom when students are on computers	1	0	0	1	2	4
I do not believe technology integration is useful in the primary classroom	0	1	0	1	2	4
I do not think technology fits my beliefs about teaching & learning	0	0	1	1	2	4
It was too difficult to integrate ICT into the curriculum	0	0	0	1	1	2

Table 32 *Cohort one survey III barriers impacting on use of technology on school placement [agree & strongly agree]*

Barriers	**Poor Expert [5]**	**Somewhat Good Expert [11]**	**Good Expert [22]**	**Very Good Expert [9]**	**TOTAL = 47**	%
I do not think technology is reliable	4	6	6	4	20	43
There was a lack of technical support in the school	2	3	5	6	16	34
There was a lack of access to technology in classrooms	3	5	3	4	15	32
The school computers were out of date/in need of repair	2	3	4	4	13	28
I do not know how to assess students' work when they do it online	2	5	4	1	12	26
There are a lack of pedagogical models on how to use ICT for teaching	0	5	5	2	12	26
The school did not expect me to use technology	0	1	8	3	12	26
There was insufficient pedagogical support for teachers	1	3	3	3	10	21
There was a lack of adequate material/content for teaching available online	0	4	5	1	10	21
I had difficulty controlling what information students accessed online	1	2	5	1	9	19
I do not know how to use technology effectively	0	1	3	1	5	11
I do not have time to integrate technology into my teaching, while on school placement	1	2	1	1	5	11
I do not know how to incorporate technology into curriculum subjects	0	1	3	0	4	9
Most supervisors were not in favour of the use of ICT during school placement	0	0	2	1	3	6
There were no incentives to use technology	1	1	0	1	3	6
Most teachers were not in favour of the use of ICT at school	0	0	3	0	3	6
It was too difficult to integrate ICT into the curriculum	0	1	2	0	3	6
I have difficulty managing the classroom when students are on computers	0	0	2	0	2	4
Most parents were not in favour of the use of ICT at school	0	0	1	0	1	6
I do not think technology fits my beliefs about teaching & learning	0	0	1	0	1	2
I do not believe technology integration is useful in the primary classroom	0	0	0	0	0	0

Table 33 *Cohort two survey II barriers impacting on use of technology on school placement [agree & strongly agree]*

Barriers	**Poor Expert [2]**	**Somewhat Good Expert [11]**	**Good Expert [11]**	**Very Good Expert [6]**	**TOTAL = 30**	**%**
There was a lack of technical support in the school	2	6	8	3	19	63
There was a lack of access to technology in classrooms	2	4	7	4	17	57
I do not think technology is reliable	1	6	5	3	15	50
The school computers were out of date/in need of repair	1	5	5	3	14	47
There was insufficient pedagogical support for teachers	2	4	3	2	11	37
I do not know how to assess students' work when they do it online	1	3	4	3	11	37
There are a lack of pedagogical models on how to use ICT for teaching	1	4	3	2	10	33
There were no incentives to use technology	2	4	3	1	10	33
The school did not expect me to use technology	0	2	3	3	8	27
There was a lack of adequate material/content for teaching available online	1	3	1	1	6	20
I have difficulty managing the classroom when students are on computers	1	3	2	0	6	20
I do not have time to integrate technology into my teaching, while on school placement	1	1	3	1	6	20
Most supervisors were not in favour of the use of ICT during school placement	0	1	2	2	5	17
Most teachers were not in favour of the use of ICT at school	1	0	2	1	4	13
I do not know how to use technology effectively	1	1	1	0	3	10
I do not know how to incorporate technology into curriculum subjects	1	1	0	1	3	10
It was too difficult to integrate ICT into the curriculum	1	1	0	1	3	10
I had difficulty controlling what information students accessed online	0	0	2	0	2	7
Most parents were not in favour of the use of ICT at school	0	0	0	1	1	3
I do not believe technology integration is useful in the primary classroom	0	0	0	0	0	0
I do not think technology fits my beliefs about teaching & learning	0	0	0	0	0	0

Table 34 *Cohort two survey III barriers impacting on use of technology on school placement [agree & strongly agree]*

Barriers	**Poor Expert [2]**	**Somewhat Good Expert [11]**	**Good Expert [11]**	**Very Good Expert [6]**	**TOTAL = 30**	**%**
I do not think technology is reliable	0	5	8	2	15	50
There was a lack of technical support in the school	0	4	6	2	12	40
I do not know how to assess students' work when they do it online	0	3	5	2	10	33
The school computers were out of date/in need of repair	0	3	6	1	10	33
There are a lack of pedagogical models on how to use ICT for teaching	0	2	5	2	9	30
There was a lack of access to technology in classrooms	0	3	4	1	8	27
There was insufficient pedagogical support for teachers	0	1	5	1	7	23
I do not have time to integrate technology into my teaching, while on school placement	0	2	5	0	7	23
I have difficulty managing the classroom when students are on computers	0	1	4	1	6	20
The school did not expect me to use technology	0	2	1	2	5	16
I had difficulty controlling what information students accessed online	0	2	3	0	5	16
I do not know how to use technology effectively	0	1	4	0	5	16
There were no incentives to use technology	0	2	3	0	5	16
Most supervisors were not in favour of the use of ICT during school placement	0	2	2	0	4	13
There was a lack of adequate material/content for teaching available online	0	0	3	0	3	10
I do not know how to incorporate technology into curriculum subjects	0	1	2	0	3	10
I do not believe technology integration is useful in the primary classroom	0	1	1	0	2	6
Most parents were not in favour of the use of ICT at school	0	0	1	0	1	3
I do not think technology fits my beliefs about teaching & learning	0	1	0	0	1	3
Most teachers were not in favour of the use of ICT at school	0	0	0	0	0	0
It was too difficult to integrate ICT into the curriculum	0	0	0	0	0	0

Conclusion

This research question investigated what barriers pre-service teachers perceived as impacting on their use of technology in the classroom and the results indicated the presence, at some level, of internal and external barriers for survey and interview participants. Generally, survey participants tended to respond neutrally to the barrier items, where they claimed the presence of these barriers to varying degrees. Interviewees tended to be more expansive on barriers and problems they had experienced using technology in their school placement classrooms and outlined plenty of examples to support their views.

Overall, the influence of the school placement environment was a prevailing theme in the data. For interviewees, the role of the supervisor and the supervising teacher, and their views on technology, had an impact on an interviewee's decision to use technology in a classroom. However, technology not being reliable in a classroom was a problem for participants. Furthermore, expertise levels had no significance over the barriers experienced, where a poor expert experienced the same types of barriers as frequently as a very good expert during their school placement blocks.

The next section will examine the results of the fourth research question, where the concepts of self-efficacy and technological self-efficacy are discussed. Self-efficacy and confidence were key determinants of use of technology on school placement, and the results of the surveys and interviews are reported latterly.

Research Question Four

This section examines the concepts of self-efficacy and technological self-efficacy and their application and presence, in the results of the current study. This fourth research question investigated if pre-service teachers' technological self-efficacy scores would correlate positively with their use of technology while on school placement (Albion, 1999; Bandura, 1994; Compeau & Higgins, 1995; Teo, 2015). The data from survey I, section II were used to answer the technological self-efficacy elements of the research question, for each cohort. The data from survey II and III (section II) was also relevant for the professional technology elements of this research question. Qualitative data pertinent to this research question was then gathered, during semi-structured interviews, with a subset of participants from each cohort.

Normal distribution of data

As outlined in the previous research questions, before any statistical tests could be conducted on the data, the technological self-efficacy items needed to be checked to see if the survey data followed a normal distribution. To test for normality the responses to survey I section II, these statements were checked, using SPSS.

The data in this fourth research question was sufficiently normally distributed, based on the results of the Shapiro-Wilk test conducted in SPSS. Figure 29, Figure 30, Figure 31 and Figure 32 give examples of the normal distribution of some of the technological self-efficacy statements, where the observed values did not diverge greatly from the expected values. Thus, parametric statistical analysis was an appropriate method on the survey data, for this research question.

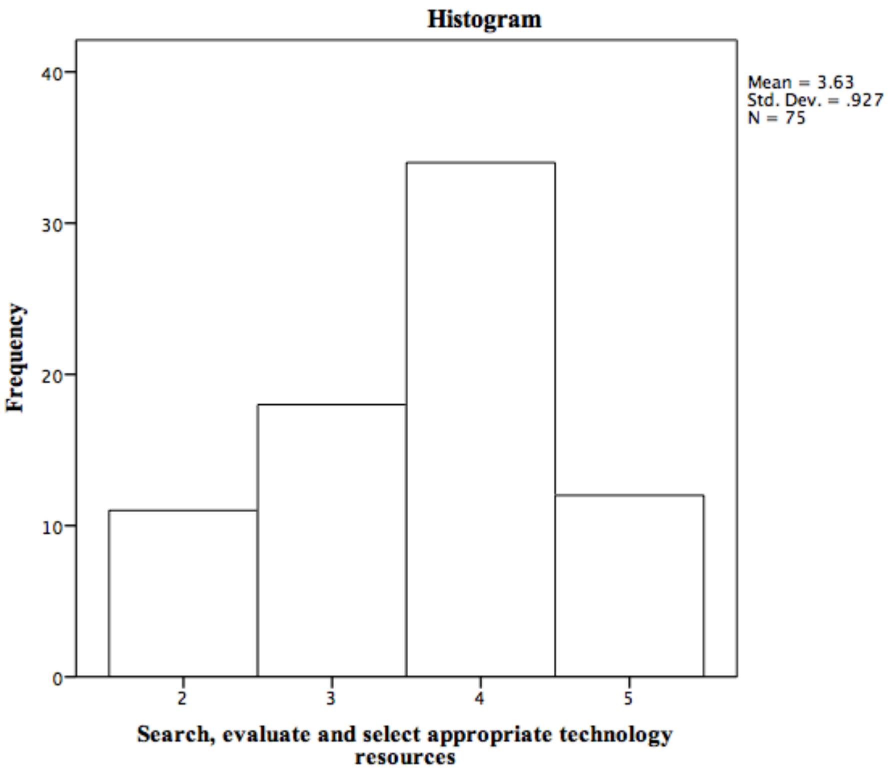


Figure 29 Histogram of normally distributed responses for an example of a self-efficacy statement cohort one

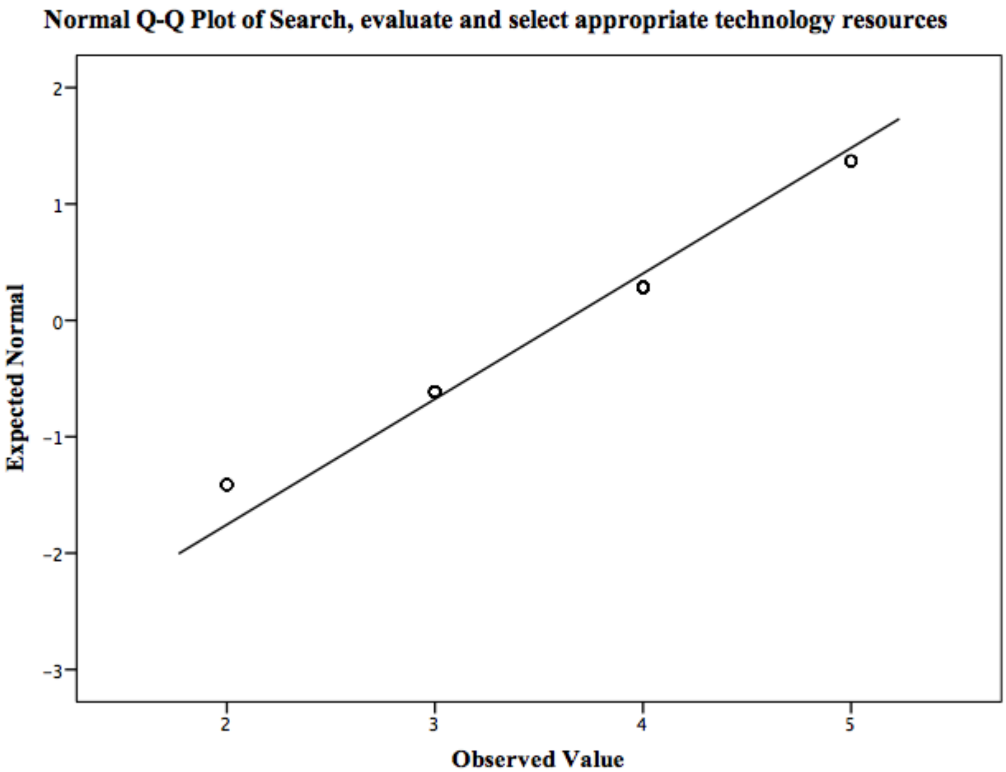


Figure 30 Quartile-Quartile plot of normally distributed responses for an example of the self-efficacy statements cohort one

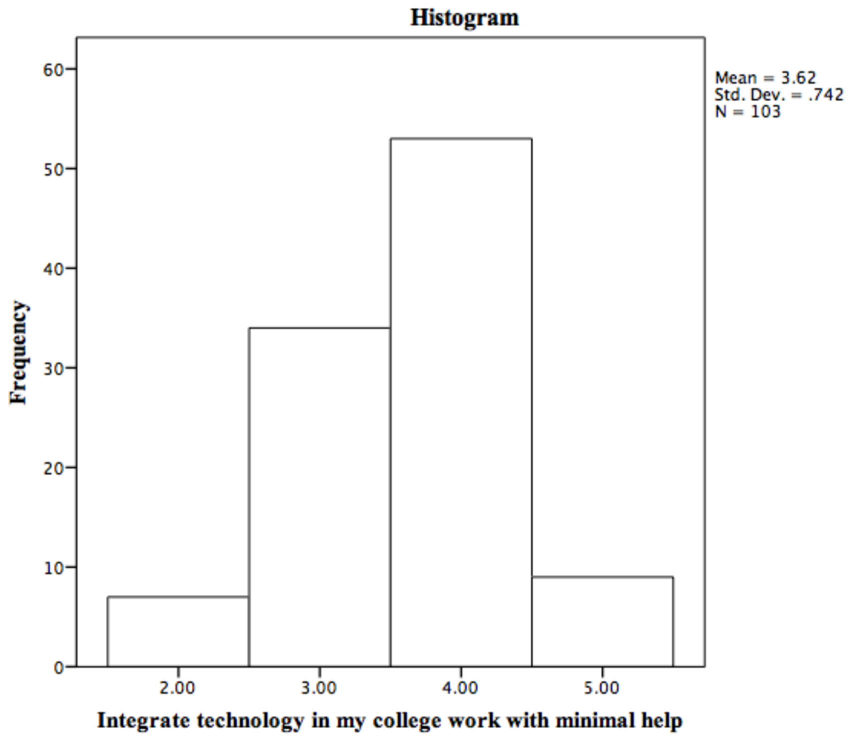


Figure 31 Histogram of normally distributed responses for an example of a self-efficacy statement cohort two

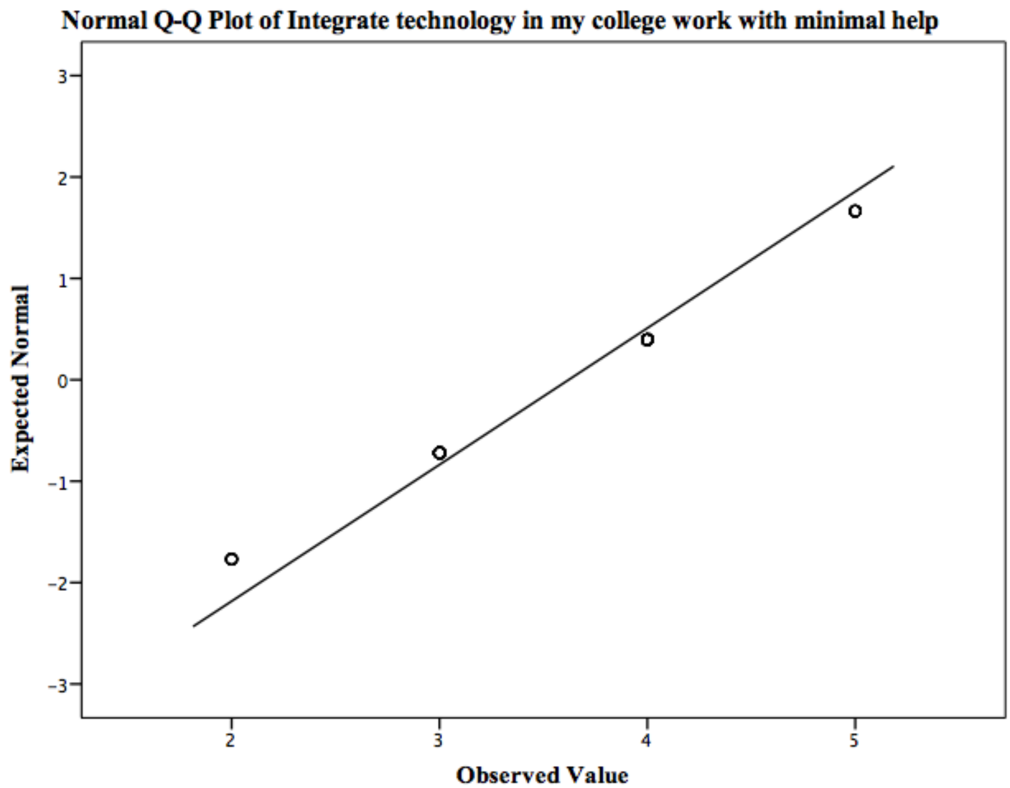


Figure 32 Quartile-Quartile plot of normally distributed responses for an example of the self-efficacy statements cohort two

Reliability.

Survey I, section II focused on technological self-efficacy with statements that commenced with the statement 'I am able to' complete various tasks using technology. Participants' levels of agreement were measured on a five-point scale, from strongly agree to strongly disagree. Statements such as 'I am able to integrate technology in my college work effectively', 'I am able to navigate the contents of a computer' and 'I am able to use technology if there are user manuals available' were used (McCoy, 2010). The Cronbach alpha scores showed that these ten statements were a reliable measure of technological self-efficacy, in this instrument, for each cohort, as outlined in Table 35 Cronbach's alpha was again used as a measure of reliability for the statements relevant to this research question.

Table 35 *Survey I self -efficacy reliability scores*

	No.of statements	**Cronbach's alpha α**
Section II – TSE statements cohort one	10	.773
Section II – TSE statements cohort two	10	.823

Descriptive Statistics

The research question investigated if a pre-service teacher's technological self-efficacy would correlate with their use of technology while on school placement. To answer this the following statistical tests were performed on the data collected for each cohort.

- Descriptive statistics, frequency counts & cross tabulations in SPSS, of ten technological self-efficacy statements from survey I, for each cohort.
- Pearson product moment correlation analysis was used to check for any differences or similarities between technological self-efficacy composite scores

in survey I, with use frequencies from survey II and survey III, while on school placement, for each cohort.

- Paired t-tests were then used to calculate any difference in response patterns by respondents in cohort one and cohort two, and whether one cohort had a higher technological self-efficacy score than the other.

Data from semi-structured interviews, conducted with members of each cohort, was also analysed and themes of self-efficacy and technological self-efficacy were explored with interview participants.

Table 36 *Technological self-efficacy statements descriptive statistics*

	Cohort one survey 1			Cohort two survey 1		
	N	*Mean*	*SD*	N	*Mean*	*SD*
Complete a job or task using technology if shown how to first	80	4.26	0.82	104	4.35	0.75
Complete a job or task using technology	80	4.08	0.76	104	4.08	0.60
Navigate the contents of a computer	79	3.85	1.06	103	4.07	0.70
Use technology if there are user manuals available	80	3.79	1.03	104	3.95	0.89
Adopt and adapt technology resources for assignments	80	3.68	0.95	104	3.86	0.77
Integrate technology in my college work creatively	80	3.66	0.95	104	3.86	0.78
Search, evaluate and select appropriate technology resources	79	3.63	0.91	104	3.82	0.68
Integrate technology in my college work with minimal help	80	3.58	0.92	104	3.66	0.80
Use technology without needing to be told how it works	77	3.52	1.18	104	3.61	0.76
Use my knowledge of technology to help my classmates	79	3.46	0.87	104	3.61	0.94

As can be seen in Table 36, pre-service teachers in both cohorts either strongly agreed or agreed that they could 'complete a job or task using technology' (C1 SI *M* 4.08 *SD* .76 and C2 SI *M* 4.08 *SD* .60), and even more so, if 'shown how to do it first' (C1 SI *M* 4.26 *SD* .83 and C2 SI *M* 4.35 *SD* .75). There was little variance in the responses to these statements (C1 SI *SD* .60, C2 SI *SD* .82) for either cohort, and the mean scores (C1 SI *M* 4.25 and C2 SI *M* 4.35) showed high levels of agreement this these technological self-efficacy statements. Small differences in mean scores began to emerge for the statement 'navigate the contents of a computer' where cohort ones' mean scores were marginally lower than cohort twos' results (C1 SI *M* 3.85 *SD* 1.06 and C2 SI *M* 4.07 *SD* .70). Further, both cohorts reported some level of agreement to being able to use technology if 'there were manuals available' and there was little difference in the mean scores (C1 SI *M* 3.79 *SD* 1.03 and C2 SI *M* 3.95 *SD* .89), again, cohort twos' responses showed marginally more agreement to this statement. Of note, was that the lowest level of agreement was with the statement 'I am able to use my knowledge of technology to help my classmates' (C1 SI *M* 3.46 *SD* .87 and C2 SI *M* 3.61 *SD* .94) but this data was from the first survey which was administered to each cohort as they started their Bachelor in Education course, and thus they may not have thought of helping their colleagues at this early juncture.

Self-Efficacy & Interviewees

Self-efficacy was concerned with a belief in one's ability to accomplish a task or master tasks, in certain situations, as outlined in the literature chapter. While there were ten specific technological self-efficacy statements in survey I (McCoy, 2010) there were no specific self-efficacy questions asked during the semi-structured interviews. Rather, experiences reported by interviewees that demonstrated their own technological self-efficacy and confidence, were explored. There was also evidence of where their reported technological self-efficacy had an effect on their professional use of technology, while on school placement. Further, there were commonalities with some of the TAM variables such as subjective norms and facilitating conditions that will be discussed in the next research question. Themes that emerged in the interview data were also similar to the three latent factors described for the survey data.

Personal mastery.

Interviewees reported they had grown up with technology and did report they were generally able 'to use a computer with no help', in regard to their personal devices, "I suppose as we were growing up kind of technology was obviously, it became more widespread" (C1 SGE1). When asked to compare their use of technology now, with their previously reported use during survey I, the majority of interviewees said their use of technology had improved, "It's not as scary as it was in first year, with the boards and stuff" (C1 SGE2) in the intervening period.

There was evidence of a sense of personal mastery (Bandura, 1977) reported by the interviewees, but their increased personal mastery was often a requirement of their course, "I probably use it a little bit more, I suppose I've got much more used to it through college and in like having to do things on, much more confident on Word and things like that" (C1 SGE2). Other interviewees were aware their technological skills were lacking and did feel a requirement to upskill in the future, "you know as times moves on there's obviously going to be new things, more things, yea but I'd definitely love to try and learn a few more things" (C1 GE1) but generally they were confident and willing to take on these future challenges.

Yet, interviewees also reported that they tended to avoid risk, with what professional technologies they did use, while on school placement as this was not a time for failure as "you're under supervision you don't want to try something new and for it to go completely pear – shaped" (C1 SGE2). Three of the interviewees did illustrate some level of technological self-efficacy when they reported their willingness to try and fix something broken in the classroom so "you would figure it out and play around with it for a few mins, and then it's fine" (C2 GE1), "yea, I'd get there, trial and error" (C2 VGE1) and "I've got to the point where if something doesn't work I say right, let's just try and figure out what I'm going to do to fix it, because there's no point sitting waiting for it to fix itself" (C2 VGE2). These examples of technological self- efficacy reported in the interview data were consistent with the survey data where survey participants had agreed they could use technology with no support.

Social models.

The pre-service teachers interviewed also reported that they used technology if they had support, on school placement. Their reported experiences were similar to the self-efficacy literature on the influence of social models (Bandura, 1994). Social modelling for the interviewees meant that if they saw the supervising teacher using technology in a classroom well, they would learn from observation of this social model. This concept of social modelling was an important feature of the results of the research. A particular example referred to by most of the interviewees was the use of a visualiser. They were shown how to use the visualiser by their supervising teacher and were excited by the potential of this technology. This supportive environment was beneficial to interviewees, and they commented on a willingness by their supervising teacher, to let them 'try stuff out' in the classroom. However, others also reported they had experienced non-supportive school environments. One interviewee gave a detailed description of when she asked the school secretary to get a replacement pen for the IWB, there was a general mistrust of technology in evidence in that particular school:

> She went on this biggest rant, I mean like it was like you know, everything is so amazing this technology but you know, it's not reliable and you know, they're all going to break soon and we're all going to be left and she was like, they're all breaking you know, they're all breaking down (C2 GE2).

These mixed experiences on school placement, were not conducive to the development of the interviewees' professional technological self-efficacy due to inconsistent social models, experienced. This lack of social models was similar to the data gathered in the barriers research question presented previously, where the influence of the school had an impact on pre-service teachers' decisions to use technology.

The majority of interviewees also remarked on the lack of good social models available during their pre-service teacher education course. Specific examples given were marked by a general lack of technological self-efficacy demonstrated by the lecturing staff:

> Some lecturers you're looking for support in technology and they physically don't have the knowledge (C1 VGE1).

There were some notable exceptions, where the majority of interviewees remarked on the skills they had learned from the creative technology lecturer and one other lecturer's use of an IWB, in particular, "and named person was great at using the board (IWB) and named person was able, named person was like doing things I've never seen before like shapes, and number lines and everything" (C2 GE1). As such, the interviewees did remark that the lecturers could use technology with support but expressed a view that they were too reliant on this support, as expressed by one interviewee: "exactly, if something goes wrong we just leave it until you know, we need to call an IT guy to come and fix it" (C2 GE2).

College requirements.

Generally, all interviewees felt capable of using technology to support their college work and did report their skills had improved since first year. The interview data was consistent with the survey data here. It also mirrored their previously reported personal mastery related to technological self-efficacy.

Generally, interview participants outlined how the purchase of a laptop for college, and the associated learning curve of using it for projects and assignments, had been a catalyst for their improved technological skills:

> I'd probably be a lot better now, with placement the module of work you do on a computer you really learn the ins and outs of a computer then, you know even just printing, putting in page sizes, reducing margins, all that kind of thing you never would've done before (C2 SGE1).

They also reported increased self-efficacy using professional technologies they had never experienced before. These included having to create a website for college, "Weebly as well - yea, so I used that a little bit as well because I had placement in mind when I did it, so it was a blog kind of and so I had one on World War II" (C2 PE1), use of various applications only used in the classroom to create their own animations and videos, "we did an App an animation, using an App, and we had a, say you made something out of clay and then you could do it, and it was really really nice" (C2 SGE1) and other hardware and software ("Mahara it's great" – C1 VGE1) that was used to complete college projects and assignments.

Interviewees did not differentiate between the context of use in relation to social media where their online peer support Facebook messenger group was mentioned as a source of support for their college work. Interviewees used this personal messaging service to share lesson plans, and other documentation useful for the classroom, with each other while on school placement, "yea, I post them (lesson plans) on Facebook and then my friends look at them and they have friends, who look at them when they have time, and stuff like that" (C2 VGE2). However, some members of the Facebook class group acted as "lurkers" (Dennen, 2008) and did not contribute anything to the peer group which irritated one of the interviewees, in particular where she commented:

> You've these whole year group pages where you've got 113 people over school placement and literally it started off as 'has anyone got any ideas for this' then it progressed onto lesson plans and then it progressed onto, has anyone got schemes and then this is 'woah', let's take a moment – and that's when it gets irritating so I actually disabled my Facebook over school placement, just to get away from that because it's hard enough as it is without having to give to everyone else (C1 VGE1).

As such, interviewees felt they had the skills (and self-efficacy) to utilise technology for college work and were using personal and professional technologies to complete college related tasks, as required of them, consistent with the survey data. This may have also been indicative of having to use these technologies to complete their college assignments, but these requirements were not explored with interview participants in detail.

Factor Analysis

Survey I section II technological self-efficacy statements were then checked for validity using factor analysis in SPSS. Factor analysis was conducted with data from cohort two, survey I as outlined previously, factor analysis was sensitive to sample size. Cohort two had 104 respondents to survey I, whereas cohort one had only 80 respondents, therefore cohort two was suitable for factor analysis.

Table 37 *KMO score for technological self-efficacy*

	No. of statements	**KMO**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy C2	10	.826

As the Kaiser-Meyer-Olkin (KMO) score was over the 0.6 sampling adequacy figure, factor analysis was then used to check the validity of the technological self-efficacy statements used. The technological self-efficacy section in survey I had ten statements; of these ten statements, when exploratory factor analysis was conducted, three latent factors were generated. These were:

(i) I am able to use a computer with no help

(ii) I am able to use a computer if there is help available

(iii) I am able to use a computer for college

Similar to the literature on self-efficacy and technological self-efficacy (Albion, 2000; Compeau & Higgins, 1995; Lee & Lee, 2014; McCoy, 2010; Teo, 2009b) students' statements about their own abilities to use technology could be reduced to three categories. An outline of the factor loadings for each technological self-efficacy statement is displayed in Table 38. For example, 'use technology if there are user manuals available' (*r=.838)* and 'complete a job or task using technology, if shown how to first' (*r=.879)* load on the factor 'use a computer with help' respectively. The reliability and validity of section II (professional use of technology statements) for each survey II and III, have been detailed previously in the second research question.

Table 38 *Technological self-efficacy statements factor loading scores for survey 1, section II*

	TSE1	**TSE2**	**TSE3**
Use technology for College work			
Use my knowledge of technology to help my classmates	**.585**	.402	.153
Adopt and adapt technology resources for assignments	**.788**	.152	-.028
Integrate technology in my college work creatively	**.868**	.077	-.002
Integrate technology in my college work with minimal help	**.752**	.246	.183
Search, evaluate and select appropriate technology resources	**.670**	.357	-.148
Use a computer with no help			
Navigate the contents of a computer	.090	**.881**	.054
Use technology without needing to be told how it works	.271	**.764**	.125
Complete a job or task using technology	.441	**.691**	.115
Use a computer with help			
Use technology if there are user manuals available	.173	.152	**.837**
Complete a job or task using technology if shown how to first	-.116	.046	**.879**

Composite technological self-efficacy scores.

A composite score for technological self-efficacy was calculated in SPSS, by creating a new variable that calculated the mean of the ten technological self-efficacy items, for each participant. Thus, each participant had a score for technological self-efficacy (TSE). These composite TSE scores had highly significant correlations with the expertise levels that had been self-reported by the respondents in each cohort (Table 39). Therefore, the composite technological self-efficacy scores calculated supported use of the self-reported expertise levels for analysis of the various uses of technology in the classroom, in the research questions, outlined in the previous data chapter. As such, a higher technological self-efficacy score was significantly analogous to a higher level of self-reported expertise.

Table 39 *Technological self-efficacy and expertise level correlation scores*

			TSE *r*
Expertise Level	Cohort 1	N=80	.702** *(p<.001)*
	Cohort 2	N=104	.561** *(p<.001)*

***. Correlation is significant at the 0.01 level (2-tailed).*

T-tests.

Paired sample t-tests were conducted on the survey data to check for similarities or differences between each cohort's composite technological self-efficacy score. There was a marginally significant difference in the composite technological self-efficacy scores between cohort one (C1 SI *M* 3.75, *SD* .591) and cohort two (C2 SI *M* 3.89, *SD* .467); $t(77)=1.88$, $p=0.06$), where cohort two demonstrated a significantly higher composite score for technological self-efficacy than cohort one; the reasons for this were explored with interview participants (Table 40).

Table 40 *Results from t-tests between cohort differences for composite technological self-efficacy scores*

Paired Sample	Composite Score	*t*	*df*	*p*
C1 * C2	Self-Efficacy (SE)	1.883	77	.063

Pearson's Correlation Coefficient Analysis

Correlational analysis was conducted for each cohort, testing whether there was any association between a participant's composite score for technological self-efficacy, and their use of the most frequently used professional technologies, while on school placement. The ten technological self-efficacy statements (survey I, section II) were combined to form a composite score for technological self-efficacy, by calculating a mean score per respondent, in SPSS. This composite technological self-efficacy score was then used as a basis for comparison with various professional technologies listed, using correlational analysis, for participants in each cohort. It was not possible to calculate a composite score for professional use generally, as these items (e.g. data projector and/or laptop) represented alternatives rather than a cumulative use of technology. Thus, the most frequently used technologies are listed separately and the Pearson product coefficient score calculated for each matched with respondents' technological self-efficacy composite scores outlined (Table 41).

Table 41 *Composite technological self-efficacy scores correlated by most frequently used technologies*

	Cohort one Survey II	Cohort one Survey III	Cohort two Survey II	Cohort two Survey III
Data Projector	-.018	-.272	.152	-.245
Laptop	-.169	-.235	.130	.199
Internet	.028	-.233	.078	-.169
IWB	.047	-.164	-.214	-.256
MS PowerPoint	.103	-.041	.010	.091
Google	.213	-.322	.089	.259

For cohort one, there was no relationship between their composite technological self-efficacy score and their scores for the most frequently used technologies while on school placement. For example, when technological self-efficacy scores and use of IWB scores were calculated there was no relationship (C1 SII *r =-.047*) and none either for survey 3 (C1 SIII *r=-.164*). This also applied to other technologies used on school placement, such as Internet (C1 SII *r=.047*, C1 SIII *r=-.164*), projectors (C1 SII *r=-.018*, C1 SIII *r=-.272*), Google (C1 SII *r=.213*, C1 SIII *r=-.322*), MS PowerPoint (C1 SII *r=.103*, C1 SIII *r=-.041*) and laptops (C1 SII *r=-.169*, C1 SIII *r=-.235*). There were some significant results for technological self-efficacy with technologies such as smartphone (*r=.504 p<.001*) and YouTube (*r=.311 p=.05*). While these results were significant they were not meaningful, as both these technologies had not been used frequently in the school placement classroom by members of this first cohort. Participants may have been competent using these particular technologies in a personal capacity only (research question one) and not differentiated their context of use when responding to these survey items.

For cohort two, a similar pattern emerged where the correlation co-efficient scores were distributed far more widely, and no associations were evident in the data. There were two significant results for this second cohort, where Google Books (*r=.432 p=.05*) and Photo sharing (*r=.414 p=.05*) were mentioned, but these were technologies that had not been frequently used on school placement. As such, while interesting, these results demonstrated no overall relationship with technological self-efficacy for the respondents in cohort two. However, given the small rate of participation generally by cohort two, no generalisations can be drawn from the data here. Further analysis of this apparent lack of association between technological self-efficacy and use of technology on school placement and associated concepts, were explored at interview with participants from each cohort.

Technological Self-Efficacy & Expertise Levels

The following two tables (Table 42 and Table 43) outline the levels of self-reported technological self-efficacy matched with expertise levels of each cohort, using the cross-tabulation function in SPSS. One would expect that the more expertise a participant had reported, the more technological self-efficacy they would have demonstrated using technology. The concept of what use of technology meant to each participant had already been explored in the second research question. These tables demonstrated that strong levels of agreement were present for the self-efficacy statements presented, where confidence using technology was present for all expertise levels, not just the 'very good' and 'good' experts.

Table 42 *Cohort one technological self-efficacy statements by expertise level and levels of agreement [agree & strongly agree]*

Technological Self-Efficacy Statements	**Poor Expert [8]**	**Somewhat Good Expert [22]**	**Good Expert [35]**	**Very Good Expert [15]**	**N = 80**	**%**
Complete a job or task using technology if shown how to first	8	20	29	13	70	87
Complete a job or task using technology	4	11	32	15	62	77
Navigate the contents of a computer	2	11	27	14	54	67
Use technology if there are user manuals available	4	13	26	11	54	67
Integrate technology in my college work creatively	2	6	30	15	53	66
Adopt and adapt technology resources for assignments	2	9	27	14	52	65
Integrate technology in my college work with minimal help	2	11	24	13	50	62
Search, evaluate and select appropriate technology resources	3	8	26	12	49	61
Use technology without needing to be told how it works	2	8	23	11	44	55
Use my knowledge of technology to help my classmates	1	7	22	14	44	55

Table 43 *Cohort two technological self-efficacy statements by expertise level and levels of agreement [agree & strongly agree]*

Technological Self-Efficacy Statements	**Poor Expert [8]**	**Somewhat Good Expert [35]**	**Good Expert [45]**	**Very Good Expert [16]**	**TOTAL = 104**	**%**
Complete a job or task using technology if shown how to first	8	32	41	13	94	90
Navigate the contents of a computer	4	30	41	15	90	86
Complete a job or task using technology	3	29	41	16	89	85
Use technology if there are user manuals available	5	28	36	11	80	76
Integrate technology in my college work creatively	2	22	39	16	79	75
Search, evaluate and select appropriate technology resources	2	23	40	12	77	74
Use my knowledge of technology to help my classmates	0	16	32	16	64	61
Adopt and adapt technology resources for assignments	4	20	32	6	62	59
Integrate technology in my college work with minimal help	1	19	30	12	62	59
Use technology without needing to be told how it works	0	18	29	13	60	57

As demonstrated in the previous tables, 44 (55%) experts in cohort one agreed they 'could use technology without being told how to' (11 VGEs, 23 GEs, eight SGEs and two PEs). Cohort two participants reported similar results, where 60 (58%) experts reported their ability to use technology without direction (13 VGEs, 29 GEs and 18 SGEs). However, some participants in each cohort (C1 16 participants and C2 12 participants) disagreed with the statement. Of note was, that in both cohorts, a tendency to not answer the question emerged, where 17 C1 participants, and 32 C2 participants were neutral in their responses. Further, in cohort two, four PEs disagreed with the statement about being able 'to use technology with no direction'. As such, perhaps they (PEs) were more realistic in their technological self-efficacy, where they were not as confident using technology as other members of their peer group had reported. This was explored further at interview, especially with PEs from cohort two.

For both cohorts, similar results were reported where the majority of participants agreed they 'could navigate the contents of a computer' (C1 14 VGEs, 27 GEs, 11 SGEs and two PEs: 68%) and in cohort two (C2 15 VGEs, 41 GEs, 30 SGEs and four PEs: 87%). In cohort one, only ten participants (one GE, five SGEs and four PEs) disagreed with this statement. Similarly, in cohort two, participants could 'integrate technology into their college work creatively' (C2 16 VGEs, 39 GEs, 22 SGEs and two PEs: 76%). However, these responses were gathered in first year of their college preparation course, and exploration of their self-reported expertise levels was further discussed at interview, with a subset of participants, from each cohort.

Of note were the differences that emerged between cohort one and cohort two in their willingness to help their class colleagues to use technology. In cohort one, only 44 participants (14 VGEs, 22 GEs, seven SGEs and one PE: 55%) reported they would help their colleagues, whereas in cohort two 65 participants (16 VGEs, 32 GEs, 16 SGEs: 62%) said they would. In cohort two, no PEs reported they would help a colleague, and as such were perhaps more aware of the limitations of their technological ability. Overall, there were high levels of self-reported technological self-efficacy across all expertise levels, and participants were confident they could use technology when given adequate direction.

Conclusion

This research question established that a pre-service teacher's technological self-efficacy had little association with use of technology on school placement, where the results were mixed. The survey data demonstrated that generally pre-service teachers did feel confident in their use of technology, but this technological self-efficacy was limited to personal technologies such as YouTube, their smartphones and using photo sharing applications. Technological self-efficacy composite scores demonstrated a significant correlation to self-reported expertise levels, where generally respondents who had higher self-efficacy composite scores had also rated themselves as more expert users of technology. There was, however, a difference between the technological self-efficacy scores reported for cohort one and two, where cohort two had yielded higher technological self-efficacy results.

Interviewees had reported personal mastery using technology and this personal mastery had increased due to purchasing a laptop, for college. The role of a school placement environment and a teacher's views about using technology in a classroom had impacted on an interviewee's self-efficacy using technology in that classroom. The influence of a school environment was also demonstrated in this research question. In the next section, the results of the final research question are presented, and the analytical procedures used to obtain them, discussed.

Research Question Five

This final research question investigated if pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM variables (facilitating conditions and subjective norms), would act as a positive predictor of their use of technology while on school placement? (Davis, 1989; Venkatesh et al., 2003). The responses from survey I, section IV were used to answer the quantitative elements of the research question, for each cohort. Qualitative data pertinent to this research question was then gathered during semi-structured interviews, with a subset of participants from each cohort. Data from the semi-structured interviews added to the survey data, and gave a broader perspective on the TAM variables that influenced use of technology on school placement and therefore, they are presented together.

Normal distribution of data

Before any statistical tests were conducted on the TAM survey data, it was tested to see if the results in these sections followed a normal distribution, as with the previous parametric research questions. To check for normality the responses to survey I section IV TAM items were checked, using SPSS.

The data in this final research question was sufficiently normally distributed, based on the results of a Shapiro-Wilk test conducted in SPSS, for each cohort. Figure 33 and Figure 34 give examples of the normal distribution of these TAM statements, where the observed values did not diverge greatly from the expected values. The histogram distributions were also normal, and thus parametric statistical analysis was conducted on the data from each cohort for this final research question.

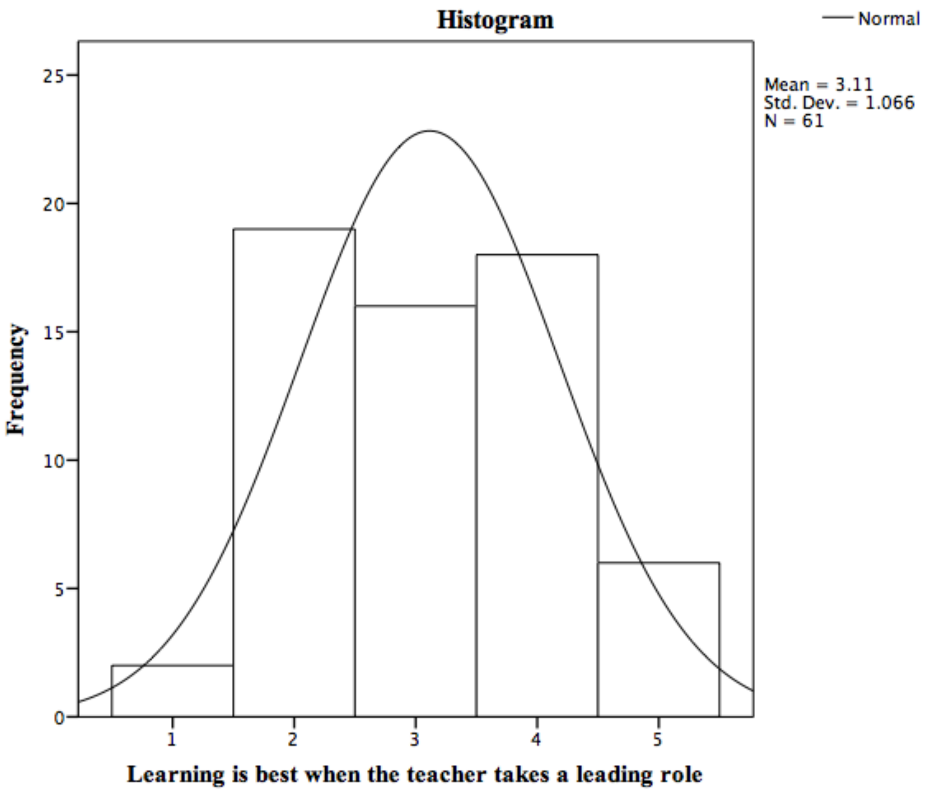


Figure 33 Cohort one histogram of normal distribution of sample TAM statement

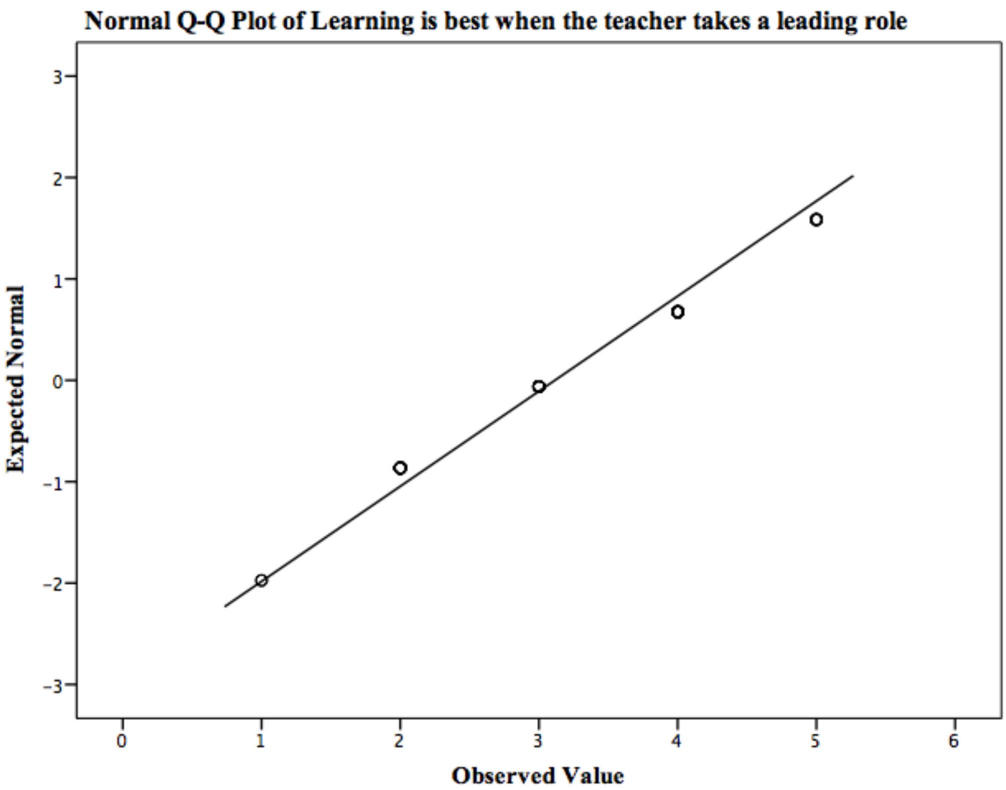


Figure 34 Cohort one Quartile-Quartile plot of sample TAM statement's normal distribution

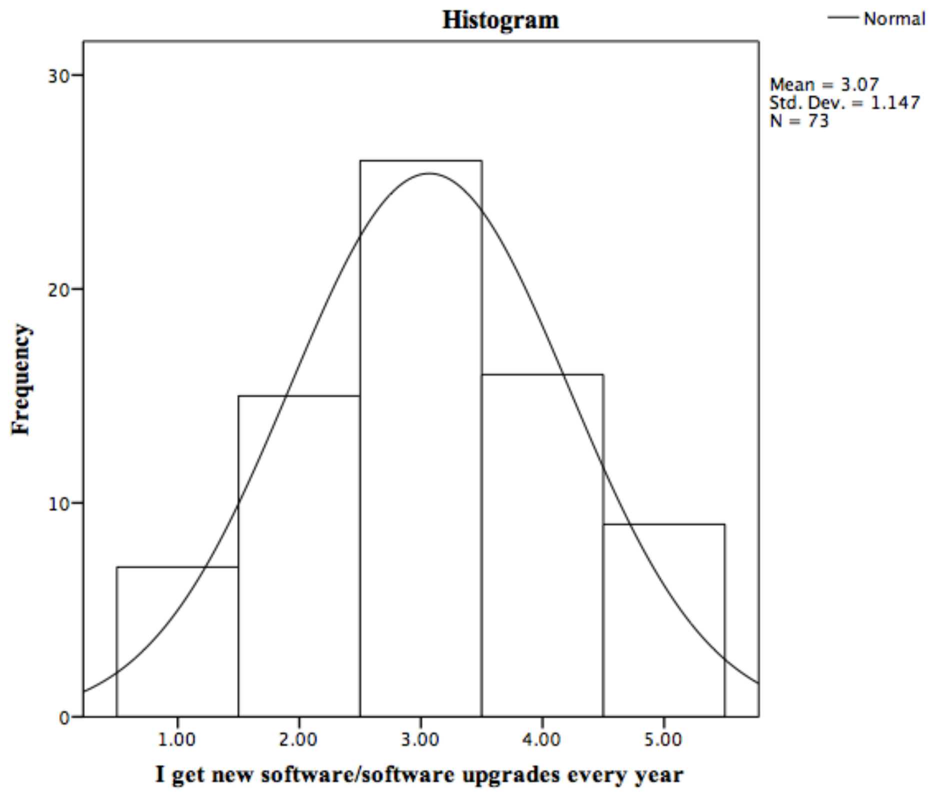


Figure 35 Cohort two histogram of normal distribution of sample TAM statement

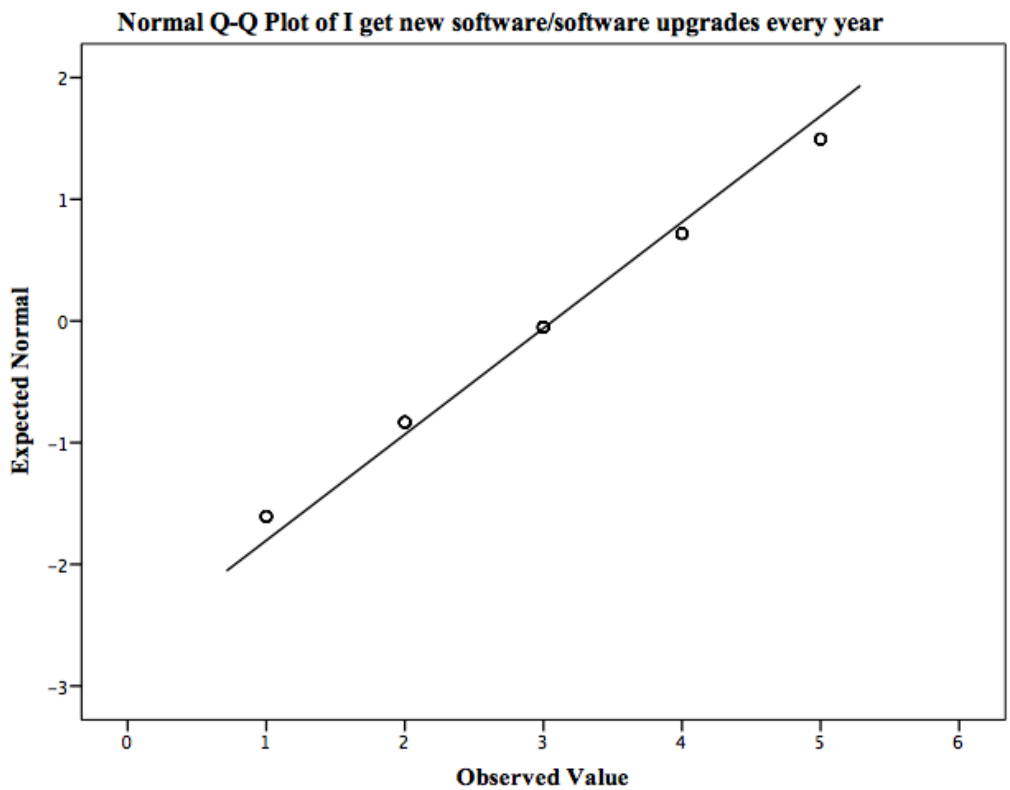


Figure 36 Cohort two Q-Q plot of sample TAM statement's normal distribution

Reliability.

In survey I, Section IV Technology Acceptance Model (TAM) statements were presented to participants, and levels of agreement sought for these, using Likert type items. As with previous sections of the different survey instruments, Cronbach's alpha was used as a measure of reliability of the TAM statements. In both instances, a score of over the standard .7 alpha score was achieved, indicating reliability of the instrument, for use in the current research.

Table 44 *Survey I reliability of TAM statements*

	No. of statements	**Cronbach's alpha α**
Section IV - TAM Statements – Cohort One	40	.779
Section IV - TAM Statements – Cohort Two	40	.743

Descriptive Statistics

The research question investigated if a pre-service teacher's TAM scores would correlate with their use of technology while on school placement. To answer this the following statistical tests were performed on the data collected for each cohort:

- frequency counts, mean and standard deviation calculations
- factor analysis
- Pearson's product moment correlation co-efficient and
- paired sample t-tests

The results of these are discussed, after the descriptive statistics, displayed in Table 45.

Table 45 *Technology Acceptance Model [TAM] Mean Scores per Cohort sorted by TAM Factors*

	Cohort 1 Survey 1			**Cohort 2 Survey 1**		
	n	***Mean***	***SD***	**n**	**Mean**	***SD***
Learning on computers is fun [A1]	78	4.00	0.77	94	4.03	0.68
Using technology is a good idea [A1]	78	4.44	0.35	94	4.47	0.58
I like using technology [A1]	78	4.19	0.81	94	4.25	0.80
Learning is best when activities are constructed in the classroom [A1]	78	4.18	0.86	94	4.06	0.72
Data given to students needs to be carefully screened and planned [A2]	78	4.21	0.71	94	2.76	0.95
Students should take responsibility for their own learning [A2]	78	3.09	1.10	94	3.86	0.90
Students are often frustrated by the digital divide between home and school [A2]	78	2.06	0.89	94	1.96	0.75
Assuming wireless technology was available I would use it on a regular basis [BI]	78	4.48	0.60	94	4.27	0.70
If I heard about new technology I would look for ways to incorporate it into my teaching [BI]	78	3.64	0.74	94	3.96	0.84
Using computers will enhance my teaching [BI]	78	4.17	0.65	94	4.31	0.59
Using technology helps me realise my future aims for my students [BI]	78	3.51	0.84	94	3.59	0.73
I intend to increase my use of technology in the future [BI]	78	3.99	0.81	94	4.01	0.72
I find computers easy to use [PEU1]	78	3.84	0.92	94	3.94	0.84
It was easy for me to become skilful at using a computer [PEU1]	78	3.58	0.85	94	3.55	0.82
I find it easy to recover from errors when using technology [PEU1]	78	3.27	0.95	94	3.26	0.88
I find it easy to get the computer to do what I want it to do [PEU1]	78	3.50	0.92	94	3.62	0.82
Interacting with technology is often frustrating [PEU2]	78	3.15	0.99	94	3.11	1.00
Technology often behaves in unexpected ways [PEU2]	78	3.67	0.92	94	3.39	0.87
I make errors frequently when using technology [PEU2]	78	3.05	0.94	94	2.85	0.94
I need to consult the user manual often, when using technology [PEU2]	78	2.55	0.96	94	2.52	0.91
Learning to use the computer takes too much of my time [PEU2]	78	2.23	0.87	94	2.22	0.77
My job would be difficult without technology [PU]	78	3.62	0.92	94	3.51	0.93
Technology enables me to accomplish tasks more quickly [PU]	78	3.95	0.78	94	3.94	0.68
Using computers will enhance my teaching [PU]	78	4.17	0.65	94	4.32	0.59
Using technology will help my students gain success in the future [PU]	78	3.99	0.71	94	4.26	0.59
Students should have access to as many data sources as possible [PU]	78	3.64	0.74	94	3.59	0.73

Attitude.

For this research question frequency distributions and standard deviation scores were measured for each cohort, and their responses to each TAM statement presented (Table 45). Generally, both cohorts strongly agreed with the positive attitude (AI) statements that ‘using technology is a good idea’ (C1 *M* 4.44, *SD* .35 and C2 *M* 4.47, *SD* .58), that ‘I like using technology’ (C1 *M* 4.19, *SD* .812 and C2 *M* 4.25, *SD* .79) and that ‘learning on computers is fun’ (C1 *M* 4.00, *SD* .77 and C2 *M* 4.03, *SD* .67). A positive attitude to using technology was demonstrated by both cohorts’ responses, and there was little variance in their responses, given the tight standard deviation scores.

For the negative attitude to technology statements (AII) participants tended to disagree and given their positive attitudes to technology, these results were as expected. There was disagreement with the statement that ‘students are often frustrated with the digital divide between school and home’ (C1 *M* 2.06, *SD* .88 and C2 *M* 1.96, *SD* .75). Respondents answered neutrally ‘students should take responsibility for their own learning’ (C1 *M* 3.09, *SD* 1.10 and C2 *M* 3.86, *SD* .89). However, ‘data given to students needs to be carefully screened and planned’ was strongly agreed with by cohort one (C1 *M* 4.21, *SD* .70) and answered neutrally by cohort two (C2 *M* 2.76, *SD* .95). This was one of the only TAM statements where there was a marked difference between the cohorts’ responses. This may have been indicative of a miscomprehension of the statement by either cohort, and was unclear from the survey data.

During the semi-structured interviews, participants from both cohorts expressed positive attitudes about using technology in the classroom. This data was similar to the survey data, where positive attitudes to technology were also evident. When asked a direct question about how an interviewee would describe their own attitude to technology, all interviewees reported their attitudes were positive. These quotes are reflective of responses from the larger data set. “I would have a good attitude towards it” (C2 SGE1) and “definitely I’d say I have a positive attitude” (C2 VGE1). Technology was seen as a good idea generally and all interviewees stated they liked using technology. This positive attitude was also evident in the positive words interviewees used, when describing their own improved use of technology on school placement and was similar to the technological self-efficacy data reported previously, “before I started college I would’ve said I was terrible I wasn’t good, well not terrible, I wasn’t that great at using it but em I’ve definitely got a lot better” (C1 GE1).

However, when interviewees were questioned about their experiences of using technology on school placement, negative attitudes were evident. These negative attitudes had not been present in the survey data. Negative words used to describe experiences of technology use on school placement were particularly marked by the emotive terminology used. Words used included frustration, “I have a strong positive attitude towards technology, em if something doesn’t work I get so easily frustrated by it,” (C2 VGE1), irritation, “when it gets irritating so I actually disabled my Facebook over school placement, just to get away” (C1 VGE2), fear, “now there was always the fear that they wouldn’t work then because I was afraid to save it on my laptop and then plug in my laptop and suddenly it probably wouldn’t work” (C2 PE1) and a general wariness about using technology. These emotive words were used by the many of the interviewees, when describing their experiences on school placement. This wariness was often due to having heard stories in the media about instances of cyber bullying where “there had been reported cases and this is common in schools of online bullying number one and then all of these other websites that are potentially harmful” (C1 GE2), “I’ve heard lots of bullying stories - like take a picture, you rate this person and it’s being sent around” (C2 VGE1) and a general fear related to privacy on the web: “you know with the Facebook messenger and stuff like that if you read the terms and conditions they can go through your personal information and you know, it’s just weird”(C1 PE2). Furthermore, some interviewees expressed a preference for using traditional methodologies in the classroom such as, "yea, I prefer the you know, just the whiteboard really to be quite honest, like yea, it's just easier, it's more reliable I think" (C1 PE1), as they had negative experiences with technology, and their attitude was thereby affected. Other interviewees were not in favour of an over reliance on technology (such as Buaine Cainte – Irish curriculum software) in the classroom. They expressed the view that such a technology dependent environment, was not reflective of their personal attitudes to teaching, where traditional resources and methods were more appropriate and useful:

> I would have a good attitude towards it but I just feel like in terms of like, some schools and teachers maybe too reliant on it and kids aren't getting that childhood that we got, I know that's impossible, but also sensory because like when you do take young children out to school garden, to smell the plants and smell all that, Bloom Festival, I did that and they had a sensory garden, and it was just, they loved it, it's just amazing so you know when you go over and you can smell this, and they smell it, and they're touching, like especially special needs, they love - water is such a, oh my god, because there was a solar fountain in the middle and it had spurted water and the kids were drawn to it, it's just its so, I sound like such a mother, but it's just so nice to see them enjoying that whereas technology is kind of taking over - but some schools use it really well, just minimal, you know, when it's needed its great (C2 SGE1).

Behavioural intention.

Behavioural intention (BI I) statements were generally agreed with, by survey participants, in both cohorts and were concerned with the participants' intentions to use technology in their future classrooms. Survey I was completed by each cohort during term one of their first year and all participants, from both cohorts, agreed that using technology in the future would be a good idea and beneficial. Statements such as 'if wireless technology was available I would use it on a regular basis' (C1 *M* 4.48, *SD* .59 and C2 *M* 4.27, *SD* .69) and 'using computers will enhance my teaching' (C1 *M* 4.17, *SD* .65 and C2 *M* 4.31, *SD* .59) were strongly agreed with by both cohorts. Other BI statements such as 'I intend to increase my use of technology in the future' (C1 *M* 3.99, *SD* .81 and C2 *M* 4.01, *SD* .72), 'using technology helps me realise the future aims for my students' (C1 *M* 3.51, *SD* .84 and C2 *M* 3.59, *SD* .72) and 'if I heard about new technologies I would incorporate them into my teaching' (C1 *M* 3.65, *SD* .73 and C2 *M* 3.96, *SD* .83) showed levels of agreement with all aspects of these behavioural intention statements. If these positive behavioural intentions had any influence on subsequent use of technologies in the classroom, will be explored shortly.

All interviewees expressed a desire to use more technology in the future. The interview data was consistent with the survey data on behavioural intention. The majority of interviewees were looking forward to being able to use technology in their own classrooms, where the school placement environment would not confine their use and they would have more time to experiment with technology they were interested in:

> I'd say like when you're a teacher you kind of have the time to say right, I might give this a go and look at different avenues you know (C1 PE1),
>
> But I think in the future, it might be, like if you knew, like that you could say oh I've junior infants, or I seem to be getting this class (C1 SGE2),
>
> But I feel there's so much more I could learn about like, it's endless I think just everything to do with technology (C1 GE2).

Perhaps the most realistic view was expressed by a cohort two interviewee who commented that:

> I suppose that's just, it's kind of you have to keep up with it don't you, its kind just say if you just completely stayed away from technology and then you came in, even in a year or two years later you'd be lost, so I think it's just even if you don't use it constantly to like know about the changes and just like be aware of it really (C2 SGE1).

Of note, was that the majority of the interviewees in both cohorts felt that iPads, and tablet devices, were the way forward. They expressed strong intentions to use iPads in their own future classrooms. Their behavioural intention was that these iPads and tablet devices would be used for the benefit of the children and opinions expressed by interviewees, were quite optimistic in this regard:

> Well, I suppose having iPads would be brilliant – like I know it's not everything but there's so much you can do with it like, just even getting

> children involved, having their own iPad in front of them, doing their own little typing, even making their own worksheets, like you know, stuff like that – its brilliant, just because they learn a lot from doing it themselves and you know instead of being handed stuff in book, so that's the way the world is going like, it's going with technology (C1 GE1).

Whether these behavioural intentions related to tablet devices would translate into use of technology in their own classrooms, was outside the confines of this research study, but would be of interest in the future.

Perceived ease of use.

The perceived ease of use (PEU I & II) statements asked whether technology was perceived as easy (PEU I) or difficult (PEU II) to use. The descriptive statistics for both the positive and negative PEU statements provided some interesting results, when both latent factors were analysed. While respondents agreed that they 'found computers easy to use' (C1 *M* 3.84, *SD* .91 and C2 *M* 3.94, *SD* .68), they also responded neutrally 'that technology often behaves in unexpected ways' (C1 *M* 3.67, *SD* .92 and C2 *M* 3.39, *SD* .87). Other PEUI statements including 'I find it easy to get the computer to do what I want it to do' (C1 *M* 3.50, *SD* .91 and C2 *M* 3.62, *SD* .82) and 'I find it easy to recover from errors when using technology' (C1 *M* 3.27, *SD* .94 and C2 *M* 3.26, *SD* .88) were answered neutrally, with some level of agreement, by participants. As such, there was evidence of some ease of use using technology and an awareness that errors could be made, when using technology. Then, PEU II statements such as 'I make errors frequently when using technology' (C1 *M* 3.05, *SD* .94 and C2 *M* 2.85, *SD* .94) and 'I need to consult the user manual when using technology' (C1 *M* 2.55, *SD* .96 and C2 *M* 2.52, *SD* .91) were also answered neutrally, where generally participants in each cohort may have made errors using technology but rarely consulted a user manual to resolve those same errors. This meant that while both cohorts agreed they found computers easy to use, they had encountered some problems using technology, and these results were reflective of their mixed experiences using technology generally.

The majority of interviewees, from both cohorts, did perceive that technology was easy to use. The interview data was similar to the survey data here where “I suppose because you’re able to look up things that you can’t look up in a book or its easier and quicker to look them up” (C1 PE2) and “there’s such a wide and versatile variety of technology available nowadays, that although we mightn’t use everything we can certainly use something to help us in the classroom and it certainly does make life easier” (C1 VGE1).

However, the survey data had also reported that respondents thought ‘technology often behaved in unexpected ways’. The experiences of interviewees when faced with technological problems on school placement, again, mirrored the survey findings in this regard, for example “last year I’d have like a problem of the week and go through different things and it was difficult if you couldn’t put it up on the board” (C1 PE1). Further, as outlined in the previous research question, interviewees tended to rely on technologies they were comfortable using, “I was probably using stuff, like I wasn’t branching out too far, I was using stuff I was comfortable with” (C1 SGE2) and did not tend to use technologies they were afraid would not work, while on school placement. Thus, while technology may be easy to use, the interviewees felt they were limited in what technologies they could use, while on school placement.

Perceived usefulness.

As displayed in Table 45, the scores for perceived usefulness (PU) were agreed with on average, by more participants than the PEU statements. The PU statements that participants tended to agree with included ‘technology enables me to accomplish tasks more quickly’ (C1 *M* 3.95, *SD* .78 and C2 *M* 3.94, *SD* .84) and ‘using technology will help my students gain success’ (C1 *M* 3.99, *SD* .81 and C2 *M* 4.01, *SD* .71). Equally, both sets of participants agreed that 'my job would be difficult without technology' (C1 *M* 3.62, *SD* .91 and C2 *M* 3.51, *SD* .93) and 'students should have access to as many data sources as possible' (C1 *M* 3.64, *SD* .73 and C2 *M* 3.59, *SD* .72). Thus, we can see that both sets of pre-service teachers, rated perceived usefulness of technology as important to them, at that time. Further, there was little difference between the cohorts' responses to the PU statements where the mean scores for each statement were very close, for each cohort. This was further demonstrated where there was little variance in the standard deviation scores for each set of responses.

Interviewees did perceive technology as useful for school placement classroom and the majority of interviewees reported on the "handiness" (C2 GE2) of technology where,

> I just google image it and say that that's what it actually looks like and things like that, so it's handy like that (C1 PE2),
>
> You can get apps on it, you know for different things, it's just handy - it does everything and then you can use it in the classroom as well, which is good (C1 GE1),
>
> It's so handy I was doing Maths, and it was like you know how do you measure a squiggly line and it was like, you know you can't properly measure, you have to straighten it out so I had you know like, it was like the Active Inspire but it was a squiggly line, but you could then pull and straighten out (C2 GE2),
>
> Well, for handiness, I mean what I was saying was you could just throw a picture up there rather than make a resource (C2 SGE1),
>
> but it's just like a visual that they can just look at straight there, so you're not trying to you know hold up this tiny piece of paper and be like, so look here, so if I had a worksheet for them to do I'd have it up and I'd be like so this is what you'll be doing and it was just a lot easier - it was just a lot easier rather than having to go around and explain it to everyone (C2 GE2).

This data was analogous to the survey data, where participants had indicated they needed technology to be able to do their jobs more efficiently, and that using technology facilitated quicker completion of tasks. However, one interviewee was critical that the school she was placed in had used a particular software programme as an "easy option" (C2 SGE1) and she did not favour this approach. As such, while using technology might be perceived as useful, this interviewee felt technology should be used appropriately, rather than just because it was available.

Subjective norm & facilitating conditions.

Other TAM variables measured in survey I included subjective norm and facilitating conditions. These variables did not pass the KMO test to check if there were any latent factors underlying these statements. However, descriptive statistics for these two TAM variables were analysed nonetheless. Subjective norm statements such as ‘in general my school has supported the use of technology’ (C1 *M* 3.95 *SD* .88 and C2 *M* 3.91 *SD* .96) and ‘colleagues in my class have been helpful in the use of technology’ (C1 *M* 3.86 *SD* .75 and C2 *M* 3.78 *SD* .74) were agreed with, but not strongly agreed with, by both cohorts. The FC statements such as ‘people in my class come to me for advice about using technology’ (C1 *M* 2.53 *SD* .995 and C2 *M* 2.54 *SD* .89) were answered neutrally by both cohorts, with little difference in either cohorts’ responses to the FC statements. The timing of the survey instrument may have had an impact on the survey results here, as respondents had not yet been out in schools, and as such were not aware of problems they may have encountered in a classroom.

These two variables were raised directly with participants at interview, and responses were gathered as to whether these two variables had any impact on use of technology in the school placement classroom. As the interviews happened at the end of third year, when interviewees had experienced two blocks of school placement, interviewees were more expansive in their responses about the facilitating conditions and subjective norms in those schools. The similarities between the findings of research question three regarding the factors that impact on use of technology during school placement, and the role of facilitating conditions and subjective norms on use of technology, were also evident in relation to this research question.

Facilitating conditions meant the environment the pre-service teachers experienced, while on school placement, and whether this environment hindered or aided their use of technology in the classroom. As the pre-service teacher was in a supervising teacher's classroom, they tended to do whatever the supervising teacher usually did, rather than try anything different that may not work, or even "annoy" (C2 PE1) the supervising teacher:

> At the start my teachers - like really I wouldn't be too familiar with them, but then they'd show me like everything I could do in it, and explain to me how they used it and what kind of things they put on and like and how they'd use it for all subjects, like so many subjects and they'd show me how to use it even and they'd promote like me using it (C1 GE2),
>
> yea, she was very annoyed about it so somehow, I managed I just said look I'll be chalk and talk so (C2 PE1)
>
> they need to know that it is going to work and that you're not going to be sitting there with nothing on your screen for a half hour lesson (C2 VGE2).

Indeed, the school norms around using technology were also influential for interviewees, where they described how the school reacted if there was a technological issue. Further, interviewees also noted how the presence or lack of technology in a school hindered or helped their efforts to use technology while on school placement:

> The pen isn't working, she was like OMG (sic.), it was like the biggest deal, she was like it's not working and I was like no, it's just like, the board is grand it's just the pen, the pen isn't connecting to it, she was like omg (sic.), just like such a nuisance (C2 GE2),
>
> the class teacher said now, you can only go on this site, or this site, and you can't use this site unless you ask permission (C1 VGE1).

Subjective norm meant the perceived social pressure to use technology and if parents, teachers, supervisors and other pre-service teachers thought using technology was a good thing, the interviewees were influenced by this social pressure to use technology. Again, similar to research question three, the school placement supervisor exerted an influence over the pre-service teachers in this study. If a supervisor did not rate technology, the pre-service teacher tended not to use it, as this may have affected the grade achieved for that school placement block:

> What we're kind of seeing is the ones (supervisors) that are kind of taken aback with the technology who mightn't have experience with it, are the ones that tend to go 'well, here are a few suggestions for next time' and veer away from the technology (C1 VGE1),
>
> in first year there was one inspector who wasn't really in favour of technology or anything really modern but that was just I suppose different people, like it depends who you get (C1 GE1).

Hence the concept of subjective norms and facilitating conditions and the influence of these TAM variables on a decision to use technology in a classroom had a greater impact on the interviewees, than reported by the survey participants.

Factor Analysis

This section of survey I section IV was then checked for validity using factor analysis in SPSS. Initially, exploratory factor analysis was conducted to investigate the quality of the statements used in the TAM section of survey I. As factor analysis was sensitive to sample size, exploratory factor analysis was performed on cohort two. Cohort two had 104 respondents, and as such was a larger sample than cohort one (n = 80). Cohort twos' respondents were divided randomly (using a random sampling function in SPSS) into two sub-groups. For the first sub-group, exploratory factor analysis was used to check the TAM variables within survey I, for their validity. This exploratory factor analysis was used to calculate if any latent TAM factors were present in the TAM instrument. The expected latent factors were attitude (A), perceived ease of use (PEU), perceived usefulness (PU), behavioural intention (BI), facilitating conditions (FC) and subjective norms (SN) (Davis, 1989; Pynoo et al., 2012; Venkatesh & Davis, 2000).

Within the TAM section in survey I, there were 40 statements. Of these 40 statements, when exploratory factor analysis was conducted on the TAM variables, 11 initial latent factors were discovered. Of these 11 latent factors, six (BI, PEU, PU and A) were all above the required Keyser–Meyer–Olkin (KMO) sampling adequacy level of 0.6

(Table 46). The other five latent factors (SN, FC, TC & CSE items) were present but with a lower KMO score and were therefore not suitable for subsequent use.

Table 46 *Survey I KMO scores for TAM variables cohort two*

	No. of statements	**KMO**
Attitude Statements (A)	7	.702
Behavioural Intention Statements (BI)	6	.793
Perceived Ease of Use Statements (PEU)	10	.862
Perceived Usefulness Statements (PU)	4	.687

To confirm the latent factors investigated by EFA then existed with the second sub - sample of cohort two, confirmatory factor analysis was then conducted. The 6 latent factors present in cohort two's first exploratory sample, were also present in the second confirmatory sample calculated for the second cohort. As such, the six latent factors were also present and the TAM instrument, as such, was a reliable measurement tool of the underlying TAM constructs therein (A, PEU, PU, BI). Factor analysis was then conducted on the data from cohort one, and the same six latent factors were present. These findings were similar to recent literature where Teo and colleagues had used factor analysis to examine the validity of the Technology Acceptance Model as an effective measurement tool (Teo, 2011, 2014).

The results of factor analysis can be viewed are displayed in the following tables where the six latent factors are discussed individually. Attitude had two latent factors (AI and AII) where AI factor loadings were related to positive statements about technology, and AII factor loadings were related to negative attitudes to technology. Both AI and AII statements were then used to calculate *composite positive* and *composite negative* score using the mean calculation function in SPSS. Therefore, a score for positive attitude could be attributed to a survey participant, and the same for negative attitude. These composite scores were useful later in the research question.

Table 47 *Factor loading scores for attitude cohort two*

Attitude	**AI**	**AII**
Learning on computers is fun	**.760**	-.052
Using technology is a good idea	**.794**	.047
I like using technology	**.782**	.023
Data given to students needs to be carefully screened and planned	.118	**.745**
Students should take responsibility for their learning and choices	-.014	**.742**
Students are frustrated and dissatisfied with the digital disconnect between school & home	-.034	**.435**
Learning is best when activities are used to allow knowledge to be constructed in the classroom	-.439	**.443**

Extraction Method: Principal Component Analysis.

Behavioural intention had one latent factor which measured a participant's intention to use technology in their future classroom, with their future students, as displayed in Table 48. Thus, a composite score for behavioural intention could be calculated, based on these results.

Table 48 *Factor loadings for behavioural intention cohort two*

Behavioural Intention	**BI I**
Assuming wireless technology would be available in my classroom, I predict that I would use it on a regular basis	**.661**
If I heard about a new technology, I would look for ways to experiment with it in my teaching	**.566**
Using computers will enhance my teaching	**.776**
Using technology will help my students gain success in the future	**.817**
Using technology helps me to realise my future aims for my students	**.649**
I intend to increase my use of technology in the future	**.731**

Extraction Method: Principal Component Analysis.

Perceived ease of use had two latent factors which measured a participant's ease of use with technology and differentiated between finding technology easy to use, and finding technology difficult to use, as shown in Table 49. Thus, a composite score for PEUI technology was easy to use and a composite score for PEUII technology was difficult to use could be calculated. These composite scores were then used for further analysis.

Table 49 *Factor loadings for perceived ease of use cohort two*

Perceived Ease of Use	**PEU I**	**PEU II**
I make errors frequently when using technology	-.280	**.725**
I often become confused when I use technology	-.710	**.501**
Interacting with technology is often frustrating	-.514	**.637**
Technology often behaves in unexpected ways	-.003	**.642**
I need to consult the user manual often when using technology	-.287	**.676**
Learning to use the computer takes too much of my time	-.545	**.318***
I find computers easy to use	**.772**	.274
I find it easy to recover from errors encountered when using technology	**.649**	.306
I find it easy to get the computer to do what I want it to do	**.791**	.199
It was easy for me to become skilful at using a computer	**.911**	.018

*Extraction Method: Principal Component Analysis. *low r coefficient*

Finally, perceived usefulness variables were reduced to one latent factor that measured a participant's perception that technology was easy to use (Table 50). Thus, a composite score for perceived usefulness (PUI) could be calculated, for subsequent use in this research question.

Table 50 *Factor loadings for perceived usefulness cohort two*

Perceived Usefulness	**PU I**
My job would be difficult without technology	.675
Technology enables me to accomplish tasks more quickly	.612
Using computers will enhance my teaching	.807
Using technology will help my students gain success in the future	.799

Extraction Method: Principal Component Analysis.

As indicated, these six latent factors were then used as composite scores for measurement of positive attitude (AI), negative attitude (AII), behavioural intention (BII), perceived ease of use (positive PEUI) or negative (PEUII) and perceived usefulness (PUI) of technology. The composite score for each TAM variable was calculated in SPSS using the mean calculation function. A composite score for each participant was attributed to each factor and these were then measured for any relationship to those participants' use of technology scores. Correlational analysis was then conducted to check whether there were any significant correlations between these composite scores for each TAM variable, and various professional uses of technology.

An alternative method proposed was to calculate a total TAM composite score for each participant, combining the scores for all 11 factor loadings, even those without the requisite KMO adequacy quotient. This type of analysis would have included the subjective norm (SN) and facilitating conditions (FC) TAM variables that were present in the full survey instrument. When this factor analysis was conducted in SPSS, with data from cohort two (due to it being a larger sample size), the 11 latent factors were still present, but again only six had the requisite KMO level. However, as the research question sought to query the relationship of *each* of the TAM constructs to professional use of technology a total TAM score was not useful for individual analysis required. Thus, while conducting factor analysis on the combined 40 TAM statements confirmed the presence of the 11 latent factors outlined earlier, a more detailed approach was required to respond to the specifics of the research question.

Interview data was collected from two sets of cohorts and analysed in light of the latent factors gathered from the survey data, which provided a useful proxy for discussion of the interview data. For example, the concept of subjective norm (SN) explored the social pressure felt by interviewees to use (or not use) technology on school placement, and the various stakeholders in an interviewee's sphere of influence (e.g. parents, children, teachers and supervisors).

T-tests.

Paired sample t-tests were conducted on the data to compare the differences in answering patterns for respondents' composite TAM variable scores, per cohort. There were no significant differences in the answering patterns for any of the TAM variables between cohort one and cohort two (Table 51). The composite positive attitude scores for cohort one (*M* 4.21, *SD* .59) and cohort two (*M* 4.23, *SD* .53); $t(77)=-.22$, $p=0.82$ demonstrated no significant difference for either cohort's response patterns. These results were mirrored in the results of the paired t-tests conducted on the other TAM composite scores, for and between each cohort. These included behavioural intention for cohort one (*M* 3.91 *SD* .50) and cohort two (*M* 3.88, *SD* .52); *t*(69)=.380, *p=.70*, perceived ease of use (C1 *M* 3.55 *SD* .74 and C2 *M* 3.56 *SD* .68); *t*(69)=.05, *p=.96* and perceived usefulness (C1 *M* 3.97 *SD* .58 and C2 *M* 3.94 *SD* .48); *t*(69)=.29, *p=.77*. These t-test results demonstrated there were no significant differences for any of the composite scores measured, for respondents in each cohort. As such, both cohorts answered the TAM section of the first survey instrument in a similar fashion.

Table 51 *Paired t-test results for all TAM composite scores for differences between cohort one and cohort two*

Pair	**Composite Score TAM Variable**	***t***	***df***	***p***
C1 * C2	Positive Attitude (AI)	-0.22	77	0.83
C1 * C2	Negative Attitude (AII)	-0.44	69	0.66
C1 * C2	Behavioural Intention (BII)	0.38	69	0.71
C1 * C2	Perceived Ease of Use (PEUI)	-0.05	69	0.96
C1 * C2	Perceived Ease of Use (PEUII)	1.02	69	0.31
C1 * C2	Perceived Usefulness (PUI)	0.29	69	0.77

Pearson's Correlation Coefficient Analysis

Correlation coefficient analysis was conducted between each cohorts' responses to the TAM statements in survey I, and their reported uses of professional technologies, in surveys II and III, after each school placement block. The TAM variables had been reduced to six latent factors, as discussed previously. A composite score for each latent TAM factor was calculated in SPSS as outlined earlier. These composite TAM scores were then measured for any significant correlations to the most frequently used technologies on school placement, in SPSS. As mentioned earlier, a composite score could not be calculated for professional use of technology as technologies listed in the survey instrument represented alternatives, rather than a cumulative frequency of use figure.

Using a composite score for positive attitude (C1 *M* 4.21 *SD* .59 and C2 *M* 4.25 *SD* .52*)* and then subsequent uses of technology, we would expect to see a positive correlation between these two sets of data where if a participant had a positive attitude to technology, it would be expected they would use technology more frequently. However, the results of the correlational analysis showed few significant results. For example, cohort ones' positive attitude scores had a weak but significant correlation with using email (C1 $r=.308$ $p=.05$) and desktop machine (C1 $r=.362$ $p=.05$). Cohort one also showed a highly significant correlation for positive attitude and use of a smartphone (C1 $r=.561$ $p<.001$). There were no weak or strong correlations between positive attitude and any professional technologies for respondents in cohort two. There were no correlations for the negative attitude composite score (C1 *M* 3.22 *SD* .49 and C2 *M* 3.21 *SD* .43) with any of the professional technologies listed. This lack of correlation was mirrored in other TAM variables.

For PEU I statements (I find technology easy to use) (C1 *M* 3.54 *SD* .73 and C2 *M* 3.59 *SD* .70) a correlation between that TAM variable and professional use, would also be expected. Again, few correlations existed for any of the technologies used in survey II or survey III, for either cohort. There were weak, but significant, correlations between PEU I statements with smartphones (C1 $r=.355$ $p=.05$), desktop machines (C1 $r=.455$ $p=.05$) and photo-sharing websites (C2 $r=.363$ $p=.05$) only. There were no significant correlations present for any of the PEU II (I find technology hard to use) statements (C1 *M* 2.99 *SD* .72 and C2 *M* 2.83 *SD* .70).

For PU statements (I find technology useful) there were two technologies that were deemed 'useful', they were smartphones (C1 $r=.340$ $p=.02$) and Google Drive (C2 $r=.370$ $p=.05$). Thus, for all the professional technologies listed in the survey instruments, only two were perceived as useful by respondents, and then not particularly strongly.

Finally, behavioural intention (BI) (C1 *M* 3.90 *SD* .49 and C2 *M* 3.97 *SD* .52) showed some significant correlations with use of various professional technologies, where respondents would use these technologies in their future classrooms. These included professional websites (C1 $r=.416$ $p<.001$), Moodle (C1 $r=.356$ $p=.05$), MS Word (C2 $r=.419$ $p=.05$) and eBook readers (C2 $r=.527$ $p=.05$). These results were interesting as they indicated that the individual TAM variables were not a strong indicator of frequent use of professional technologies listed in the survey instruments, for these research participants. As such, the value of the TAM instrument as a predictor of use of technology was not upheld, for the current research study.

TAM Variables & Expertise Levels

The individual TAM composite scores were then matched with expertise levels using the cross-tabulation function in SPSS. This data was checked for any significant correlations where expertise levels were matched with the different TAM composite scores, such as attitude, perceived ease of use, perceived usefulness and behavioural intention. Table 52 and Table 53 represents the different cohorts' responses to each of the latent TAM factors discovered during factor analysis earlier, and these results are then, further analysed.

Table 52 *TAM statements attitude & behavioural intention: levels of agreement by expertise level for each cohort*

	Cohort one						Cohort two					
Strongly Agree & Agree Levels reported	**Very Good Expert [15]**	**Good Expert [35]**	**Somewhat Good Expert [21]**	**Poor Expert [7]**	**TOTAL = 78**	**%**	**Very Good Expert [16]**	**Good Expert [41]**	**Somewhat Good Expert [31]**	**Poor Expert [7]**	**TOTAL = 95**	*%*
Learning on computers is fun-A1	15	28	13	3	59	76	13	37	22	5	77	81
Using technology is a good idea-AI	15	32	21	6	74	95	16	39	29	7	91	96
I like using technology-AI	15	34	12	3	64	82	16	37	23	4	80	84
Learning is best when activities are constructed in the classroom-AI	6	15	6	1	28	36	11	30	20	5	66	69
Data given to students needs to be carefully screened and planned-AII	10	33	17	7	67	86	12	31	29	6	78	82
Students should take responsibility for their own learning-AII	13	30	20	7	70	90	1	12	8	2	23	24
Students are often frustrated by the digital divide between home and school-AII	3	8	0	1	12	15	16	34	23	4	77	81
Assuming wireless technology was available I would use it on a regular basis-BII	14	33	20	6	73	94	15	37	23	6	81	85
If I heard about new technology I would look for ways to incorporate it into my teaching-BII	12	23	12	2	49	63	13	34	21	4	72	76
Using computers will enhance my teaching-BII	14	30	18	5	67	86	15	40	27	6	88	93
Using technology helps me realise my future aims for my students-BII	10	16	11	4	41	53	8	24	17	1	50	53
I intend to increase my use of technology in the future-BII	13	27	17	4	61	78	12	28	23	6	69	73
Using technology will help my students gain success in the future -BII	12	29	14	5	60	77	15	40	25	6	86	90

Table 53 *TAM statements perceived ease of use & perceived usefulness: levels of agreement by expertise level for each cohort*

	Cohort one						Cohort two					
Strongly Agree & Agree Levels reported	**Very Good Expert [15]**	**Good Expert [35]**	**Somewhat Good Expert [21]**	**Poor Expert [7]**	**TOTAL = 78**	**%**	**Very Good Expert [16]**	**Good Expert [41]**	**Somewhat Good Expert [31]**	**Poor Expert [7]**	**TOTAL = 95**	*%*
It was easy for me to become skilful at using a computer-PEUI	13	24	12	1	50	64	13	28	11	0	52	55
I find it easy to recover from errors when using technology-PEUI	11	21	7	1	40	51	14	15	11	0	40	42
I find it easy to get the computer to do what I want it to do-PEUI	10	26	8	1	45	58	14	29	18	0	61	64
I find computers easy to use-PEUI	14	31	9	1	55	71	16	37	20	0	73	77
Interacting with technology is often frustrating-PEUII	5	9	14	5	33	42	5	13	15	5	38	40
Technology often behaves in unexpected ways-PEUII	10	21	14	4	49	63	7	18	18	4	47	49
I make errors frequently when using technology-PEUII	4	9	9	5	27	35	2	7	6	5	20	21
I need to consult the user manual often, when using technology-PEUII	2	4	4	3	13	17	2	5	5	1	13	14
Learning to use the computer takes too much of my time-PEUII	0	4	2	1	7	9	0	1	3	1	5	5
I often become confused when using technology-PEUII	2	6	10	5	23	29	1	8	9	6	24	25
My job would be difficult without technology-PUI	9	19	11	4	43	55	10	18	14	5	47	49
Technology enables me to accomplish tasks more quickly-PUI	13	28	16	4	61	78	16	32	21	2	71	75
Using computers will enhance my teaching – PUI	14	30	18	5	67	86	15	40	27	6	88	93

The attitude statements displayed a difference between cohort one and cohort twos' responses to 'students should take responsibility for their own learning' where cohort one experts strongly agreed/agreed that students should. Cohort two, however, did not agree with this statement, across all expertise levels. Equally, there was a discrepancy between cohort ones' responses to 'students are often frustrated with the digital divide' statement, where cohort one had only 12 respondents agree with that statement, where the rest of that cohort disagreed, or strongly disagreed, with that statement. Further, cohort two and cohort one disagreed about teaching strategies using technology, where cohort two agreed 'learning is best when activities are constructed in the classroom' and cohort one did not.

For the perceived ease of use variable, the participants in both cohorts responded similarly to the statements posed. For example, with 'I find computers easy to use' both sets of VGEs and GEs strongly agreed and agreed with these statements. This would be as expected, as based on their own self-rated level of expertise, one would expect them to find technology easy to use. These levels of agreement were further re-iterated with 'it was easy for me to become skilful using a computer' (13 C1 VGEs and 13 C2 VGEs, 24 C1 GEs and 28 C2 GEs). Yet, the PEs in both cohorts had not reported such 'ease of use' of technology, where only one C1 PE said they found 'technology easy to use', and another C1 PE said it was 'easy for them to become skilful with technology' – these were two different PEs from cohort one but this would suggest these particular pre-service PEs were not aware of their own limitations.

All expertise levels responded similarly to the 'negative' perceived ease of use statements where they did not strongly agree or agree they found technology difficult to use. For example, 'learning to use computers takes too much time' was only agreed with by seven participants in cohort one, and five participants in cohort two, across all expertise levels. Few participants needed to 'consult the user manual often' (C1 two

VGEs, four GEs, four SGEs and three PEs, C2 two VGEs, five GEs, five SGEs and one PE).

Behavioural intention statements described a participant's intention to use technology in their future classrooms, and all participants either strongly agreed or agreed with the BI statements posed. Table 52 demonstrated strong levels of agreement across all expertise levels, for each cohort for these BI items. Statements such as 'I intend to increase my use of technology in the future' were similarly answered by VGEs (C1 13, C2 12), GEs (C1 27, C2 28), SGEs (C1 17, C2 23) and PEs (C1 four, C2 six) alike.

Perceived usefulness statements were used to measure whether a pre-service teacher perceived technology as useful for either their own personal use, or as useful in their future classrooms. Again, similar responses were apparent across all expertise levels, in both cohorts. The first PU statement that 'my job would be difficult without technology' was not met with universal agreement by either cohort. Only 43 participants (out of 78) in cohort one (and 47 out of 95 in cohort two) agreed with the statement. Further, 16 (out of 21, cohort one) and 21 (out of 31, cohort two) SGEs did not agree with the statement 'technology helped them accomplish tasks more quickly'. Yet, similar to the BI statements reported earlier, there were stronger levels of agreement with the 'using technology will help my students gain success in the future' statement. This was similar to the strong levels of agreement expressed in earlier BI statements, for all expertise levels.

Conclusion

With respect to this research question the results indicated that the TAM instrument had unclear predictive value for usage of technology by members of both cohorts. TAM was well established in the literature, by Teo, Davis and others, as a reliable predictor of use of technology, hence its use in the current research. However, when sub-scale analysis was conducted on the TAM variables with two sets of pre-service teachers in this research, the results were not as clear for these pre-service teachers. Generally, even though these latent composite TAM variables were present for both cohorts, when correlated with usage of professional technologies, on school placement, there were no significant results. While the survey results indicated positive attitudes to technology, positive behavioural intentions to use technology in their future classrooms, and that generally these pre-service teachers found technology useful and easy to use, these results tended to have no predictive value on actual use of technology on school placement. Yet, the data for the TAM variables had been collected in first year (survey I), thus, the interview findings may have been more reflective of the predictive value of the instrument. However, given the small interview sample, these results were not generalisable to the larger cohorts.

Further analysis of the lack of correlation between any TAM scale item and use of technology on school placement had been explored during the interviews, and the impact of the school environment, again, was influential. The interview results supported two TAM variables as predictors of use of technology, these were facilitating conditions (FC) and subjective norms (SN). Thus, the influence of a school environment had also been demonstrated in this research question, and, as previously outlined, this theme will be explored in the next chapter.

Chapter Five Conclusion

This second findings chapter reviewed the results of parametric analyses of the various data sets gathered over the duration of the research study. In the third research question participants were asked to report on any barriers that impacted on their ability to use technology while on school placement, and both external and internal barriers were prevalent in the results. The extrinsic barriers included lack of technology, the school placement environment and lack of pedagogical models to use with technology. The intrinsic barriers included pre-service teachers' beliefs about using technology, their own skills gap, technology not being reliable, including classroom management issues and technology being too difficult, and time-consuming to use. The survey results generally indicated levels of agreement and disagreement with the statements presented, where the pre-service teachers claimed these barriers to varying degrees, with the presence of these barriers made more explicit by interviewees, than survey respondents. The influence of the school placement environment as a social context, and the impact this placement had on a pre-service teacher's decision to use technology was a prevailing theme of the current study.

The fourth research question queried if pre-service teachers' technological self-efficacy would correlate positively with their use of technology on school placement, and the results were mixed. The descriptive statistical data suggested that pre-service teachers had strong levels of personal technological self-efficacy and were generally positive about their ability to use technology. However, when composite scores for self-efficacy were checked against frequency counts for use of a number of classroom technologies, few significant correlations were found in the survey data. Of note in the data, was a marked difference in the reported self-efficacy scores for cohort one and two, where cohort two had yielded higher results, hence they rated themselves as more confident users of technology. However, despite this confidence, reported use of technology had declined from one placement to the next, for cohort one. The reasons for this are discussed in the next chapter.

In the final part of this chapter, the TAM results were examined, and this model was found to have limited predictive value on subsequent use of technology by the pre-service teachers in the study. Yet, TAM was well established in the literature as a reliable predictor of use of technology, however, when sub-scale analysis was conducted on the TAM variables with two sets of pre-service teachers in this research, the results were ambiguous. While the survey results had indicated positive attitudes to technology, positive behavioural intentions to use technology in their future classrooms, and that generally these pre-service teachers found technology useful and easy to use, there were no significant associations with any of the professional technologies listed. The interview results expanded on two TAM constructs, subjective norms and facilitating conditions, and again, the influence of a school environment, classroom and the experience of school placement generally, were pertinent to the research.

The next chapter will review the key findings of the research and discuss the common themes that emerged from the results presented in chapters four and five. It will examine the results in the context of current literature of relevance and determine where the research study has contributed to the research on the use of technology by pre-service teachers.

Chapter Six Discussion

The purpose of this chapter is to analyse the key findings of the research study in the context of current literature. This discussion chapter is guided by the five research questions, which sought to provide an explanation for the apparent disparities between personal and professional uses of technology by the pre-service teachers in this study. Upon review of the results for each of these research questions, as outlined at the end of the previous chapter, two main themes have emerged in the research. These themes are the social and environmental factors affecting use of technology, and pre-service teachers' confidence and competence using technology in personal and professional capacities. How these themes align with current literature, and where other new themes emerged, are discussed and provide new insights into pre-service teachers' use of technology, personally and professionally.

Expertise Levels

In the previous findings chapters, it was noted that the self-reported expertise levels were not indicative of any difference in use, or ability, using technology by the pre-service teachers in the research. Indeed, a poor expert experienced the same difficulties and challenges using technology, as a very good expert. Furthermore, technological self-efficacy and levels of expertise, while significantly associated with each other, proved equally ineffective measures. Thus, the stratification of user types, while interesting to observe, was not very constructive in the current work.

Theme One Confidence & Competence

This section will explore the themes of confidence and competence using technology, and how these two psychological constructs were evident in the data gathered in the study. These constructs are then discussed in light of research on the social cognitive theory of self-efficacy (Bandura, 1977, 1994, 1997), and the associated theory of technological self-efficacy (Compeau & Higgins, 1995), where often confidence using technology did not equate to competent use of technology, for participants in the current research. The results were of interest as these pre-service teachers were said to be members of the millennial generation and therefore presumed to be experts in the use of technology in the classroom (Hartnett, 2017; Howe & Strauss, 2009) while on school placement. The identification type of social influence (Kelman, 1958), was again relevant where pre-service teachers demonstrated a change in attitudes or behaviours due to the influence of someone, or something, they identified with. This section will also outline other concepts relating to self-efficacy and discuss their impact on use of technology by the pre-service teachers in light of the findings presented. These include pre-service teachers' prior experience using personal technologies, the role of modelling by pre-service teacher educators, social persuasion and finally, other influences that prevailed upon use of technology by participants in the study. An outline of the current literature of relevance and where the research findings have augmented, differed or further substantiated literature in this area is then provided.

Confident Users of Personal Technologies

Self-efficacy was defined in the literature chapter as the belief in one's ability to accomplish a task and this, and Compeau and Higgins' (1995) definition of technological self-efficacy, were applicable to the findings. In the current research, the expectation was that those who had reported higher personal self-efficacy scores in first year (survey I) would exert a greater effort to overcome technological obstacles they may have faced in the classroom while on school placement, based on earlier literature (Albion, 1999; Hammond et al., 2011). However, as demonstrated in the previous findings chapters, while technological self-efficacy was present in the survey data, this did not manifest in actual use of professional technologies in a school placement classroom.

The findings for personal technology usage demonstrated that pre-service teachers in this study did fit the age profile for millennials (Brown, 2016). Survey respondents had grown up digital (Tapscott, 1998), and technology was present in their homes, from an early age. In particular, interviewees referred to their memories of a desktop computer at home, where it was used specifically to explore educational games and acquire typing skills. Interviewees mentioned early mobile phone devices and the presence of various games consoles, and other personal technologies (including television), at home. Survey respondents also indicated widespread levels of confidence using personal technologies where none of the respondents had rated themselves as a very poor expert, and sub-scale scores for self- efficacy were consistently positive, for both cohorts. Thus, Yeung, Lim, Tay, Lam-Chiang, and Hui (2012) results were applicable to the research findings where "participants' use of computer software was frequent, yet it was more so in their personal lives than in their teaching" (p. 1317).

However, the results demonstrated that where technological self-efficacy was present, it was limited to personal use of the Internet, social media, YouTube, pre-service teachers' own laptops and smartphone/mobile devices, akin to Drabowicz (2017), Kirschner and De Bruyckere (2017) and Lau, Hung, and Jongs' (2016) recent similar conclusions. The pre-service teachers were frequent users of personal technology but were not necessarily competent in all aspects of using those technologies where, similar to Sieber's (2009) work, using aspects of a software programme (MS Word) were problematic. Moreover, the results of correlational analysis of sub-scale scores for self-efficacy and other personal technologies, from the survey instruments, did not provide any positive correlation results for any of those other personal technologies listed. Thus, the pre-service teachers were confident users of personal technologies, but this self-efficacy and confidence was limited to a few specific technologies only. Indeed, the term digital native has lost credibility over the course of this research study, where it was prevalent in early literature (Prensky, 2001; Dede, 2005; Thinyane, 2010) but had lost credibility and was being proven as contentious (Akçayır, 2016; Barak, 2018; Hartnett, 2017; Kirschner, 2017; Šorgo, 2017) by the time the current research study had completed.

Facebook groups.

A reliance on laptops and smart/mobile phones was commonplace for survey respondents. These personal devices were used to access social media platforms, watch videos and communicate with their friends and class colleagues. An interesting finding in the data was both cohorts' reliance on their class Facebook group as a peer content sharing tool, akin to a community of practice (Lave & Wenger, 1991), during the school placement block. Similar to current literature on this topic (Acarli & Sağlam, 2015; García-Martín & García-Sánchez, 2017; Greenhow & Askari, 2017; Hatch, Shuttleworth, Jaffee, & Marri, 2016; Lau et al., 2016; Manca & Ranieri, 2013) interviewees also noted the potential of this social media platform to share lesson plans, schemes and other ideas for classes, with each other, for the duration of a school placement block. This reliance on social media was of note and mirrors Mercieca and Kelly's (2017) research where social media was seen "as a means of sharing resources and ideas whilst on practical experience and of maintaining social bonds" (p. 7). However, one interviewee had questioned the reliability of some of the content being shared where she preferred to use the college learning environment only and had since removed Facebook from her devices. Other research participants were not as discerning and used Facebook to share, upload and download resources for use in class on a daily basis. Of particular interest was the "blurring of boundaries" (Sánchez Abril, Levin, & Del Riego, 2012, p. 63) between the contexts of use of this social media platform, and other social media, including Pinterest, where there was no delineation between personal and professional usage.

Competence using professional technologies was then challenged, when the pre-service teachers entered the school placement classroom, in second year of the study. A lack of competence was evident in the interview data, due to interviewees not being able to overcome the various barriers they experienced when using technology in a school placement classroom. Yet, survey participants had demonstrated some competence using technology where they had responded neutrally to the barrier items in surveys II and III, as such, the results were not definitive. Hence, the suggestion posed by Li and Ranieri (2010) was still applicable to some of the research findings, where "living in a digital environment did not imply being digitally competent" (p. 1041). The relevance of competence to self-efficacy, and its relationship to the current study is now considered.

Technological Competence & Efficacy

Lack of technological competence was evident in the research findings, echoing Albion's (2007) earlier research where:

> First year university students while reporting high levels of confidence (self-efficacy) when using the Internet, do not necessarily manifest matching levels of competence (p.1244).

A competence gap had been reported more recently by Gross and Latham (2012) where "students [are] coming to higher education without needed information literacy skills" (p. 581), and the issue is still the subject of frequent debate in the literature (Hartnett, 2017;

Lai & Hong, 2015; Senkbeil & Ihme, 2017; Teo, 2013a; Wang, Hsu, Campbell, Coster, & Longhurst, 2014). As such, a technological skills gap was present in the results where confident use of personal technologies was not translating into competent use of professional technologies. This was also apparent when technological self-efficacy scores were checked against use of individual professional technologies, and no correlations were present in either survey instrument (II and III), for either cohort.

Computer self-efficacy was based on prior experiences of pre-service teachers (Varma & Marler, 2013) and the results of this research were similar where a pre-service teachers' beliefs and previous experiences using technology were material influences on subsequent use. As Albion's (1999) early research had suggested, technology use during "practicum have found that…pre-service teachers lacked confidence in their capacity to teach successfully with computers" (p. 1604). Bandura (1997) had considered the most effective way of creating a "strong sense of self-efficacy was through mastery experiences where successes build a robust belief in one's personal efficacy" (p. 3) and this was relevant here where pre-service teachers' beliefs about using technology in a school environment (Rohatgi, Scherer, & Hatlevik, 2016; Scherer et al., 2015; Turel, 2014) were important, based on their school placement experience, and any successes they may have had using technology therein. Pre-service teacher education is an opportune time to provide these 'mastery experiences' [using technology] to pre-service teachers, and this should be considered by the colleges of education. This will be discussed further as a socio-cultural factor, in the second theme.

The findings relating to use of technology were also comparable to Kruger and Dunning's (1999) seminal analysis that "skills that engender confidence are often the same skills you need to evaluate your competence in that particular domain" (p. 1121) where Kruger and Dunning suggested that often confidence did not necessarily equate to competence, in a particular field. Mahmood (2016) had tested the Dunning-Kruger effect with information technology literacy skills, and the findings of the current study demonstrated similar results where "there was no match between self-efficacy and actual performance [using IT] where people generally inflate their perceived levels of skills in a particular domain" (p. 205). Indeed, in the current research, the self-reported expertise levels reported in survey I were not associated with any increased use of technology by the research participants, as described earlier. This was again evident where, in relation to the composite self-efficacy items, there were few significant correlations between these and composite scores for use of many professional technologies, by the research participants, as outlined earlier. Subsequently, a general inability to deal with simple technical issues was also present in the interview data, and respondents from both cohorts did not have the competence to tackle technical difficulties they encountered, in a school placement classroom. Akin to Maderick, Zhang, Hartley, and Marchands' (2016) findings who suggested the pre-service teachers in their study were,

> either not aware of how much they do not know about the technologies that they will need to carry to their perspective classrooms or they are indeed, cognizant of their gap in knowledge without having an accurate understanding of its magnitude (p. 342).

As such, Maslow's (1962) early model of learning competencies had continued relevance for the current research where participants in the study had moved from the unconscious incompetence to the conscious incompetence stage of learning, and an awareness of their own technological skills gap was reported.

Substitution.

The research findings also indicated that research participants were still at the substitution and augmentation levels of the Substitution, Augmentation, Modification, Redefinition (SAMR) model (Puentedura, 2010) of classroom technology integration, during their school placement experiences. Thus, they were using technology (IWB for example) as a direct substitute for a more traditional technology (such as a dry-wipe whiteboard) where the technology was being used to display resources (such as flash cards and images) in lieu of a regular whiteboard. There was some evidence that participants had moved into the augmentation phase where videos, music and other multimedia were used to facilitate lesson transitions and lesson introductions (sic.), where participants were moving away from more traditional delivery and transmission type teaching modes, similar to recent work by Bray and Tangney (2017) in their review of the SAMR model. Ultimately, Tondeur, van Braak, Ertmer, and Ottenbreit-Leftwich (2016) remarked that when deciding what technology to use it was down to the individual where "the qualitative evidence [in their review] supports the idea that the technology integration process is an individual process, unique to each teacher" (p. 10) and as such, was related to individuals' own beliefs about the benefits of using technology in a classroom. More recent literature in Finland has suggested "most teachers' reasons for using technology were related to the realisation of educational goals and facilitation of the learning process" (Heitink, Voogt, Verplanken, van Braak, & Fisser, 2016, p. 81) rather than just technology for technology's sake. In the Finnish research a pre-service teacher's confidence to integrate technology into their school placement classroom was down to their individual beliefs about using technology in a classroom. Their individual beliefs were also a factor in the current study, akin to the intrinsic barriers outlined in chapter five. However, these beliefs were tempered by the influence of school context, which is considered shortly.

To try and improve pre-service teachers' skills using technology, recent literature has advocated an approach whereby they should be equipped with strategies to use a wide range of technologies (Banas & York, 2014; Celik & Yildirim, 2016; Roy, Giraldo-

Garcia, Mathew, Matias, & Bommisetty, 2016; Teo, 2015) during their college preparation course. Such an approach would then ensure conscious competence (Maslow, 1962) in respect of using technology in their future classrooms. However, such strategies to deal with a wide range of technologies are but one approach, there are many others advocated in the literature where exposure to technology during the college preparation course, is a first step. Other strategies mentioned in the literature discuss the influence of role models in pre-service teacher education (Scherer et al., 2015; Tondeur et al., 2012; Young, O'Neill, & Mooney, 2015), and provision of pedagogical methods associated with technology use (Campbell et al., 2012; Lehtinen, Nieminen, & Viiri, 2016; Reyes, Reading, Doyle, & Gregory, 2017). These, and other strategies will be discussed under the second theme, related to school placement and the environmental factors that influenced use of technology by the research participants. Pre-service teacher education had a role in engendering positive beliefs about technology use in a classroom, and the experiences of this, reported by members of each cohort, are now discussed

Pre-Service Teacher Education

Competent models of good practice were salient for the research study where Bandura (1997) had suggested that “seeing people similar to oneself succeed by sustained effort raises observers’ beliefs that they too possess the capabilities to master comparable activities required to succeed” (p. 72). Thus, the role of the college lecturers and their modelling of competent use of technology was an influential factor for the pre-service teachers, in this research. The content covered in the college preparation course also came into focus in the findings, and this and other issues of relevance to the on-going theme of identification, are now discussed.

Technology focused.

Rovai and Childress (2002), referred to in the literature chapter earlier, had suggested that pre-service teacher education should focus on "building computer confidence and expanding students' knowledge about computers" (p. 226). Equally, Pierson and Cozart (2004) advocated that "the more and varied the technological experience, the more and varied the use they (pre-service teachers) could imagine" (p. 60) and this approach, adopted by the technology lecturer in particular, was remarked on favourably by interviewees. However, exposure to a wider range of technologies should also be accompanied with explicit demonstrations on how those technologies can be integrated in a classroom setting, as suggested by a variety of authors on this topic (Lee & Lee, 2014; Pope, Hare, & Howard, 2002). Therefore, using technology in pedagogically meaningful ways, where pre-service teachers can see *how* the technology is used, in conjunction with demonstrations of content appropriate technologies, can affect pre-service teachers' intentions to use technology for teaching and learning (Mena, 2017; Uerz, 2018; Valtonen et al., 2015), as demonstrated in the research findings.

Technological knowledge was generally lacking for respondents from both cohorts, as reported in the survey data. Survey respondents tended to be frequent users of six main types of technology only in classrooms, namely data projectors, laptops, internet, IWB, MS PowerPoint and search engines (e.g. Google) and had not used, or did not have access to, other technologies listed in the survey instruments (surveys II & III). Moreover, interview participants commented on specific examples of where their own technological knowledge was lacking, in particular using a Smart IWB when they had experienced a Promethean IWB only, in their college preparation course. The interviewees also commented on a general lack of ability to use document cameras/visualisers that were available in school placement classrooms. As such, the research participants were concerned they were ill prepared for their future classrooms, despite having aspirational behavioural intention scores to use technology in the future.

In particular, the techno-centric focus of the college preparation course was commented on by the majority of interviewees, where they had noted a gap between what they were shown during their course, and then what they were then likely to use, during school placement (Tondeur et al., 2012). Tondeur's SQD (Synthesis of Qualitative Data) model (2012) had acknowledged that preparation of pre-service teachers to use technology effectively happens at both a micro and macro level where "aligning theory and practice were as important as systematic and systemic change efforts" (p. 141). The research participants were keenly aware they had spent a limited time learning how to use a small number of technological tools. Tondeur et al. (2017), Tondeur, van Braak, Siddiq, and Baran (2016) and Tondeur, van Braak, Siddiq, and Scherer (2016) have all acknowledged latterly, the difficulties experienced by pre-service teacher education colleges when helping pre-service teachers design ICT rich lessons. These difficulties include providing pre-service teachers with adequate feedback on how to use technology in a classroom and ensuring their exposure to a wide range of technologies, the results of the current research were not dissimilar. Indeed, Powers and Musgrove (2016) acknowledged that the digital tools pre-service teachers used would always be changing and it was critical that pre-service teachers were equipped with the ability to adapt to a rapidly changing global information society (p. 3048). Thus, in the research study interviewees were aware of a gap in their capacity to use different technologies, *other* than the technologies they had experience of, during their college preparation course. They were concerned that it would be difficult to keep up with technological advances in the future, but this problem is not unique to pre-service teacher education, and is a concern mirrored in most professional contexts (Bronfenbrenner, 1979; Fredrickson & Branigan, 2005). Technology will always change, and it has been suggested that pre-service teacher education should equip the pre-service teachers with skills and professional resilience to be able to cope with these changes (Mansfield, Beltman, Price, & McConney, 2012). The next section will outline one suggested strategy that could be adopted in pre-service teacher education to prevent this pedagogical skills gap and ensure technological resilience amongst pre-service teachers in the future.

Pedagogical knowledge lacking.

Generally, pedagogical knowledge domains for classroom technology integration were lacking for the pre-service teachers in the research, as described by the interviewees. Similar to the constructivist paradigm advocated by early educational philosophers (Dewey (1916, 1938, 1956), Piaget (1971) & Papert (1996)), recent literature has questioned whether new pedagogies are now required to accommodate use of digital technologies in schools (Caro & Harvey, 2016; Ertmer & Ottenbreit-Leftwich, 2013; Fitzgerald & Adams, 2016; Heitink et al., 2016; Mama & Hennessy, 2013; Reyes, 2017; Spaulding, 2016). Of note were the pedagogical teaching methods *not* employed by participants from either cohort (multi-media production tools, data logging tools and teacher-parent communication tools, for example) while on school placement, as reported in the survey data. Martinovic and Zhang (2012) acknowledged the “role of teacher-educators is crucial in this process” (p. 8) and that integration of technology, pedagogy and content knowledge was key to a pre-service teacher’s understanding of technology integration in the classroom.

Content knowledge, curriculum knowledge and pedagogical knowledge have been outlined as key domains of knowledge required to be an effective teacher (Ball, Thames, & Phelps, 2008; Dewey, 1904; Dewey, Boydston, & Ross, 1983; Shulman, 1986). Looking at the concept of pedagogical content knowledge, Shulman (1986) established that teachers not only needed to know their subject matter, they needed a different level of knowledge to be able to teach this subject matter. So, while their content knowledge was a given, "pedagogical content knowledge is a particular form of content knowledge that embodies the aspects of content most germane to its teachability (sic)" (p. 7). The addition of technological knowledge to the pedagogical and content knowledge domains has led to the concept of TPACK (Technological, Pedagogical & Content Knowledge) (Mishra & Koehler, 2006) that has been a prevalent discourse in the literature for the past ten years (Banas & York, 2014; Campbell, 2012; Campbell et al., 2012; Caro & Harvey, 2016; Koh & Chai, 2014, 2016; Lehtinen et al., 2016; Olofson, Swallow, & Neumann, 2016; Powers & Musgrove, 2016; Shinas, Yilmaz-Ozden, Mouza, Karchmer-Klein, & Glutting, 2013; Tondeur et al., 2016; Voogt et al., 2013). The TPACK model concentrated on "the relationships between content (the actual subject matter that is to be learned and taught), pedagogy (the process and practice or methods of teaching and learning) and technology (both commonplace, like chalkboards, and advanced, such as digital computers)" (Mishra & Koehler, 2006, p. 1026). Further, recent work by Klichowski and Costa (2015) concluded "there is no doubt that the education of pre-service teachers required many significant modifications in the context of ICT" (p. 164) and, advocating a TPACK approach, they cautioned use of ICT by pre-service teachers that was based on a "rational fear of having to adapt to a new technological environment in their educational setting" (p. 166). Hence, similar to the research findings, integration of these domains of knowledge, necessary for effective teaching, was difficult for the pre-service teachers in this research, and a lack of pedagogical models on how to use technology in the classroom, were highlighted by participants from both cohorts, in the survey and interview data.

Interviewees had commented that there were few pedagogical models provided during their college preparation course on how to use technology in the classroom (Mama & Hennessy, 2013). Participants were shown a wide range of technologies, but had not used many of them, while on school placement. Further, they were still at the substitution and augmentation levels of technological use, as outlined earlier. The reasons for this will be discussed shortly, under the school context theme. However, the requirement for new pedagogies was noted by the EU Commission (Bocconi, Kampylis, & Punie, 2013) as part of a European *Innovating Learning* Strategy and Creative Classrooms initiative. The EU Commission had "acknowledged that a fundamental transformation of education and training is needed to address the new skills and competences that will be required if Europe is to remain competitive" (p. 1). Fullan and Langworthy (2014) also recommended that new pedagogies were now required in education, where old pedagogies were no longer suitable in the digital age:

> The dawning digital era changes fundamental aspects of education. It changes the traditional role of teachers and textbooks as the primary sources of knowledge. It changes *what it is possible for students to do,* as technology enables them to discover, create and use knowledge in the real world faster, more cheaply, and with authentic audiences. In the past what most educators meant by the term 'applying knowledge' was working on tasks or solving problems to demonstrate mastery of concepts. But the solutions remained within the boundaries of textbooks, classrooms and schools. Digital access makes it possible for students to apply their solutions to real-world problems with authentic audiences well beyond the boundaries of their schools (Fullan & Langworthy, 2014, p. 4).

Using such a learning partnership approach, new tasks can be structured towards knowledge creation, using the digital tools and resources available, where the teacher and student are co-creators in this process (Fullan & Langworthy, 2014, p. 10). In the research findings, such co-creation was seen as lacking in schools, for both survey and interview participants.

In Ireland, pre-service teacher education has been slow to adopt different teaching methodologies when using technology, as highlighted recently by Butler et al. (2015). Grossman, Hammerness, and McDonald (2009) had suggested that pre-service teacher education should focus on the "core practices for teaching" (p. 276) and not just the curriculum content required. In the current research use of technology would be considered one of those core practices. As advocated by Butler et al. (2015) pre-service teacher education colleges should allow technology permeate all courses in pre-service teacher education, and not be seen as a standalone subject.

Pre-service teacher education courses, in other countries, have begun to adopt a TPACK (Mishra & Koehler, 2006) approach to technology integration in a classroom, with positive results, where the concepts of technology, pedagogy and content knowledge are combined and not taught separately (Almerich, Orellana, Suárez-Rodríguez, & Díaz-García, 2016; Campbell et al., 2012; Meisalo, Lavonen, Sormunen, & Vesisenaho, 2010; Perkmen, Antonenko, & Caracuel, 2016; Redecker & Johannessen, 2013; Spaulding, 2016; Tondeur, De Bruyne, Van Den Driessche, McKenney, & Zandvliet, 2015). The *Digital Strategy for Schools* (DES, 2015) has acknowledged the benefits of a TPACK approach to ensure effective implementation of technology in a classroom, but as outlined earlier, progress has been slow to date. Pre-service teacher education colleges in Ireland need to embrace this TPACK approach to ensure effective integration of technology in a classroom. The next short section will discuss how pre-service teacher educators modelled use of technology, and how this influenced the pre-service teacher participants in the study.

Pre-service teacher educators.

The research findings, were similar to recent literature that has suggested that role-models of good technological use may not have been present amongst the faculty, for the pre-service teachers in this research (Feng, Ching Sing, Chin-Chung, & Min-Hsien, 2014; Lunenberg, Korthagen, & Swennen, 2007; Reyes et al., 2017; Valtonen et al., 2015; Wong, 2015). Muis and Duffy (2013) established that beliefs about using technology could be changed by teachers modelling new approaches to learning, and Mouza, Karchmer-Klein, Nandakumar, Yilmaz Ozden, and Hu (2014, pp. 214-215) suggested that a persistent challenge for pre-service teachers was to have seen their lecturers use technology in an effective manner, suggesting TPACK (Mishra & Koehler, 2006) as their preferred model. Mouza et al.'s (2014) results indicated that a "narrow application of technology in teaching and learning" (p. 214) was the norm where their research participants described uses of digital content, and content-specific software use only, by their pre-service teacher educators:

> In many instances, participants re-iterated the same observed models indicating that only a small number of faculty actually modelled how to combine content, technologies and teaching approaches effectively in their instruction (p. 219).

There were some notable exceptions mentioned in the findings of the research study, where interviewees had mentioned specific lecturers by name, and were complimentary of their use of technology in a variety of modules.

Generally, interviewees were aware of problems experienced by lecturers when using technology, akin to literature by Heitink et al. (2016) and Martinovic and Zhang (2012). This question of professional technological competence of faculty also arose for Leger and Freiman (2016) where they stressed that current educators should be trained to have "technological resourcefulness, digital self-efficacy and open-mindedness to technology" (p. 220). The examples given by interviewees were based on various lecturers' uses of MS PowerPoint, video clips, displaying images on the IWB and using the visualiser to zoom in on content. As such, lecturers were still modelling "substitution" (Puentedura, 2010) and transmissionist approaches to teaching (Meschede, 2017), where

PowerPoint and the IWB were their favoured technological tools. Further, lecturers were not modelling technological self-efficacy when dealing with technical issues they experienced, where at various times when they encountered difficulties, they called upon the college's technical support staff in the first instance. Thus, they were modelling a reliance on technical support. This had not gone unnoticed by research participants, and they were keenly aware they would not have such technical support in their classrooms. The current *Action Plan for Education 2017* had noted a key theme was the,

> use of digital technologies to enhance teaching, learning and assessment at all levels: we will commence implementation of the *Digital Strategy for Schools 2015 – 2020,* including outlining the competencies that teachers need to effectively embed ICT in teaching and learning and working on the planning, design and delivery of coherent CPD programmes (p. 12).

The role of the Department of Education and Skills in ensuring technology is embedded in teaching and learning is noteworthy. Furthermore, the digital capacity of those teaching in higher education has been a focus of the National Forum for the Enhancement of Teaching and Learning, where their Digital Roadmap publications are keenly aware of a skills gap in this regard. However, implementation of the recommendations of the *Digital Strategy* and National Forum are also within the remit of the pre-service teacher education colleges. This is an outcome of the research that should be considered by teacher education colleges generally, where all parties require competence with technology, not just the pre-service teacher participants in the current study.

Conclusion

This first theme has considered the concepts of confidence and competence in relation to use of technology in personal and professional contexts, by the pre-service teachers in the research study. This section discussed the fact that the pre-service teachers in the study were confident users of personal technologies, but this confidence was not translating into competent use of professional technologies, during school placement. The results indicated there was some use of technology during school placement, but it was at the substitution and augmentation levels of the SAMR model only. Furthermore, the research participants were modelling what they had seen during their college preparation course, where the pre-service teacher educators were also at this first stage of the SAMR model. Pre-service teacher education was not providing 'mastery experiences' [using technology] to pre-service teachers. Some strategies to improve use of professional technologies by pre-service teachers were mooted. These included building technological competence of the pre-service teachers, use of the TPACK model and technology being used across all curriculum subjects during the college preparation course. Implementation of these suggestions would aid the pre-service teachers use technology more effectively in their future classrooms. The next section will discuss the environmental factors that impacted on use of technology by the research participants, where despite behavioural intentions to use technology, the reality of a school placement classroom often ensured these ideas were thwarted.

Theme Two Physical, Social & Cultural Factors

The influence of contextual factors experienced in school placement classrooms by the pre-service teacher participants is now discussed, in light of the findings for each research question presented in the previous two chapters. A school's environment, including the physical, social and cultural environment, was the one of the main themes that influenced the pre-service teachers' use of technology in the current study (Chu & Chen, 2016; Yeung, Taylor, et al., 2012). Other psychological literature on social models (Bandura, 1969, 1989; Bandura & McDonald, 1963) and social influence (Kelman, 1958) were also relevant to the findings, and will be analysed in this section.

The first section of this theme discusses the significance of a pre-service teachers physical and social environment and the impact these had on use of technology. The findings were similar to earlier work on school placement classrooms (Sime & Priestley, 2005) where pre-service teachers had identified three themes that influenced their decisions to use technology - physical, human and cultural factors, all of which were mirrored in the current research. Social and cultural factors are then discussed utilising the notion of a teaching triad to demonstrate the influence a "student teacher, co-operating teacher and university supervisor" (Cochran-Smith et al., 2015, p. 110) had on the research participants. Then, the discussion moves into a consideration of school placement as an assessed environment, and the impact this had on use of technology by participants in the research. The results of this study were broadly similar to recent Irish research in this area (Johnston, 2014, p. 192), where the complexity of school context (Selwyn, 2011a, 2011b) and its impact on use of technology, was noted. How the current study has added to the literature on school contextual factors is now considered.

School Context

Physical, social and cultural contextual factors impacted on use of technology by the pre-service teachers in the research study. These contextual factors were prevalent in the interviewees' responses to the research. In addition, survey statements that queried facilitating conditions and subjective norms were used as a proxy for these physical and social factors affecting use of technology in classrooms. The findings in this study were similar to Teos' (2009b, 2015; 2016) research where social norms and facilitating conditions had an important influence on use of technology in a classroom. Further, Cochran-Smith et al. (2015) had noted "the intricate ways different school contexts shape the learning opportunities available to teacher candidates" (p. 113) and this applied to the current research. Although each factor is discussed in turn, the complexity of the interaction of these contextual factors with each other is acknowledged and recognised in the study.

Physical environment.

The technology available to the pre-service teachers in their school placement classrooms varied in terms of quantity and quality and the most frequently reported technological barrier experienced by interviewees was 'lack of technology' in the classroom, similar to Vrasidas' (2015) experiences in Cyprus. There were mixed responses to the statements posed in the survey instruments (II and III) that there was 'lack of access to technology' for each cohort, where cohort two reported an improvement in the technologies available to them, by their second placement (survey III). Interviewees had tried to circumvent a lack of technology by bringing their own laptops into the school placement classroom, but then experienced problems when trying to connect their own technology to the school network, projector or IWB. These problems using technology are discussed shortly.

Other barriers experienced included a reliance on old desktop machines in a classroom, as noted in the survey (II and III) data. The recent 2013 ICT *Census in Schools* report had noted a prevalence of desktop machines in primary schools and were aware that "40% of computing devices in primary schools…are more than six years old" (Cosgrove et al., 2013, p. 194). Hence, the pre-service teachers encountered problems using these aged machines, and as such, the school placement classroom had not facilitated conditions that were conducive to using technology in that classroom for survey participants. Other physical factors encountered by research participants included lack of a reliable Internet connection, where access to broadband in some of the regional schools remained a concern. Despite recent publicity in Ireland regarding provision of 100mb broadband connections to "an additional 105 schools" (Kennedy, 2014), interviewees, in particular, were not convinced. As such, it was noted in the results that facilitating conditions, defined by Venkatesh et al. (2003) as "the degree to which an individual believes that …technical infrastructure exists to support use of the system" (p. 445), were not present in school placement classrooms.

However, the physical environment was not the only factor that impeded use of technology during school placement. Often, when technology was present in a classroom, it was not used due to lack of maintenance and upkeep. Access to technical support was also identified as a physical impediment to use by participants and is discussed in the next section.

Technical support.

Frequently, in the data, it became apparent that despite having technology in a classroom, there were shortcomings in maintenance of that technology (Kurt & Ciftci, 2012; Nistor et al., 2014; Venkatesh et al., 2003). Lack of access to technical support was prevalent in the majority of schools these pre-service teachers had attended for school placement, similar to Sánchez and Hueros' (2010) results. Instances of IWB bulbs not being replaced, having to share pens between classrooms for IWBs, old operating systems on desktop machines and a general lack of maintenance of installed equipment, was common in the data. A lack of technical support had been noted in the *Digital Strategy for Schools* document (DES, 2015) where "the challenge of attaining reliable and timely technical support" (p. 43) continued to be a major issue for schools. Provision of such timely technical support was not evident in the recent *Action Plan for Education* (DES, 2016), nor this year's annual progress report (DES, 2017). A need for access to timely technical support was an important finding in this research, given that the pre-service teacher respondents had noted aged technology present in their school placement classrooms.

These physical factors were symptomatic of Ireland's approach to integration of technology in primary school classrooms, which has been technology focused, and has not yet moved on to "technology-enabled learning" (Ertmer & Ottenbreit-Leftwich, 2013, p. 175) as advocated in the literature. Ireland has not been unique in its approach to technology integration as, similar to other countries' approaches (Perkmen et al., 2016), ICT policies were focused on technology acquisition primarily, only then followed by supplemental policies addressing the pedagogical practices associated with using technology in the classroom (Selwyn, 2013). McDonagh and McGarr (2015) had used the term "technology somnambulism" (p. 55) (a phrase coined by Winner (1986)) to describe the nature of ICT integration in Irish schools. McDonagh and McGarr (2015) identified that, generally, a school's impetus for technology integration was driven by a view of progress as "hardware acquisition" (p. 55). This techno-centric focus viewed technology as the impetus for change, rather than as a facilitator, best expressed by Papert (1987b) where "it is not drill and practice, or Logo, that will achieve this or that result, it is how we use things" (p. 23). Recent Irish government policy documents (DES, 2016, 2017) have a continued focus on technological infrastructure, indeed, they have been criticised latterly as being too hardware focused in their approach (McGarr & Johnston, 2016). The *Action Plan for Education* (DES, 2016) still reflects this techno-centric approach where investment in infrastructure has remained the primary objective of that document:

> Actions include investment in infrastructure, including high-speed broadband for primary schools…increased technology-enhanced and blended learning opportunities (p. 16).

As a result of lack of available technology, intermittent broadband access and aged machines in classrooms, a general theme emerged in the research data that, ultimately, technology was perceived by the some of the research participants, as not being reliable, similar to Brush, Glazewski, and Khe Foon (2008). Indeed, this was borne out in the findings where, by survey III, cohort ones' use of technology had significantly reduced for their third-year school placement block. Therefore, physical barriers, mirroring Ertmer's (1999) earlier concept of external barriers, persisted in classrooms attended by the research participants in the study. Her contention that these first-order barriers had "since been eliminated" (Ertmer et al., 2012, p. 423) was not valid in an Irish context.

Furthermore, other social factors were also relevant, and the complexity of a school placement classroom was noted in the results. The subjective norms of the school, with particular reference to a school's attitude to technology, and the co-operating teacher's attitude to technology, are considered in the next section. This social and cultural environment is discussed, and similarities to the concepts of subjective norm (Ajzen, 1991; Bagozzi, 1992) and social models (Bandura & McDonald, 1963; Hughes, Liu, & Lim, 2016; Loveless, 2003) evident in the research, illustrated.

Social environment.

Cochran-Smith et al. (2015) outlined the

> dissonance between universities and schools regarding educational goals, with universities generally promoting contemporary views of teaching that support constructivist views of learning while schools are

> typically organized in a way that promote traditional transmission teaching (p. 111).

The role of a co-operating placement teacher, and their modelling of what the social models were in a particular school around use of technology, was an important finding in the research. Valtonen et al. (2015) have suggested that such subjective and cultural norms had the largest influence on a pre-service teachers' attitudes toward and subsequent decisions to use technology while on school placement, which were further substantiated in the current findings. Further, van den Beemt and Diepstraten (2016) had noted the importance of Bronfenbrenner's (1979) learning ecology model and applied this to technology integration. Their research noted that where "teachers develop dependence on others, or when they are not encouraged to use ICT, they appear less open to innovation and less eager to look outside school for possible educational uses of ICT" (van den Beemt & Diepstraten, 2016, p. 168). Thus, the co-operating teacher's attitude to technology in their classroom was germane for interviewees in particular (Bandura & McDonald, 1963). As discussed by Jones et al. (2016) often pre-service teachers are "in receipt of conflicting advice in schools" (p. 110), where the theories they have learned during their college course, cannot be put into practice in a school placement classroom. Indeed, Batane and Ngwako's (2017) recent research where "perceived non-expectancy to use technology by the pre-service teachers in this study was perpetuated by the fact that the mentor teachers did not use technology in their teaching" (p. 57) was consistent with the interview data in the current research. As such, the literature has continued to highlight the impact of social models around using technology, and these persisted for the research participants (Ell et al., 2017; Trevethan, 2017; Vega-Hernandez, 2018). However, the co-operating teacher's attitude to technology was also tempered by the school's general attitude to technology, this is now discussed.

Referred to as institutionalised use in recent literature, (Vanderlinde et al., 2014, p. 1) the influence of a school environment has also been viewed as a strong predictor of "adoption intent" (Sawang et al., 2014) to use technology. Perkmen et al. (2016) established that "the external factor of school climate predicted pre-service teachers' intentions to integrate technology" (p. 215) and was relevant for survey and interview participants in the current research. Latterly, Chu and Chen (2016) have argued that individual behavioural intention can be changed due to external social influences (p. 37), and this was evident in the research study. Despite strong behavioural intentions to use technology in their future classrooms, expressed in survey and interview data, the school environment impeded use of technology, akin to recent work by Thibaut, 2018 and Vermeulen, 2017.

Thus, pre-service teachers were unlikely to use technology on school placement, if they were not expected to do so, and this will continue until technology is viewed more favourably by those in a pre-service teacher's ecosystem (Bronfenbrenner, 1979), or those with a shared cognition (Salomon, 1993) of the benefits of technology use, in a classroom environment. Hence, the complexity of a schools' physical and cultural attitude to technology was material in the current research. A schools' attitude to technology may have also been influenced by a general media discourse about the benefits and problems associated with technology, and this is considered briefly in the next section.

Media influence.

McGarr and Johnston (2016) had noted the "prevalence of positivity regarding the potential of technology in education, and the role of media in mediating such messages" (p. 7152) where, akin to Papert's (1987b) earlier work, technology's role in education was seen as unassailable. However, survey participants were keen to stress they would use technology in their future classrooms 'if it were available' to them, again, the prevalence of provision of technology being their primary concern. However, recent literature has begun to question the validity of using technology in an educational setting at all, where despite the "prevalent positive rhetoric, few independent evaluations comparing educational settings versus about ICT intervention have been conducted, and those that exist are rather equivocal in their conclusions" (Livingstone, 2010). Furthermore, recent print media has focused on negative side-effects associated with over-use of technology generally, citing "screen time" (Kirk, 2017; O'Brien, 2016; Pollak, 2015) and "cyber-bullying" (Aftab, 2015; Harrold, 2016; O'Brien, 2017; Pope, 2015) as problematic by-products due to a reliance on technology by children. The prevalence of these stories in the media did not go unnoticed by the research participants.

Interviewees from both cohorts mentioned cyber-bullying, and a more generalised wariness associated with using technology with children. Recent media and literature has also highlighted the negative associations of use of technology for educational purposes where "sleep deprivation, distraction and multitasking all of which directly impact on learning" (Butler, 2015a; 2015b, p. 3). As such, technology was beginning to reach the "trough of disillusionment" (p. 9) for these interviewees (Smith, 2016), as referred to in Gartner's hype cycle of technology adoption (Linden & Fenn, 2003), where media discourse had an effect on participants' attitudes to technology use, and its perceived usefulness in their future classroom environments. The next section will consider the role of school placement supervision, and this and the complexity of the school placement examination process are discussed.

Supervision of School Placement

The complexity of a school placement classroom has been acknowledged recently by Howard, Ma, and Yang (2016) and Almerich et al. (2016) where, as in the current study, an interviewee may have wanted to use more technology but was advised not to, by an examiner (also termed university supervisor by Cochran-Smith and Villegas (2015); Cochran-Smith et al. (2015)). Thus, the on-going impact of a pre-service teacher's ecosystem (Bronfenbrenner, 1979) was also relevant to the supervision process. The fact that school placement was an examined process, and that school placement supervisors had differing personal opinions about using technology in school, impacted on the use of technology by participants. These themes had not been queried with survey participants, and as such, were only evident in the interview data, which is now examined.

Supervisor opinions.

A school placement supervisor's attitude to technology had a considerable influence over the pre-service teachers' use of technology while on school placement. Bandura (1994) had outlined the concept of "social persuasion as a way of strengthening people's beliefs that they have what it takes to succeed" (p. 4) where positive verbal feedback to a pre-service teacher on their use of technology in a classroom from a supervisor, would have been motivational. The findings of the research were similar to recent work by Tondeur, van Braak, Fazilat Siddiq, et al. (2016, p. 146) who established that "providing adequate feedback can be considered more challenging" where they suggested the importance of feedback during "field experiences seemed to be the most critical factor influencing their (pre-service teachers) educational use of technology" (p. 148). Inconsistent feedback from supervisors, related to use of technology in a classroom, was a feature in the current study, for interviewees.

This was apparent where the survey data had reported that school placement supervisors *did* expect and were in favour of use of technology in the classroom. The survey data had suggested that supervisors were interested in how technology had been used to engage the children in the classroom. Yet, interview participants indicated that if the placement supervisor was 'not that into' (sic.) technology, there was no expectation for them to use technology over the course of that placement. Other supervisors were reported to have more traditional expectations of the students they were supervising, where some had suggested that interviewees should only use traditional resources ('fior earrai' translated from Irish as real resources) or indeed, not use technology at all. Therefore, it was apparent from the survey and interview data, that a lack of a consolidated approach by supervisors, regarding use of technology in school placement classrooms was prevalent.

Compliance by the pre-service teachers with whatever the technology preferences were, of the different university supervisors, was also symptomatic of such a non-unified approach to technology integration. Indeed, university supervisors should expect the pre-service teachers to include the use of appropriate technology in their classrooms, given their awareness that technology was an integral part of the pre-service teacher's college preparation course. Darling-Hammond and Lieberman (2012) had advised that an "intentional set of experiences and learning during the clinical part of the program" (p. 162) should be made explicit to all members of the teaching triad, and this was not apparent in the current research. Thus, that school placement was an examined environment, also had an impact on a pre-service teachers' use of technology, and this is now considered in light of this lack of clarity regarding technology integration requirements.

An assessed environment.

Bandura (1977) had suggested that "stressful and taxing situations…could affect perceived self-efficacy" (p. 198) where the pre-service teachers' awareness of school placement as an examination, had an effect on their use of technology. Pajares (1996) had previously equated self-efficacy and academic performance, and in the current research pre-service teachers were keenly aware that school placement was an assessed environment. As they were being judged on their performance on a particular lesson, participants tended to rely on teaching methods they were confident using, where they could demonstrate technological self-efficacy, and were not going to try something new in front of their university supervisor.

This was evident in the survey data where the results for technological self-efficacy statements were consistently positive. Examples of this technological self-efficacy were also present in the interview data, where participants gave examples of where they had used technologies, on school placement. However, this confidence and technological self-efficacy was limited to a small range of technologies only. Indeed, the pre-service teachers tended to rely on technologies they had experienced during their college preparation course where anything new proved problematic for them (for example the Smart whiteboard and visualisers). Zajacova, Lynch, and Espenshade (2005) had established that often stress can have a negative effect on self-efficacy. This was evident in the current findings where the assessed environment, along with a myriad of other factors that are considered in this chapter, impacted on use of technology by the research participants. However, while technological self-efficacy and confidence were present for the research participants, this had not resulted in competent use of technology in a placement classroom, as previously discussed.

Systematic Approach Required

It was evident in the results that the theory-practice nexus, advocated in the college preparation course, was often at odds with the co-operating teachers and schools' use of technology in their classrooms (Grossman et al., 2009; Korthagen, Loughran, & Russell, 2006; Korthagen, 2004). Hence, lack of facilitating conditions, where technology was not available, and social norms, where schools did not attribute any value to technology, had impeded use of technology for some of the research participants. As noted by Cochran-Smith et al. (2015) in their recent review of teacher preparation courses:

> The studies reveal that novice teachers struggle with the reality of schools where…not finding the schools amenable to the views of teaching and learning they were taught and feeling pressurised by school policies that contradict those views, some new teachers succumb to the traditional school culture (p. 113).

Conway, Murphy, Rath, and Hall (2009) had noted a similar requirement in Irish teacher education where a need for "coherence" (p. xii) in initial teacher education was suggested. Coherence was lacking with members of the placement triad, where inconsistent attitudes to use of technology were present on school placement. Coherence was also lacking where technology was either not available, or not functional, in the various placement classrooms. These, and other factors previously discussed, were symptomatic of a lack of a consolidated approach to school placement, where the pre-service teacher participants did indeed 'struggle' with the reality of schools. This was an important finding of the study.

Partnership.

The implications of this research for pre-service teacher education are apparent. An integrated approach to technology integration is required, where all members of the teaching triad should require and expect use of technology in a school placement classroom. Indeed, allocation of pre-service teachers to partner schools that are known to have the required physical, social and cultural environment that promotes use of technology would also be advisable. Such a partnership model has long been advocated in the literature (Cochran-Smith et al., 2015; Darling-Hammond & Lieberman, 2012; Furlong, 1996) and was applicable in the research findings. Indeed, Conway et al. (2009, p. 89) had recommended such an approach to the Teaching Council, when they began their review of initial teacher education, as discussed in chapter two earlier. However, a collaborative partnership model, where both the school and university are responsible for implementation of such school placement criteria, would "put a heavy demand on the partner schools" (Jones et al., 2016, p. 53) due to the level of involvement required by them. Thus, while it would ensure all pre-service teachers would gain a similar type of experience on school placement and could rely on the technology available in that partner school, implementation of Conway and other's suggestion has not been evident in the recent *Action Plan for Education* (DES, 2016, 2017). As such, an on-going absence of a consolidated approach to technology integration was evident in the research and was suggestive of the dissonance and complexity of the theory-practice nexus between the college preparation course and the reality of a school classroom (Cochran-Smith et al., 2015; Conway et al., 2009; Conway & Murphy, 2013; Festinger, 1957).

Conclusion

Consequently, two variables contained in the TAM instrument (facilitating conditions and subjective norms) were shown to have predictive value on use of technology in a school placement classroom. However, the complexity of a school placement classroom cannot be ignored where the physical, social and cultural factors experienced by the pre-service teachers in the current study, were influential. The impact of facilitating conditions, including availability of technology in classrooms, lack of maintenance of that technology and schools' views on use of technology were prevalent in the survey and interview data. Further, the subjective norms experienced by the participants, including the co-operating teachers and university supervisors' attitudes to technology, were also important outcomes of the research.

Chapter Six Conclusion

This chapter has been designed to provide a reasoned summary of the main themes that emerged from the data collected over the past five years of research. The two main themes suggested that a pre-service teachers' ecosystem continued to have an impact on use of technology by the research participants. The research participants were aware of a pedagogical gap in their knowledge, and were concerned by this, despite strong behavioural intentions to use technology in their future classrooms.

The findings relating to confidence and competence were of note where the pre-service teacher participants were confident users of personal technologies, but not of professional ones. The presence of the Dunning-Kruger effect in the findings was interesting, where the pre-service teachers had moved from a position of unconscious incompetence to conscious incompetence during the course of their college preparation course. Suggestions for changes to the college preparation course were made, where a systematic and consolidated approach to use of technology in schools is still required, in an Irish context. The consequences of these themes will be discussed in the next chapter, and the impact of the research findings for future pre-service teachers considered, in light of the results of the current work.

Chapter Seven Conclusion

This chapter will discuss the implications of the findings of the research study for policy, practice, and future development of pre-service teacher education. A review of the research problem, literature of relevance and method used to address the research questions is first presented. Then, a brief review of the findings for each research question is considered and their implications discussed. The strengths and limitations of the study are then considered and how this research study has made a contribution to the field of research analysed. Suggestions for additional research and publication on this topic are then provided, and a personal reflection of the researcher included.

The Research Problem

The research study arose from the researcher's position as head of information technology in a college of education and her previous role running continuing professional development in a professional organisation. There, the researcher began to observe emergent positive and negative attitudes to technological innovations in each profession. This then led to the overall aim of the research, when it commenced in September 2011. The purpose of the current study was to try and establish what technologies pre-service teachers were using in a personal and professional capacity, and to identify any factors that aided or impeded use of those technologies in a school placement classroom.

At the outset, the literature review contextualised the research where the history of pre-service teacher education in Ireland provided a backdrop to the research study. In that chapter, it was established that Ireland has had an inconsistent approach to technology integration in classrooms, when various government initiatives over the past few decades were analysed and discussed. A review of the literature on use of technology by digital natives was then provided, as the research participants were deemed to be part of that millennial generation. The associated problems of use of that terminology were then examined. The literature also considered how pre-service teachers learned about technology and queried the concepts of effective role models of good technological integration, and where they had experienced these. The literature section then reviewed the persistence of first and second order barriers to use of technology, and whether these applied in an Irish classroom context. The second order barriers were expanded to include technological self-efficacy, and this, along with other psychological influences that impacted on use of technology, were explored. Then a review of the theoretical framework [TAM] that underpinned the research study was provided and a justification for its application to the study examined. Hence, as a result of the literature and the researchers' experiences of different professions' use of technology, the research questions emerged. A reminder of the research questions and methodology chosen to conduct the research is pertinent here.

Research Questions

- Based on their personal uses of technology, rather than just age profile, can the pre-service teachers in this study be considered as members of the net generation or millennial learners (Cuban et al., 2001; Dede, 2000; Tapscott, 1998)?
- What technologies are pre-service teachers using in the classroom, while on school placement, and how are these technologies being used? What are pre-service teachers' perspectives on their experiences of technology use in their pre-service teacher education classes (Cosgrove et al., 2005; Shiel et al., 2006)?
- What barriers, if any, do pre-service teachers perceive as impacting on their use of technology in the classroom (Ertmer, 1999; Ertmer et al., 2012)?
- Does pre-service teacher's technological self-efficacy correlate positively with their use of technology while on school placement (Albion, 2007; Bandura, 1977)?

- Do pre-service teachers' Technology Acceptance Model (TAM) scores for attitude, perceived ease of use, perceived usefulness, behavioural intention, and other TAM variables (facilitating conditions and subjective norms), act as a positive predictor of their use of technology while on school placement (Davis, 1989; Teo et al., 2007; Venkatesh & Davis, 2000)?

Methods used to address the research problem.

The research study was conducted within a pragmatic epistemological paradigm and utilised a mixed methods approach. The methods used included surveys and interviews, administered in a sequential explanatory design over three years, with each of two cohorts of pre-service teachers. The first survey occurred when the pre-service teachers entered their Bachelor in Education course, and then subsequent surveys happened at critical junctures during the course of each academic year. A sub-sample of survey respondents was then invited to interview in the final year of the research study. Statistical and thematic analyses were conducted on the survey and interview data. As a result, the main findings of the research are now considered briefly.

Summary of Main Findings

The overall aim of this research was to establish what technologies pre-service teachers used in a personal and professional capacity, and to identify any factors that aided or impeded their use of those technologies in a classroom environment. The research also sought to establish if the pre-service teacher participants were millennials by virtue of their personal uses of technology, rather than just based on when they were born.

Overall, the data reflected a complex and multi-faceted interplay of components that impacted on use of technology by the pre-service teachers in the research study. These internal and external factors exerted an influence over the pre-service teachers' efforts to use technology at a social, cultural and personal level. Whilst technology-related issues did emerge as factors in this research, the influence of significant personnel, particularly the co-operating teacher and the school placement supervisor, were particularly to the fore within the findings. Technologies utilised tended to reflect transmissionist type uses, where they aided preparation of lesson plans or enhanced teacher-led instructional activities. However, it was noted in the findings that pre-service teachers were modelling technological practices of teacher educators in the locus of the research. While on school placement, some first-order barriers were still experienced by the pre-service teachers in this research, but second-order barriers were also prevalent. These second-order barriers included a perceived skills gap in relation to their own ability to use technology in the classroom, where their confidence was not matched by competence using technologies that were available on placement. The influence of school contextual factors were also noteworthy, where the schools' expectations regarding technology enhanced learning were also relevant. For example, if a mentor teacher advised the pre-service teacher participant to not use technology 'in her classroom' they did not. The role of the school placement supervisor and their opinions about use of technology were also important in the findings, where a pre-service teacher tended to be risk averse during school placement, as it was an examined environment. However, the findings indicated that pre-service teachers were confident, but not necessarily competent, in their technological abilities and demonstrated strong behavioural intentions to use technology in their future classrooms.

Hence this research study, similar to other technology integration and acceptance studies, aims to inform future policy, practice and research in this area. The implications of this research for policy and practice are presented individually.

Policy Recommendations

The implications for the Department of Education's approach to technology integration in schools and pre-service teacher education colleges cannot be ignored.

Acknowledgement and consideration of the influence of a school environment on use of technology was a key finding of this research. Policy documents have consistently avoided discussion of environmental factors that affect use of technology (Butler et al., 2015; DES, 2016; DES, 1997). Recent literature has considered this where Thibaut, Knipprath, Dehaene & Depaepe (2018) suggested “different aspects of school context influence instructional practices either directly or indirectly” (p. 190). Indeed, in the current research if a mentor teacher advised a pre-service teacher not to use technology, such ‘direct’ advice was not ignored. Hence, government policies should acknowledge the role school environment has on technology integration, where this has not been evident heretofore.

Other policy considerations should include the pre-service teacher educators and their abilities regarding technology integration. While recent policy documents have mentioned the role of the pre-service teacher educators and colleges in this regard, they have not been specific as to expectations or requirements therein. The establishment of a *National Forum for the Enhancement of Teaching and Learning* has had some impact due to their remit to increase the digital capacities of those teaching in higher education. However, not all colleges of education are funded by the HEA, and as such, may not have access to the programmes and initiatives promoted by this government agency. Access to and ongoing support of this *National Forum* should be a key consideration for government policy makers, where the technology skills of pre-service teacher educators must also be included to ensure consistency in the technological capabilities of all teaching staff in higher education.

As discussed in chapter six, technology is transient and is always changing but sound pedagogical underpinnings that are not technology dependent, such as SAMR (Puentedura, 2010) and TPACK (Mishra & Koehler, 2006), would build on pre-service teachers’ apparent confidence to use technology in their future classrooms. The recent

Action Plan for Education has considered TPACK, but how that will be integrated into school classrooms is, as yet, uncertain (DES, 2016, 2017). As such, a reticence to integrate technology mediated by traditional pedagogical beliefs about what constitutes 'good teaching' were evident in the current research. Recently, Vongkulluksn (2018) acknowledged the effects those beliefs have on technology integration practice where there exists a,

> sub-group of teachers who lack both the skills to use new educational technologies as well as the value-beliefs to drive them to overcome existing external barriers or mitigate their lack of knowledge (p. 79).

Therefore, the impact of the transmissionist, traditional pedagogical beliefs, evident in the data, about the perceived benefits of classroom technology integration should also be considered in future policy documents and government initiatives.

Models of technology integration and technology enhanced learning should form the basis of continuing professional development (CPD) programmes for in-service teachers. Such continuing professional development could form part of a registration requirement with the Teaching Council (The Teaching Council Act, 2001). The Professional Development Service for Teachers (PDST), and their associated training programmes, have taken steps in this regard. Government policy should continue to fund such programmes, and support attendance of teachers at their nationwide events. Similar mandatory CPD requirements are part of other professions, and should be extended to the teaching profession, where lifelong learning is seen as part of the life cycle of a teacher (Huberman, 1989). This would be a welcome outcome of the research study.

Practice Recommendations

The implications of the research study for pre-service teacher education generally are apparent. These practice recommendations are mindful of the recent changes introduced by the Teaching Council and Higher Education Authority to pre-service teacher education (Dolan, 2016). These changes included amendments to modules on the Bachelor in

Education degree, to ensure a focus on literacy and numeracy in the curriculum, as was the main concern of the Irish Government (2011) at that time. As a result, the suggested recommendations are made with the caveat that the current version of the Bachelor in Education degree needs time to consolidate, before any review or new approach to technology integration is initiated.

- An integrated approach to technology integration expectations on school placement is required, where all members of the teaching triad should require and expect use of technology by a pre-service teacher in a school placement classroom. A lack of technology skills of placement supervisors was also evident in the results, where participants mentioned they knew the preferences of their supervisor, and if their supervisor 'was not that into technology' they would not use it during their assessed visit. Hence, school placement supervisors should be trained on aspects of technology integration required and expected of the pre-service teachers they are supervising. This training should also serve to enhance the digital capacities of the supervision team members.
- As noted in the policy recommendations, continuing professional development (CPD) for pre-service teacher educators and co-operating teachers is also required. This was mentioned in the *Action Plan for Education* (DES, 2016) and is required to facilitate a "step change in the use of ICT in teaching, learning and assessment at all levels of the education and training system, so that learners are equipped with the skills to live in an increasingly digitally connected world" (p. 16). This CPD would provide training to members of the teaching triad on technology, pedagogy and content knowledge associated with technology integration in a classroom environment, as noted previously. This could be provided locally by the colleges of education, on a needs basis, before each school placement block.

- Allocation of pre-service teachers to 'partner schools' that are known to have the required physical, social and cultural environment that promotes use of technology would also be advisable. A partnership model has long been advocated in the literature (Cochran-Smith et al., 2015; Darling-Hammond & Lieberman, 2012; Furlong, 1996) and should be considered in the future, by colleges of education. However, the researcher is mindful of the impact of such a recommendation, in light of the Teaching Council's requirement for extension to school placement periods. Hence, if there were not enough partner schools, pre-service teachers would not be able to fulfil their school placement requirements, in a timely manner. Nonetheless, school placement schools should have the requisite technology to allow pre-service teachers adequate opportunities to increase their confidence and competence using technology in a school environment.
- Technology should not be just an isolated module in pre-service teacher education. Technology should permeate all modules, and pre-service teacher educators should model good use of technology in all subjects. As long as technology is delivered as a separate module, the pedagogies associated with using technology in a classroom are treated as separate and adjunct. The focus of the technology module becomes what the technology does, rather than *how* it could be used in a school placement classroom. Whereas if technology permeates all subjects, it is not seen as additional, but rather part and parcel of the normal curriculum, and therefore, normal classroom operation. This approach is advocated in current literature (Alt, 2018; Reyes, 2017; Uerz, 2018 and Vermeulen, 2017) and was noted in the recent *Action Plan for Education* (2017) where with an "evolving curriculum" (p. 62) technology could be better utilised across the curriculum. However, some clarity as to what the DES meant by this statement is still required.

- The current school placement assessment form should be amended to contain criteria that rewarded specific uses of technology, by the pre-service teacher. Resources can, and do, include any materials used during a particular lesson, and a separate technology section should be included, in future criteria for the assessment of a school placement lesson conducted by pre-service teachers (Ertmer et al., 2014; Sang et al., 2010; Tondeur, van Braak, Fazilat Siddiq, et al., 2016).

Strengths and Limitations of the Research

The duration of the research was favourable as it ensured the full spectrum of a pre-service teachers' use of technology was explored, over the course of their three-year undergraduate degree. The research study captured their personal use of technology in first year, and then measured their professional use on each of their school placements, during their college preparation course. While not a longitudinal study per se, the duration of the study was extensive, nonetheless.

However, this was also a factor in the sample attrition that occurred. It became difficult to retain research participants by third year, where their own focus was their own forthcoming examinations, and not a review of their experiences on school placement. As a result of the small sample size generally the results are not a universal reflection of pre-service teachers on school placement, but a mere snapshot of two cohorts, in one of a number of pre-service teacher colleges in Ireland. This research model could be expanded to include other colleges of education, in joint research projects, investigating use of technology by other pre-service teachers in the future. This would also ensure the results were reflective of a larger educational context of pre-service teacher education in Ireland. Indeed, the research model could also be utilised to conduct research with other countries, to determine if these results did not just apply in an Irish context.

Contribution to the literature.

The research findings enhance our understanding of pre-service teachers' use of technology in both personal and professional capacities. This research extends our knowledge of the complexity of the physical and social school environment on pre-service teachers' decisions to use technology in a classroom. The research also widens our knowledge of the role the mentor teacher, and school placement supervisor, and their impact and influence on pre-service teachers' actions in a school placement classroom. The research enhances our understanding of the barriers that prevent use of technology in classrooms, where second order barriers to use of technology including pre-service teachers' beliefs about their own competence to use technology, were prevalent and thus adds to the growing body of literature on this particular topic (Almerich et al., 2016; García-Martín & García-Sánchez, 2017; Instefjord & Munthe, 2017; Kaldi & Xafakos, 2017; Leger & Freiman, 2016; Maderick et al., 2016; Tang, Wong, & Cheng, 2016).

The research extends our understanding of the nature of millennials' use of technology, where the research participants were using their personal devices in limited ways and as consumers, rather than creators, of content. This is similar to current literature on the topic of the myth of the digital abilities of millennials, and the findings add to the literature in this regard (Akçayır, 2016; Barak, 2018; Kirschner, 2017; Šorgo, 2017). The pre-service teachers lacked of competence using some technologies, as was evident when faced with technical problems in the school placement classroom, and their default position was to not rely on technology, rather than try and fix it themselves. It was, nonetheless, interesting to note that participants had created their own communities of practice on social media to support their professional practice during school placement. Such communities of practice are similar to the discussion boards and mailing list support networks, such as CESI and TES (CESI, n.d.; TES, n.d.), that are widely used by Irish teachers.

Further Research

As the research study was conducted in one location, future research could extend the research study to other pre-service teacher education colleges, where a larger data set would inform future policies on technology integration in education in Ireland. An obvious next step would be to conduct a follow-up study with the current participants and measure their use of technology two years post-qualification, once they were employed in 'their own classrooms'. This would ensure a fuller picture of their entire experience using technology in education, and justify use of the term longitudinal, to an extension of the current research study.

Future research could include use of this research model with other professions, or undergraduate courses, to investigate if there were barriers to use prevalent in other work or placement environments. TAM and other models of technology integration could also be applied to different technological interventions individually to measure if TAM was a useful predictor of use of specific educational technologies, such as eportfolio or tablet devices, rather than just educational technology in a more general sense. Indeed, other models of technology acceptance and integration could be administered to future groups of pre-service teachers, such as the UTAUT model (Venkatesh et al., 2003) to examine whether they were an indication of use of technology in a classroom, or the DNAS (Teo, 2013) measurement tool to assess the digital skills of other groups of pre-service teachers. In the near future, a joint research project is being discussed with colleagues in Australia (Redmond and Lock (2013) and Campbell et al. (2012) to review their experiences of implementation of TPACK in their pre-service teacher education colleges and see what can be learned from that experience.

Personal reflection.

The researcher gained many additional professional skills during the course of this research project, the most notable being the ability to conduct statistical analysis. Other skills acquired included proficiency in various research computer packages including nVivo, SPSS, EndNote and various statistical functions, available in Microsoft Excel. This acquired knowledge can now be transferred to colleagues and research students, in the researcher's institution.

On a personal level, the researcher gained an invaluable insight into conducting research using mixed methods, where data collection and analysis proved interesting, and enjoyable in equal measure. However, the valuable insight afforded by conducting the research, into the nature of school placement and the complexities and pressures that school context can bring to bear on pre-service teachers, was very rewarding. The researcher also acquired knowledge of the history of technology integration in Ireland, and the various policies, plans and wider research into this area. Ireland's experience has not been unique and this knowledge has helped inform the researcher's work practices, since the project commenced. This was a welcome outcome of the research.

Chapter Seven Conclusion

As a result of this study, the researcher hopes to publish elements of the research in a number of technology and education related journals. The key findings of the research have been reviewed in this final chapter, and a short reminder serves to complete the thesis here.

Pre-service teachers are confident users of a limited number of personal technologies but need social and environmental support to use professional technologies on school placement. The school placement classroom is an interesting space for a pre-service teacher, where they have to be mindful of internal and external barriers to using technology in that space. This had an influence on the pre-service teachers in the study. The pre-service teacher participants did, however, display strong behavioural intentions to increase their use of professional technologies in their future classrooms, and were aware they had a competence gap in this regard.

This research has provided a review of two cohorts' experiences of school placement and is reflective of the complexity of conducting an extended research project. However, the pragmatic mixed methods approach ensured a large amount of data was gathered, that was more reflective of the pre-service teachers' wider experiences of use of technology, rather than one snapshot of 'use' from one placement. This research model should prove useful for other researchers to examine technology integration and use by other groups of teachers, or other professions, in the future.

References

Acarli, D. S., & Sağlam, Y. (2015). Investigation of Pre-service Teachers' Intentions to Use of Social Media in Teaching Activities within the Framework of Technology Acceptance Model. *Procedia - Social and Behavioral Sciences, 176*, 709-713. doi:10.1016/j.sbspro.2015.01.530

Aftab, P. (2015). Cyberbullying - we don't appreciate the pain we cause. *The Irish Times*.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi:10.1016/0749-5978(91)90020-t

Ajzen, I. (2012). Martin Fishbein's Legacy: The Reasoned Action Approach. *The ANNALS of the American Academy of Political and Social Science, 640*(1), 11-27. doi:10.1177/0002716211423363

Ajzen, I. (2015). The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review, 9*(2), 131-137. doi:10.1080/17437199.2014.883474

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*. United States of America: Prentice-Hall.

Akçayır, M., Dündar, H., & Akçayır, G. (2016). What makes you a digital native? Is it enough to be born after 1980? *Computers in Human Behavior, 60*, 435-440. doi:https://doi.org/10.1016/j.chb.2016.02.089

Albion, P. (1999). *Self-Efficacy Beliefs as an Indicator of Teachers' Preparedness for Teaching with Technology*. Paper presented at the Society for Information Technology & Teacher Education International Conference 1999. http://www.editlib.org/p/8156

Albion, P. (2000). *Preliminary investigation of some influences on student teachers' self-efficacy for teaching with computers*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2000. http://www.editlib.org/p/15832

Albion, P. (2007). *Student Teachers' Confidence and Competence for Finding Information on the Internet*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2007, San Antonio, Texas, USA. http://www.editlib.org/p/24731

Albion, P. (2011). *Come the Revolution: Pre-service Teachers' Access to, Attitudes toward, and Skills with ICT*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2011, Nashville, Tennessee, USA. http://www.editlib.org/p/36237

Albion, P., Jamieson-Proctor, R., & Finger, G. (2010). *Auditing the TPACK confidence of Australian pre-service teachers: The TPACK confidence survey (TCS).* Paper presented at the Proceedings of the 21st International Conference of the Society for Information Technology & Teacher Education (SITE 2010).

Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers & Education, 100*, 110-125. doi:10.1016/j.compedu.2016.05.002

Alt, D. (2018). Science teachers' conceptions of teaching and learning, ICT efficacy, ICT professional development and ICT practices enacted in their classrooms. *Teaching and Teacher Education, 73*, 141-150. doi:https://doi.org/10.1016/j.tate.2018.03.020

Angeli, C. (2005). Transforming a teacher education method course through technology: effects on preservice teachers' technology competency. *Computers & Education, 45*(4), 383-398. doi:10.1016/j.compedu.2004.06.002

Armitage, C. J., & Christian, J. (2003). From attitudes to behaviour: Basic and applied research on the theory of planned behaviour. *Current Psychology, 22*(3), 187-195. doi:10.1007/s12144-003-1015-5

Armitage, C. J., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471.

Assessment, National Council for Curriculum and (2006). *Framework for Information and Communications Technology (ICTs) in the primary school curriculum: Guidelines for Teachers*. Retrieved from website www.ncca.ie

Baek, Y., Jung, J., & Kim, B. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers & Education, 50*(1), 224-234. doi:10.1016/j.compedu.2006.05.002

Bagozzi, R. P. (1981). Attitudes, intentions, and behavior: A test of some key hypotheses. *Journal of Personality and Social Psychology, 41*(4), 607-627. doi:10.1037/0022-3514.41.4.607

Bagozzi, R. P. (1982). A Field Investigation of Causal Relations among Cognitions, Affect, Intentions, and Behavior. *Journal of Marketing Research, 19*(4), 562-583.

Bagozzi, R. P. (1986). Attitude formation under the theory of reasoned action and a purposeful behaviour reformulation. *British Journal of Social Psychology, 25*(2), 95-107. doi:10.1111/j.2044-8309.1986.tb00708.x

Bagozzi, R. P. (1992). The Self-Regulation of Attitudes, Intentions, and Behavior. *Social Psychology Quarterly, 55*(2), 178-204.

Bagozzi, R. P. (2007). The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift. *Journal of the Association for Information Systems, 8*(4), 243-254.

Bagozzi, R. P., & Burnkrant, R. E. (1979). Attitude organization and the attitude-behavior relationship. *Journal of Personality and Social Psychology, 37*(6), 913-929. doi:10.1037/0022-3514.37.6.913

Bain, C. (1991). *Student Teaching Triads: Perceptions of Participant Roles*. Paper presented at the Annual Meeting of the Northern Rocky Mountain Educational Association (9th, October 1991), Paper presented at the Annual Meeting of the Northern Rocky Mountain Educational Association (9th, October 1991).

Ball, D. L., & Forzani, F. M. (2009). The Work of Teaching and the Challenge for Teacher Education. *Journal of Teacher Education, 60*(5), 497.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching what makes it special? *Journal of Teacher Education, 59*(5), 389-407.

Balnaves, M., & Caputi, P. (2001). *Introduction to Quantitative Research Methods - An investigative approach*. London: Sage Publications.

Banas, J., & York, C. (2014). Authentic learning exercises as a means to influence preservice teachers' technology integration self-efficacy and intentions to integrate technology. *Australasian Journal of Educational Technology, 30*(6).

Bandura, A. (1969). Social-learning theory of identificatory processes. *Handbook of socialization theory and research, 213*, 262.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. doi:10.1037/0033-295x.84.2.191

Bandura, A. (1989). Human agency in social cognitive theory. *American psychologist, 44*(9), 1175.

Bandura, A. (1994). Self Efficacy. In V. Ramachaudran (Ed.), *Encyclopedia of Human Behaviour* (Vol. 4, pp. 71-81). New York: Academic Press.

Bandura, A. (1997). Self-efficacy. *Harvard Mental Health Letter, 13*(9), 4.

Bandura, A. (1999). A social cognitive theory of personality. In L. Pervin & O. John (Eds.), *Handbook of Personality* (2nd edition ed., pp. 154 - 196). New York: Guildford Publications.

Bandura, A., & McDonald, F. J. (1963). Influence of social reinforcement and the behavior of models in shaping children's moral judgment. *The Journal of Abnormal and Social Psychology, 67*(3), 274.

Barak, M. (2006). Instructional principles for fostering learning with ICT: teachers' perspectives as learners and instructors. *Education and Information Technologies, 11*(2), 121-135. doi:10.1007/s11134-006-7362-9

Barak, M. (2018). Are digital natives open to change? Examining flexible thinking and resistance to change. *Computers & Education, 121*, 115-123. doi:https://doi.org/10.1016/j.compedu.2018.01.016

Baron, R. A., Byrne, D., & Branscombe, N. R. (2006). *Social Psychology* (11th edition ed.). Boston, New York, San Francisco: Pearson Publishing.

Barton, R., & Haydn, T. (2006). Trainee teachers' views on what helps them to use information and communication technology effectively in their subject teaching. *Journal of Computer Assisted Learning, 22*(4), 257-272. doi:10.1111/j.1365-2729.2006.00175.x

Batane, T., & Ngwako, A. (2017). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology, 33*(1), 48-61. doi:https://doi.org/10.14742/ajet.2299

Bauer, J., & Kenton, J. (2005). Toward Technology Integration in the Schools: Why It Isn’t Happening. *Journal of Technology and Teacher Education, 13*(4), 519-546.

BECTA. (2004). *A Review of the Research Literature on Barriers to the Uptake of ICT by Teachers*. British Educational Communications and Technology Agency Retrieved from http://www.becta.org.uk/

Behling, O. (1980). The case for the natural science model for research in organizational behavior and organization theory. *Academy of Management Review, 5*(4), 483-490.

Biomedical, & Behavioral Research, B., MD. (1978). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research*: ERIC Clearinghouse.

Birch, A., & Irvine, V. (2009). Preservice teachers' acceptance of ICT integration in the classroom: applying the UTAUT model. *Educational Media International, 46*(4), 295-315. doi:10.1080/09523980903387506

Blaikie, N. (2004). Interpretivism. In M. S. Lewis- Beck, A. Bryman, & T. F. Liao (Eds.), *The SAGE Encyclopedia of Social Science Research Methods*: Sage Publishing.

Blumer, H. (1986). *Symbolic interactionism: Perspective and method*: Univ of California Press.

Bocconi, S., Kampylis, P., & Punie, Y. (2013). Framing ICT-enabled Innovation for Learning: the case of one-to-one learning initiatives in Europe. *European Journal of Education, 48*(1), 113-130. doi:10.1111/ejed.12021

Brandtzæg, P. B. (2010). Towards a unified Media-User Typology (MUT): A meta-analysis and review of the research literature on media-user typologies. *Computers in Human Behavior, 26*(5), 940-956.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.

Bray, A., & Tangney, B. (2017). Technology usage in mathematics education research – A systematic review of recent trends. *Computers & Education, 114*, 255-273. doi:http://dx.doi.org/10.1016/j.compedu.2017.07.004

Breathnach, P. (1984). Computer Studies Survey. *ASTIR - ASTI Journal, Autumn/Winter*, 14-18.

Bronfenbrenner, U. (1979). *The ecology of human development : experiments by nature and design / Urie Bronfenbrenner*. Harvard University Press.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher, 18*(1), 32-42. doi:10.3102/0013189x018001032

Brown, T. T. (2016). On the Brain Basis of Digital Daze in Millennial Minds. *Journal of Management Education, 40*(4), 411-414. doi:10.1177/1052562916634118

Bruce, B. C. (1993). Innovation and social change. In B.C.Bruce, J.K Peyton, & T.W Batson (Eds., *Networked-based classrooms: Promises and realities.* (pp. 9-32), Cambridge University Press.

Brush, T., Glazewski, K. D., & Khe Foon, H. (2008). Development of an Instrument to Measure Preservice Teachers' Technology Skills, Technology Beliefs, and Technology Barriers. *Computers in the Schools, 25*(1/2), 112-125. doi:10.1080/07380560802157972

Bryant, A., & Charmaz, K. (2012). Grounded theory and psychological research. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, K. J. Sher, H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological.* (pp. 39-56). Washington, DC, US: American Psychological Association.

Bryman, A. (2006). *Mixed Methods* (Vol. Volume 2). Sage Publications, New York.

Bryman, A. (2012). *Social Research Methods* (Fourth edition ed.). London: Oxford University Press.

Buettner, Y. (2006). Teaching teachers to teach ICT integration—T3. *Education and Information Technologies, 11*(3), 257-268. doi:10.1007/s10639-006-9007-3

Bullough, R. V. J. (2005a). Being and becoming a mentor: school-based teacher educators and teacher educator identity. *Teaching and Teacher Education, 21*, 143-155. doi:10.1016/j.tate.2004.12.002

Bullough, R. V. J. (2005b). Teacher Vulnerability and Teachability: A Case Study of a Mentor and Two Interns. *Teacher Education Quarterly*(2), 23.

Burton, D. (2009). *Key issues for education researchers / Diana Burton and Steve Bartlett*. Sage Publications.

Butler, D., Leahy, M., Shiel, G., & Cosgrove, J. (2015). *Towards the Development of a new Digital Strategy for Schools in Ireland*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2015, Las Vegas, NV, United States. http://www.editlib.org/p/150177

Butler, T. (2015a, 19.10.15). Ending the digital myth about electronic devices in classrooms. *The Irish Examiner*.

Butler, T. (2015b). ICT in Education: Fundamental Problems and Practical Recommendations. *UCC*, 1 - 35. Retrieved from http://afis.ucc.ie/tbutler/ICT in Education.html website: http://afis.ucc.ie/tbutler/ICT in Education.html doi:http://afis.ucc.ie/tbutler/ICT in Education.html

Calhoun, C., Gerteis, J., Moody, J., Pfaff, S., Schmidt, K., & Virk, I. (2002). *Classical sociological theory* (Vol. 9): Wiley-Blackwell.

Campbell, C. (2012). *Setting the scene: The Teaching Teachers for the Future Project*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2012, Austin, Texas, USA. http://www.editlib.org/p/40001

Campbell, C., Albion, P., Kearney, M., Maher, D., Pressick-Kilborn, K., & Zagami, J. (2012). *Teaching Teachers for the Future: Building the Educational Technology Capacity of Pre-service Teachers in Australian, Universities, Part 1*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2012, Austin, Texas, USA. http://www.editlib.org/p/39919

Caro, R., & Harvey, D. (2016). *Developing Preservice Teachers Technology Integration skills using TPACK*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2016, Savannah, GA, United States. https://www.learntechlib.org/p/172089

Celik, B., & Yildirim, Z. (2016). *Pre-Service Teachers' Self-Efficacy Beliefs in Relation to Educational Podcasting: Integration and Educational Usage Self-Efficacy*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2016, Savannah, GA, United States. https://www.learntechlib.org/p/171956

CESI. (n.d.). Computers Educations Society in Ireland. Website www.cesi.ie

Chai, C. S., Ling Koh, J. H., Tsai, C.-C., & Lee Wee Tan, L. (2011). Modeling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education, 57*(1), 1184-1193. doi:10.1016/j.compedu.2011.01.007

Charmaz, K. (2005). Grounded Theory in the 21st Century: Applications for Advancing Social Justice Studies. In N. K. Denzin, Y. S. Lincoln, N. K. Denzin, & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research (3rd ed.).* (pp. 507-535). Thousand Oaks, CA: Sage Publications Ltd.

Charmaz, K. (2008). Grounded theory as an emergent method. In S. N. Hesse-Biber, P. Leavy, S. N. Hesse-Biber, & P. Leavy (Eds.), *Handbook of emergent methods.* (pp. 155-170). New York, NY, US: Guilford Press.

Chatfield, M. D., Brayne, C. E., & Matthews, F. E. (2005). A systematic literature review of attrition between waves in longitudinal studies in the elderly shows a consistent pattern of dropout between differing studies. *Journal of clinical epidemiology, 58*(1), 13-19.

Chen, K., Chen, J. V., & Yen, D. C. (2011). Dimensions of self-efficacy in the study of smart phone acceptance. *Computer Standards & Interfaces, 33*(4), 422-431.

Chen, R.-J. (2010). Investigating models for preservice teachers' use of technology to support student-centered learning. *Computers & Education, 55*(1), 32-42. doi:10.1016/j.compedu.2009.11.015

Chesnut, S. R. (2017). On the measurement of preservice teacher commitment: Examining the relationship between four operational definitions and self-efficacy beliefs. *Teaching and Teacher Education, 68*, 170-180. doi:https://doi.org/10.1016/j.tate.2017.09.003

Chu, T.-H., & Chen, Y.-Y. (2016). With Good We Become Good: Understanding e-learning adoption by theory of planned behavior and group influences. *Computers & Education, 92-93*, 37-52. doi:10.1016/j.compedu.2015.09.013

Clarke, V., & Braun, V. (2013). Teaching thematic analysis. *Psychologist, 26*(2), 120-123.

Cochran-Smith, M., & Villegas, A. M. (2015). Framing Teacher Preparation Research. *Journal of Teacher Education, 66*(1), 7-20. doi:doi:10.1177/0022487114549072

Cochran-Smith, M., Villegas, A. M., Abrams, L., Chavez-Moreno, L., Mills, T., & Stern, R. (2015). Critiquing Teacher Preparation Research: An Overview of the Field, Part II. *Journal of Teacher Education, 66*(2), 109-121.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research Methods in Education*: Routledge.

Cohen, L., Mannion, L., & Morrison, K. (2007). *Research Methods in Education* (Sixth Edition ed.). London, New York: Routledge, Taylor & Francis Group.

Commission, E. (2013). *Survey of Schools: ICT in Education, Benchmarking Access, Use & Attitudes to Technology in Europe's Schools*. EU: European Commission

Retrieved from ec.europa.eu/digital-agenda/sites/digital.../KK-31-13-401-EN-N.pdf.
Compeau, D. R., & Higgins, C. A. (1995). Computer Self-Efficacy: Development of a Measure and Initial Test. *MIS Quarterly, 19*(2), 189-211.
Conner, M. (2014). Extending not retiring the theory of planned behaviour: a commentary on Sniehotta, Presseau and Araújo-Soares. *Health Psychology Review*(ahead-of-print), 1-5.
Conole, G., de Laat, M., Dillon, T., & Darby, J. (2008). 'Disruptive technologies', 'pedagogical innovation': What's new? Findings from an in-depth study of students' use and perception of technology. *Computers & Education, 50*(2), 511-524. doi:10.1016/j.compedu.2007.09.009
Conway, P., Murphy, R., Rath, A., & Hall, K. (2009). *Learning to Teach and its Implications for the Continuum of Teacher Education : A Nine-Country Cross-National Study*. UCC: UCC
Conway, P. F., & Murphy, R. (2013). A rising tide meets a perfect storm: new accountabilities in teaching and teacher education in Ireland. *Irish Educational Studies, 32*(1), 11-36. doi:10.1080/03323315.2013.773227
Coolahan, J. (1981). *Irish education: Its history and structure*: Inst of Public Administration.
Coolahan, J. (2001). Teacher education in Ireland and Western Europe: A comparative analysis. *Irish Educational Studies, 20*(1), 335-368.
Coolahan, J. (2004). The historical development of teacher education in the Republic of Ireland. *Teacher Education in the Republic of Ireland*, 3.
Corbin, J., & Strauss, A. (2015). *Basics of Qualitative Research: Techniques & Procedures for Developing Grounded Theory* (4th edition ed.). Los Angeles: Sage Publications.
Cosgrove, J., Butler, D., Leahy, M., Shiel, G., Kavanagh, L., & Creaven, A.-M. (2013). *The 2013 ICT Census in Schools - Main Report*. Retrieved from Educational Research Centre: www.erc.ie
Cosgrove, J., Zastrutzki, S., & Shiel, G. (2005). A survey of ICT in post-primary schools. *The Irish Journal of Education/Iris Eireannach an Oideachais*, 25-48.
Council, The Teaching, (2009) Retrieved from http://www.teachingcouncil.ie/en/Publications/Research/Documents/Learning-to-Teach-and-its-Implications-for-the-Continuum-of-Teacher-Education.pdf.
Council, The Teaching. (2010). *Draft Policy on the Continuum of Teacher Education*. Retrieved from Dublin: http://www.teachingcouncil.ie/_fileupload/Teacher Education/policybackgroundpaper brf24dec2010.pdf
Council, The Teaching (2011). *Teacher Education: Criteria and Guidelines for Programme Providers*. Retrieved from http://www.teachingcouncil.ie/en/Publications/Teacher-Education/Initial-Teacher-Education-Criteria-and-Guidelines-for-Programme-Providers.pdf
Creswell, J. (2009). *Research Design : Qualitative, Quantitative and Mixed Methods Approaches* (3rd edition ed.). United States of America: Sage Publications.
Creswell, J., & Clark, V. P. (2007). *Designing and Conducting Mixed Methods Research* (2007 ed.): Sage Publishing.
Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297-334. doi:10.1007/bf02310555
Cronin, A. (2008). Focus Group Interviews. In N. Gilbert (Ed.), *Researching Social Life* (3rd edition ed.). London: Sage.
Crotty, M. (1998). *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage.

Cuban, L. (1986). *Teachers and Machines - The Classroom Use of Technology since 1920*. Columbia University: Teachers' College Press.
Cuban, L. (1993). Computers meet classroom: Classroom wins. *The Teachers College Record, 95*(2), 185-210.
Cuban, L. (2001a). *Oversold & Underused - Computers in the Classroom*: Harvard University Press.
Cuban, L. (2001b). Why are most teachers infrequent and restrained users of computers in their classrooms. *Technology, curriculum and professional development*, 121-137.
Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.
Dallmayr, F. R. (1972). Review Symposium on Habermas : II--Critical Theory Criticized: Habermas's Knowledge and Human Interests and its Aftermath. *Philosophy of the Social Sciences, 2*(1), 211-229. doi:10.1177/004839317200200116
Darling-Hammond, L. (1987). Schools for Tomorrow's teachers. *Teachers College Record, 88*, 354-358.
Darling-Hammond, L. (2006). Constructing 21st-Century Teacher Education. *Journal of Teacher Education, 57*(3), 300-314.
Darling-Hammond, L., & Lieberman, A. (2012). *Teacher Education around the World: Changing Policies and Practices. Teacher Quality and School Development*: Routledge, Taylor & Francis Group.
Darling-Hammond, L., & Snyder, J. (2000). Authentic assessment of teaching in context. *Teaching and Teacher Education, 16*(5), 523-545. doi:http://dx.doi.org/10.1016/S0742-051X(00)00015-9
Data Protection (Amendment) Act, 2003, 6/2003, The Stationery Office, Dublin (2003).
Data Protection Act, 1988, 25/1988, The Stationery Office, Dublin (1988).
Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13*(3), 319-340.
Davis, N., Preston, C., & Sahin, I. (2009). ICT teacher training: Evidence for multilevel evaluation from a national initiative. *British Journal of Educational Technology, 40*(1), 135-148. doi:10.1111/j.1467-8535.2007.00808.x
De Smet, C., Bourgonjon, J., De Wever, B., Schellens, T., & Valcke, M. (2012). Researching instructional use and the technology acceptation of learning management systems by secondary school teachers. *Computers & Education, 58*(2), 688-696. doi:10.1016/j.compedu.2011.09.013
Dede, C. (2000). Emerging influences of information technology on school curriculum. *Journal of Curriculum Studies, 32*(2), 281-303. doi:10.1080/002202700182763
Dede, C. (2005). Planning for NeoMillennial Learning Styles. *Educause Quarterly, 28*(1), 7 - 12.
Dennen, V. P. (2008). Pedagogical lurking: Student engagement in non-posting discussion behavior. *Computers in Human Behavior, 24*(4), 1624-1633. doi:http://dx.doi.org/10.1016/j.chb.2007.06.003
Denzin, N. K., & Lincoln, Y. S. (2008). *The landscape of qualitative research / edited by Norman K. Denzin and Yvonna S. Lincoln* (4th ed. ed.). Sage Publications.
Depaepe, F., & König, J. (2018). General pedagogical knowledge, self-efficacy and instructional practice: Disentangling their relationship in pre-service teacher education. *Teaching and Teacher Education, 69*, 177-190. doi:https://doi.org/10.1016/j.tate.2017.10.003
Department of Communications, Marine and Natural Resources (2012). *Delivering a Connected Society: National Broadband Plan*. Dublin: Department of Communications, Energy & Natural Resources Retrieved from

http://www.dcenr.gov.ie/communications/en-ie/Broadband/Pages/National-Broadband-Plan.aspx.
Department of Communications, Marine and Natural Resources (2005). *National Broadband Programme for Schools*. Dublin: Stationery Office.
Department of Education and Skills, (2006). *Learning to Teach: Students on Teaching Practice in Irish Primary Schools*. Dublin: The Stationery Office.
Department of Education and Skills, (2013). Ministers Quinn & Rabitte announce roll-out of high speed broadband to schools in Dublin, Meath and Kildare.
Department of Education and Skills, (2015). Minister Jan O'Sullivan T.D. Announces Largest Ever Investment in Digital Technology in Schools. Retrieved from http://www.education.ie/en/Press-Events/Press-Releases/2015-Press-Releases/PR15-10-07A.html
Department of Education (2016). *Action Plan for Education, 2016 - 2019*. Dublin: Department of Education and Skills Retrieved from http://education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Department-of-Education-and-Skills-Strategy-Statement-2016-2019.pdf.
Department of Education (2017a). *Action Plan for Education, 2017*. Dublin: Department of Education and Skills Retrieved from http://education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Department-of-Education-and-Skills-Strategy-Statement-2016-2019.pdf.
Department of Education (2017b). Digital Learning Framework for Schools [Press release]. Retrieved from https://www.education.ie/en/Schools-Colleges/Information/Information-Communications-Technology-ICT-in-Schools/DLF.html
Department of Education (2017c). Digital Learning Planning Guidelines [Press release]. Retrieved from https://www.education.ie/en/Schools-Colleges/Information/Information-Communications-Technology-ICT-in-Schools/digital-learning-planning/digital-learning-planning-guidelines.html
Dewey, J. (1904). *The Relation of Theory to Practice in Education.* University of Chicago Press, Chicago.
Dewey, J. (1916). *Democracy and education : an introduction to the philosophy of education / John Dewey*. Project Gutenberg eBook. doi. http://www.gutenberg.org/files/852/852-h/852-h.htm
Dewey, J. (1938). *Experience and education / by John Dewey*. Simon & Schuster, New York.
Dewey, J. (1956). *School and society. The school and society ; and, The child and the curriculum / John Dewey ; introduction by Philip W. Jackson*. Southern Illnois University Press.
Dewey, J., Boydston, J. A., & Ross, R. (1983). *The middle works, 1899-1924* (Vol. 13): SIU press.
deWinter, J. C., & Dodou, D. (2010). Five - Point Likert Items : t Test versus Mann-Whitney-Wilcoxin. *Practical Assessment, Research & Evaluation, 15*(11), 1 - 16. doi:http://pareonline.net/getvn.asp?v=15&n=1.
Dishaw, M. T., & Strong, D. M. (1999). Extending the technology acceptance model with task-technology fit constructs. *Information & Management, 36*(1), 9-21.
Doering, A., Hughes, J., & Huffman, D. (2003). Preservice Teachers: Are We Thinking with Technology? *Journal of Research on Technology in Education, 35*(3), 342.
Dolan, R. (2007). *The Competences Debate and Teacher Professional Development.* Paper presented at the ScoTENS 2007, Armagh.

Dolan, R. (2016). Initiation and Implementation: Changes to Teacher Education in Ireland. In J. M. Spector, D. Ifenthaler, D. G. Sampson, & P. Isaias (Eds.), *Competencies in Teaching, Learning and Educational Leadership in the Digital Age: Papers from CELDA 2014* (pp. 33-46). Cham: Springer International Publishing.

Donnelly, D., McGarr, O., & O'Reilly, J. (2011). A framework for teachers' integration of ICT into their classroom practice. *Computers & Education, 57*(2), 1469-1483. doi:10.1016/j.compedu.2011.02.014

Drabowicz, T. (2017). Social theory of internet use: Corroboration or rejection among the digital natives? Correspondence analysis of adolescents in two societies. *Computers & Education, 105*, 57-67. doi:10.1016/j.compedu.2016.10.004

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*(1), 187-199. doi:10.1016/j.compedu.2007.05.001

Eastman, C., & Marzillier, J. S. (1984). Theoretical and methodological difficulties in Bandura's self-efficacy theory. *Cognitive Therapy and Research*, *8*(3), 213-229.

Education, Department of (1980). *White Paper on Educational Development*. Dublin: Stationery Office.

Education, Department of (1987). *Conclusion of Primary Project 1984 -1987 Computers in Irish Primary Schools*. Dublin: Department of Education.

Education, Department of (1992). *Education for a Changing World, Green Paper on Education*. Dublin: Stationery Office.

Education, Department of (1995). *Charting our Education Future, White Paper on Education*. Dublin: Stationery Office.

Education, National Centre for Technology in (2002). *Sharing Innovative Practice : The NCTE's Schools Integration Project 1998 - 2000*. Retrieved from Dublin: Stationery Office.

Edwards, A. L., & Kenney, K. C. (1946). A comparison of the Thurstone and Likert techniques of attitude scale construction. *Journal of Applied Psychology, 30*(1), 72-83. doi:10.1037/h0062418

Egan, A. (2009). *An Investigation into Podcasts and a VLE – Will Students Engage?* . M. Sc thesis. University of Dublin, Trinity College. Dublin.

Egan, A., & FitzGibbon, A. (2010). *Preservice teachers' vision of ICT in the classroom.* Paper presented at the Society for Information Technology & Teacher Education International Conference 2010, San Diego, CA, USA.

Egan, A., FitzGibbon, A., Girvan, C., & Oldham, E. (2012). *Self-Reported Competency and Technology Acceptance: Investigating the Relationship for a Cohort of Irish Pre-Service Teachers*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2012, Austin, Texas, USA. http://www.editlib.org/p/40084

Egan, A., FitzGibbon, A., & Oldham, E. (2013). *Teacher Identified Uses of Technology in the Classroom - an Irish cohort*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2013, New Orleans, Louisiana, United States. http://www.editlib.org/p/48930

Egan, A., FitzGibbon, A., Oldham, E., Girvan, C., & Hallissy, M. (2013). *A Vision for Education in 2026 – the Views of a Cohort of Pre-Service and In-Service Teachers*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2013, New Orleans, Louisiana, United States. http://www.editlib.org/p/48300

Egan, A., FitzGibbon, A., Oldham, E., & Johnston, K. (2014). *So, You're a Technology Expert - What can you do?* Paper presented at the 8th International Technology, Education and Development Conference, Valencia, Spain.

Ell, F., Haigh, M., Cochran-Smith, M., Grudnoff, L., Ludlow, L., & Hill, M. F. (2017). Mapping a complex system: what influences teacher learning during initial teacher education? *Asia-Pacific Journal of Teacher Education, 45*(4), 327-345. doi:10.1080/1359866X.2017.1309640

Ellis, R. A., Hughes, J., Weyers, M., & Riding, P. (2009). University teacher approaches to design and teaching and concepts of learning technologies. *Teaching & Teacher Education, 25*(1), 109-117.

Enochsson, A., & Rizza, C. (2009). *ICT in Initial Teacher Training: Research Review*. (No. 38). OECD Publishing.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61. doi:10.1007/bf02299597

Ertmer, P. A. (2005). Teacher Pedagogical Beliefs: The Final Frontier in Our Quest for Technology Integration? *Educational Technology Research & Development, 53*(4), 25-39.

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64*(0), 175-182. doi:10.1016/j.compedu.2012.10.008

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423-435. doi:10.1016/j.compedu.2012.02.001

Ertmer, P. A., Ottenbreit-Leftwich, A. T., & Tondeur, J. (2014). Teachers' beliefs and uses of technology to support 21st-century teaching and learning. *International Handbook of Research on Teachers' Beliefs*, 403.

Eynon, R., & Malmberg, L.-E. (2011). A typology of young people's Internet use: Implications for education. *Computers & Education, 56*(3), 585-595. doi:10.1016/j.compedu.2010.09.020

Feng, D., Ching Sing, C., Chin-Chung, T., & Min-Hsien, L. (2014). The Relationships among Chinese Practicing Teachers' Epistemic Beliefs, Pedagogical Beliefs and Their Beliefs about the Use of ICT. *Journal of Educational Technology & Society, 17*(2), 245-256.

Festinger, L. (1957). *A Theory of Cognitive Dissonance*: Evanston, Ill. : Row, Peterson, 1957.

Finch, J. (1986). *Research and policy : the uses of qualitative methods in social and educational research / Janet Finch*.

Fishbein, M., & Ajzen, I. (1972). ATTITUDES AND OPINIONS. *Annual Review of Psychology, 23*(1), 487.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior : an introduction to theory and research*. Reading, Mass. ; London [etc.]: Reading, Mass. ; London [etc.] : Addison-Wesley, 1975.

Fitzgerald, A., & Adams, S. (2016). *Design and Formative Evaluation of an e-Learning Module for Training Teachers to Integrate Technology into Teaching*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2016, Savannah, GA, United States. https://www.learntechlib.org/p/171750

FitzGibbon, A., Egan, A., Oldham, E., & Girvan, C. (2012). *What Should We Investigate Next? A Scoping Exercise to Identify Variables of Relevance in Teachers' Views on Technology-Related Issues*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2012, Austin, Texas, USA. http://www.editlib.org/p/40085

FitzGibbon, A., Girvan, C., Oldham, E., & Mc Loughlin, H. (2010). *Digital Divides: Experiences and Beliefs of Education Students in Ireland*. Paper presented at the

Society for Information Technology & Teacher Education International Conference 2010, San Diego, CA, USA. http://www.editlib.org/p/33736

FitzGibbon, A., Oldham, E., & Johnston, K. (2007). *An Investigation of Student-Teachers' Use of Social Networks and their Perceptions of Using Technology for Teaching and Learning*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2007, San Antonio, Texas, USA. http://www.editlib.org/p/24646

Flick, U. (2009). *An Introduction to Qualitative Research* (4th edition ed.). London: Sage Publications.

Forbes. (2012, 27 June 2012). Portrait of a Millennial. *Prosper Now.* Retrieved from http://www.forbes.com/sites/prospernow/2012/06/27/portrait-of-a-millennial-2/ - 2965b652acf9

Frank, K. (2002). Technology Practices Survey - Michigan State University. Retrieved from https://www.msu.edu/~kenfrank/research.htm

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion, 19*(3), 313-332. doi:10.1080/02699930441000238

Freeman, E., Holmes, B., & Tangney, B. (2001, March 2001). *ICTs for Learning: An International Perspective on the Irish Initiative.* Paper presented at the Society for Information Technology & Teacher Education, Charlottesville, VA, USA.

Friel, T., Britten, J., Compton, B., Peak, A., Schoch, K., & VanTyle, W. K. (2009). Using pedagogical dialogue as a vehicle to encourage faculty technology use. *Computers & Education, 53*(2), 300-307. doi:10.1016/j.compedu.2009.02.002

Frost, J. (2016). Best Way to Analyze Likert Item Data : Two Sample T-Test versus Mann-Whitney. Retrieved from http://blog.minitab.com/blog/adventures-in-statistics-2/best-way-to-analyze-likert-item-data:-two-sample-t-test-versus-mann-whitney

Fullan, M., & Langworthy, M. (2014). *A rich seam: How new pedagogies find deep learning*. London. Pearson Publishing.

Funkhouser, B. J., & Mouza, C. (2013). Drawing on technology: An investigation of preservice teacher beliefs in the context of an introductory educational technology course. *Computers & Education, 62*, 271-285. doi:10.1016/j.compedu.2012.11.005

Furlong, J. (1996). Re-defining Partnership: Revolution or reform in initial teacher education? *Journal of Education for Teaching, 22*(1), 39-56. doi:10.1080/02607479650038418

Fuson, W. M. (1942). Current Items. *American Sociological Review, 7*(6), 853-865.

García-Martín, J., & García-Sánchez, J.-N. (2017). Pre-service teachers' perceptions of the competence dimensions of digital literacy and of psychological and educational measures. *Computers & Education, 107*, 54-67. doi:10.1016/j.compedu.2016.12.010

Gebre, E., Saroyan, A., & Bracewell, R. (2014). Students' engagement in technology rich classrooms and its relationship to professors' conceptions of effective teaching. *British Journal of Educational Technology, 45*(1), 83-96. doi:10.1111/bjet.12001

Ghasemi, A., & Zahediasl, S. (2012). Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. *International Journal of Endocrinology and Metabolism, 10*(2), 486-489. doi:10.5812/ijem.3505

Gibson, P. A., Stringer, K., Cotten, S. R., Simoni, Z., O'Neal, L. J., & Howell-Moroney, M. (2014). Changing teachers, changing students? The impact of a teacher-focused intervention on students' computer usage, attitudes, and anxiety. *Computers & Education, 71*, 165-174. doi:10.1016/j.compedu.2013.10.002

Gilbert, N. (2008). *Researching Social Life*. London: Sage Publications Ltd. .

Goktas, Y., Gedik, N., & Baydas, O. (2013). Enablers and barriers to the use of ICT in primary schools in Turkey: A comparative study of 2005–2011. *Computers & Education, 68*, 211-222. doi:10.1016/j.compedu.2013.05.002
Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly, 19*(2), 213-236.
Gray, C., & Kinnear, P. R. (2012). *IBM SPSS Statistics 19 Made Simple*. United Kingdom: Psychology Press.
Greenhow, C., & Askari, E. (2017). Learning and teaching with social network sites: A decade of research in K-12 related education. *Education and Information Technologies, 22*(2), 623-645.
Gressard, C. P., & Lloyd, B. H. (1985). *Validation Studies of a new computer attitudes scale.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.
Groff, B. (2016). Analysis: Nuremberg Code. In: Salem Press.
Gross, M., & Latham, D. (2012). What's skill got to do with it?: Information literacy skills and self-views of ability among first-year college students. *Journal of the American Society for Information Science and Technology, 63*(3), 574-583. doi:10.1002/asi.21681
Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching, 15*(2), 273-289. doi:10.1080/13540600902875340
Gu, X., Zhu, Y., & Guo, X. (2013). Meeting the"Digital Natives": Understanding the Acceptance of Technology in Classrooms. *Educational Technology & Society, 16*(1), 392-402.
Hall, K., Conway, P. F., Murphy, R., Long, F., Kitching, K., & O'Sullivan, D. (2012). Authoring oneself and being authored as a competent teacher. *Irish Educational Studies, 31*(2), 103-117. doi:10.1080/03323315.2011.649402
Hammond, M., Crosson, S., Fragkouli, E., Ingram, J., Johnston-Wilder, P., Johnston-Wilder, S., . . . Wray, D. (2009). Why do some student teachers make very good use of ICT? An exploratory case study. *Technology, Pedagogy and Education, 18*(1), 59-73. doi:10.1080/14759390802704097
Hammond, M., Reynolds, L., & Ingram, J. (2011). How and why do student teachers use ICT? *Journal of Computer Assisted Learning, 27*(3), 191-203. doi:10.1111/j.1365-2729.2010.00389.x
Harrold, M. (2016). How to tame teenagers' technology use in the digital age. *The Irish Times*.
Hartnett, M. (2017). Differences in the digital home lives of young people in New Zealand. *48*(2), 642-652.
Hatch, T., Shuttleworth, J., Jaffee, A. T., & Marri, A. (2016). Videos, pairs, and peers: What connects theory and practice in teacher education? *Teaching and Teacher Education, 59*, 274-284. doi:https://doi.org/10.1016/j.tate.2016.04.011
Haydn, T., & Barton, R. (2007). 'First do no harm': developing teachers' ability to use ICT in subject teaching: some lessons from the UK. *British Journal of Educational Technology, 38*(2), 365-368. doi:10.1111/j.1467-8535.2006.00639.x
Higher Education Authority (HEA). (n.d.). Retrieved from http://hea.ie/
Higher Education Authority Act, http://www.irishstatutebook.ie/eli/1971/act/22/enacted/en/print, 22 Stat. (1971).
HEAnet. (2012). Schools 100 Mbit/s Project - SCHOOLS 100MBIT/S HIGH-SPEED NETWORK. Retrieved from http://www.heanet.ie/community/100mbproject
Heitink, M., Voogt, J., Verplanken, L., van Braak, J., & Fisser, P. (2016). Teachers' professional reasoning about their pedagogical use of technology. *Computers & Education, 101*, 70-83. doi:10.1016/j.compedu.2016.05.009

Helsper, E. J., & Eynon, R. (2010). Digital Natives: where is the evidence? *British Educational Research Journal, 36*(3), 503-520. doi:10.1080/01411920902989227
Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education, 51*(4), 1499-1509. doi:10.1016/j.compedu.2008.02.001
Hew, K., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research & Development, 55*(3), 223-252. doi:10.1007/s11423-006-9022-5
Heyes, S., Hardy, M., Humphreys, P., & Rookes, P. (1993). *Starting Statistics*. London: Weidenfeld & Nicholson Ltd. .
Hill, P. W., & Rowe, K. J. (1998). Modelling student progress in studies of educational effectiveness*. *School effectiveness and school improvement, 9*(3), 310-333.
Hinton, P. R. (2001). *Statistics Explained - A Guide for Social Science Students* . London, UK: Routledge.
Hoffman, J. V., Wetzel, M. M., Maloch, B., Greeter, E., Taylor, L., DeJulio, S., & Vlach, S. K. (2015). What can we learn from studying the coaching interactions between cooperating teachers and preservice teachers? A literature review. *Teaching and Teacher Education, 52*, 99-112. doi:http://dx.doi.org/10.1016/j.tate.2015.09.004
Howard, S. K., Ma, J., & Yang, J. (2016). Student rules: Exploring patterns of students' computer-efficacy and engagement with digital technologies in learning. *Computers & Education, 101*, 29-42. doi:10.1016/j.compedu.2016.05.008
Howe, N., & Strauss, W. (2000). *Millennials rising: the next great generation*. New York: Vintage.
Howe, N., & Strauss, W. (2009). *Millennials rising: The next great generation*: New York: Vintage.
Huberman, M. (1989). The Professional Life Cycle of Teachers. *Teachers College Record, 91*(1), 31-57.
Hughes, J. E., Liu, S., & Lim, M. (2016). Technological Modeling: Faculty Use of Technologies in Preservice Teacher Education from 2004 to 2012. *Contemporary Issues in Technology and Teacher Education, 16*(2), 184-207.
Hunt, C. (2011). *National Strategy for Higher Education to 2030*. Dublin: The Stationery Office Retrieved from http://hea.ie/assets/uploads/2017/06/National-Strategy-for-Higher-Education-2030.pdf.
Hur, J. W., Cullen, T., & Brush, T. (2010). Teaching for Application: A Model for Assisting Pre-Service Teachers with Technology Integration. *Journal of Technology and Teacher Education, 18*(1), 161-182.
Instefjord, E. J., & Munthe, E. (2017). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. *Teaching and Teacher Education, 67*, 37-45. doi:http://dx.doi.org/10.1016/j.tate.2017.05.016
INTO. (1996). *Information Technology in Irish Education: Issues & Recommendations*. Retrieved from Dublin: INTO website.
INTO. (2015). Digital Strategy fails to address key concerns of primary schools. *In Touch*. November edition. INTO website
Ireland, Government of (2007). *Ireland: National Development Plan 2007 - 2013: Transforming Ireland A Better Quality of Life for All*. Dublin: The Stationery Office Retrieved from http://www2.ul.ie/pdf/932500843.pdf.
Johnson, L., Adams Becker, S., Estrada, V., Freeman, A., Kampylis, P., Vuorikari, R., & Punie, Y. (2014). *Horizon Report Europe : 2014 Schools Edition*. Retrieved from Luxembourg, Austin, Texas, USA:

Johnson, R. B., & Onwuegbuzie, A. J. (2006). Mixed Methods Research: A Research Paradigm Whose Time has Come. In *Mixed Methods, Volume II* (Vol. II, pp. 25-49). London: Sage Publications.
Johnston, K. (2014). *The Development and Implementation of ICT Policy for Schools in the Irish Post-Primary Context: A Critical Analysis.* (PhD), University of Limerick, Ireland.
Johnston, K., FitzGibbon, A., Oldham, E., & Seery, A. (2006). *Have Irish Pre-Service Teachers Crossed the Digital Divide?* Paper presented at the Society for Information Technology & Teacher Education International Conference 2006, Orlando, Florida, USA. http://www.editlib.org/p/22299
Jones, C., Ramanau, R., Cross, S., & Healing, G. (2010). Net generation or Digital Natives: Is there a distinct new generation entering university? *Computers & Education, 54*(3), 722-732. doi:10.1016/j.compedu.2009.09.022
Jones, M., Hobbs, L., Kenny, J., Campbell, C., Chittleborough, G., Gilbert, A., . . . Redman, C. (2016). Successful university-school partnerships: An interpretive framework to inform partnership practice. *Teaching and Teacher Education, 60*, 108-120. doi:https://doi.org/10.1016/j.tate.2016.08.006
Judge, M. (2002). *Introducing ICT in the Irish School System: An Exploratory study of the impact of innovative technology models on schools participating in the Schools IT 2000 initiative.* (PhD), Dublin City University, Dublin. Retrieved from http://doras.dcu.ie/17938/1/Miriam_Judge_1-3.pdf (17938)
Kagan, D. M. (1992). Implication of Research on Teacher Belief. *Educational Psychologist, 27*(1), 65.
Kaldi, S., & Xafakos, E. (2017). Student teachers' school teaching practice: The relation amongst perceived self-competence, motivation and sources of support. *Teaching and Teacher Education, 67*, 246-258. doi:http://dx.doi.org/10.1016/j.tate.2017.05.019
Kay, R. H. (2006). Evaluating Strategies Used To Incorporate Technology Into Preservice Education: A Review Of the Literature. *Journal of Research on Technology in Education, 38*(4), 383-408.
Kellaghan, T. (2002). *Preparing Teachers for the 21st Century : Report of the Working Group in Primary Pre-service Teacher Education*. Retrieved from Dublin: DES website.
Kelly, J. F. (1985). The Curricular Impact of 'Computers in Education'. *Irish Educational Studies, 5*(1).
Kelman, H. C. (1958). Compliance, Identification, and Internalization: Three Processes of Attitude Change. *The Journal of Conflict Resolution, 2*(1), 51-60.
Kennedy, G., Judd, T., Dalgarno, B., & Waycott, J. (2010). Beyond natives and immigrants: exploring types of net generation students. *Journal of Computer Assisted Learning, 26*(5), 332-343. doi:10.1111/j.1365-2729.2010.00371.x
Kennedy, J. (2014). 105 additional Irish schools to be connected to 100Mbps broadband. *Silicon Republic*. Retrieved from www.siliconrepublic.com website: http://www.siliconrepublic.com/comms/item/37624-105-additional-irish-school doi:http://www.siliconrepublic.com/comms/item/37624-105-additional-irish-school
Kimmel, A. J., Smith, N. C., & Klein, J. G. (2011). Ethical Decision Making and Research Deception in the Behavioral Sciences: An Application of Social Contract Theory. *Ethics & Behavior, 21*(3), 222-251. doi:10.1080/10508422.2011.570166
King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management, 43*(6), 740-755.
Kirk, A. (2017, 25.04.17). Are children getting enough 'me' time? *The Irish Times*.

Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education, 67*, 135-142. doi:http://dx.doi.org/10.1016/j.tate.2017.06.001

Klichowski, M., & Costa, C. S. (2015). How do Pre-Service Teachers rate ICT Opportunity for Education? A Study in Perspective of the SCOT Theory. *Kultura i Edukacja, 4*(110), 152 - 168.

Knowles, J. G. (1992). Models for Understanding Pre-service Teachers and Beginning Teachers' Biographies. In I. F. Goodson (Ed.), *Studying Teachers' Lives* (pp. 254).

Koc, M. (2013). Student teachers' conceptions of technology: A metaphor analysis. *Computers & Education, 68*, 1-8. doi:10.1016/j.compedu.2013.04.024

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70.

Koh, J. H. L., & Chai, C. S. (2014). Teacher clusters and their perceptions of technological pedagogical content knowledge (TPACK) development through ICT lesson design. *Computers & Education, 70*, 222-232. doi:10.1016/j.compedu.2013.08.017

Koh, J. H. L., & Chai, C. S. (2016). Seven design frames that teachers use when considering technological pedagogical content knowledge (TPACK). *Computers & Education, 102*, 244-257. doi:10.1016/j.compedu.2016.09.003

Kolikant, Y. B.-D. (2010). Digital natives, better learners? Students' beliefs about how the Internet influenced their ability to learn. *Computers in Human Behavior, 26*(6), 1384-1391. doi:10.1016/j.chb.2010.04.012

Koohang, A. (1987). A study of the attitudes of pre-service teachers toward the use of computers. *Educational Technology Research and Development, 35*(3), 145-149. doi:10.1007/bf02793842

Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education, 59*(4), 1109-1121. doi:10.1016/j.compedu.2012.05.014

Korthagen, F., Loughran, J., & Russell, T. (2006). Developing fundamental principles for teacher education programs and practices. *Teaching and Teacher Education, 22*(8), 1020-1041. doi:http://dx.doi.org/10.1016/j.tate.2006.04.022

Korthagen, F. A. J. (2004). In search of the essence of a good teacher: towards a more holistic approach in teacher education. *Teaching and Teacher Education, 20*(1), 77-97. doi:http://dx.doi.org/10.1016/j.tate.2003.10.002

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1121-1134. doi:10.1037/0022-3514.77.6.1121

Kundu, G. (1972). A comparison of the Likert and a new technique of attitude measurement. *Indian Journal of Psychology, 47*(3), 245-258.

Kurt, S., & Ciftci, M. (2012). Barriers to Teachers' Use of Technology. *International Journal of Instructional Media, 39*(3), 225-238.

Kvale, S., & Brinkmann, S. (2009). *Interviews Learning the Craft of Qualitative Research Interviewing* (2nd edition ed.). USA: Sage Publications.

Lai, H.-M., & Chen, C.-P. (2011). Factors influencing secondary school teachers' adoption of teaching blogs. *Computers & Education, 56*(4), 948-960. doi:10.1016/j.compedu.2010.11.010

Lai, K.-W., & Hong, K.-S. (2015). Technology use and learning characteristics of students in higher education: Do generational differences exist? *British Journal of Educational Technology, 46*(4), 725-738. doi:10.1111/bjet.12161

Lala, G. (2014). The Emergence and Development of the Technology Acceptance Model (TAM). *Proceedings of the International Conference Marketing - from Information to Decision, 7*, 149-160.

Lane, J. (2011). *Preparing Teachers of the Future: A National Initiative to Integrate ICT in Teacher Education in Australia*. Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011, Lisbon, Portugal. http://www.editlib.org/p/37904

Lau, W. W. F., Hung, J. C. Y., & Jong, M. S. Y. (2016). *Demographic Predictors of Social Media Usage among Pre-service Teachers*. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2016, Vancouver, BC, Canada. https://www.learntechlib.org/p/172941

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation* New York: Cambridge University Press.

Learning, H. (2015). H2 - ICT in Education. Retrieved from http://www.h2.ie/Site/About Us/7EE4E8EA-4CB2-4DE6-9CAC-A1F40F1A307E.html

Lee, D. Y., & Lehto, M. R. (2013). User acceptance of YouTube for procedural learning: An extension of the Technology Acceptance Model. *Computers & Education, 61*, 193-208. doi:10.1016/j.compedu.2012.10.001

Lee, Y., & Lee, J. (2014). Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice. *Computers & Education, 73*, 121-128. doi:10.1016/j.compedu.2014.01.001

Leger, M., & Freiman, V. (2016). *Examining Developing Digital Competence in Teachers and Students Over Time: A Mixed Method Case Study of a School That Has Undertaken a Technological Shift in Its Educational Environment*. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2016, Vancouver, BC, Canada. https://www.learntechlib.org/p/172955

Lehtinen, A., Nieminen, P., & Viiri, J. (2016). Preservice Teachers' TPACK Beliefs and Attitudes Toward Simulations. *Contemporary Issues in Technology and Teacher Education, 16*(2), 151-171.

Li, Y., & Ranieri, M. (2010). Are 'digital natives' really digitally competent?-A study on Chinese teenagers. *British Journal of Educational Technology, 41*(6), 1029-1042. doi:10.1111/j.1467-8535.2009.01053.x

Lichtman, M. (2006). *Qualitative Research in Education: A User's Guide*: SAGE Publications (CA).

Lichtman, M. (2010). *Qualitative research in education : a user's guide* (2nd ed. ed.).

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 22 140*, 55.

Lin, C.-C. (2013). Exploring the relationship between technology acceptance model and usability test. *Information Technology and Management, 14*(3), 243-255. doi:10.1007/s10799-013-0162-0

Lincoln, Y. S. (1985). *Naturalistic inquiry / Yvonna S. Lincoln, Egon G. Guba*. Sage Publication.

Linden, A., & Fenn, J. (2003). Understanding Gartner's hype cycles. *Strategic Analysis Report Nº R-20-1971. Gartner, Inc*. doi: http://www.bus.umich.edu/KresgePublic/Journals/Gartner/research/115200/115274/115274.html

Liu, Y., Li, H., & Carlsson, C. (2010). Factors driving the adoption of m-learning: An empirical study. *Computers & Education, 55*(3), 1211-1219. doi:10.1016/j.compedu.2010.05.018

Livingstone, S. (2010). Interactive, engaging but unequal : critical conclusions from internet studies. In Bloomsbury (Ed.), *Media and Society* (5th ed. / edited by James Curran. ed., pp. 122 - 142). London: Bloomsbury.

Loveless, A. M. (2003). The Interaction between Primary Teachers' Perceptions of ICT and Their Pedagogy. *Education and Information Technologies, 8*(4), 313-326. doi:10.1023/B:EAIT.0000008674.76243.8f

Loyd, B. H., & Gressard, C. (1984). The effects of sex, age, and computer experience on computer attitudes. *AEDS journal, 18*(2), 67-77.

Lunenberg, M., Korthagen, F., & Swennen, A. (2007). The teacher educator as a role model. *Teaching and Teacher Education, 23*(5), 586-601. doi:http://dx.doi.org/10.1016/j.tate.2006.11.001

Mackenzie, N., & Knipe, S. (2006). Research Dilemmas: Paradigms, Methods and Methodology. *Issues in Educational Research, 16*. doi:http://www.iier.org.au/iier16/mackenzie.html

Maderick, J. A., Zhang, S., Hartley, K., & Marchand, G. (2016). Preservice Teachers and Self-Assessing Digital Competence. *Journal of educational computing research, 54*(3), 326-351. doi:doi:10.1177/0735633115620432

Mahmood, K. (2016). Do People Overestimate their Information Literacy Skills? A Systematic Review of Empirical Evidence on the Dunning-Kruger Effect. *Communications in Information Literacy, 10*(2), 199-213.

Mama, M., & Hennessy, S. (2013). Developing a typology of teacher beliefs and practices concerning classroom use of ICT. *Computers & Education, 68*, 380-387. doi:10.1016/j.compedu.2013.05.022

Manca, S., & Ranieri, M. (2013). Is it a tool suitable for learning? A critical review of the literature on Facebook as a technology-enhanced learning environment. *Journal of Computer Assisted Learning, 29*(6), 487-504.

Mansfield, C. F., Beltman, S., Price, A., & McConney, A. (2012). “Don’t sweat the small stuff:” Understanding teacher resilience at the chalkface. *Teaching and Teacher Education, 28*(3), 357-367. doi:https://doi.org/10.1016/j.tate.2011.11.001

Margaryan, A., Littlejohn, A., & Vojt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. *Computers & Education, 56*(2), 429-440.

Marshall, K., & Anderson, J. (2008). The Emperor’s new clothes? A meta-study of education technology policies in Ireland, North and South (1996–2006). *Computers & Education, 50*(2), 463-474. doi:http://dx.doi.org/10.1016/j.compedu.2007.09.010

Martinovic, D., & Zhang, Z. (2012). Situating ICT in the teacher education program: Overcoming challenges, fulfilling expectations. *Teaching and Teacher Education, 28*(3), 461-469. doi:10.1016/j.tate.2011.12.001

Maslow, A. H. (1962). *Toward a psychology of being / by Abraham H. Maslow*. Wiley.

May, T. (2011). *Social Research: Issues, Methods and Process* (4th edition ed.): Open University Press.

McCoy, C. (2010). Perceived self-efficacy and technology proficiency in undergraduate college students. *Computers & Education, 55*(4), 1614-1617. doi:10.1016/j.compedu.2010.07.003

McDonagh, A., & McGarr, O. (2015). Technology leadership or technology somnambulism? Exploring the discourse of integration amongst information and communication technology coordinators. *Irish Educational Studies, 34*(1), 55-68. doi:10.1080/03323315.2015.1010292

McDonald, H., & Adam, S. (2003). A comparison of online and postal data collection methods in marketing research. *Marketing Intelligence & Planning, 21*(2), 85-95. doi:10.1108/02634500310465399

McGarr, O. (2009). The development of ICT across the curriculum in Irish schools: A historical perspective. *British Journal of Educational Technology, 40*(6), 1094-1108. doi:10.1111/j.1467-8535.2008.00903.x
McGarr, O., & Johnston, K. (2016). 'Never let the facts get in the way of a good story' - Exploring Prevalent Discourses in the Reporting of OECD students, computers and learning study in the national media in Ireland. *Paper presented at the INTED 2016, Valencia, Spain.*
Meisalo, V., Lavonen, J., Sormunen, K., & Vesisenaho, M. (2010). ICT in Finnish Initial Teacher Education. Country report for the OECD/CERI New Millennium Learners Project ICT in Initial Teacher Training. *Reports of the Ministry of Education and Culture, Finland, 25*.
Mena, J., Hennissen, P., & Loughran, J. (2017). Developing pre-service teachers' professional knowledge of teaching: The influence of mentoring. *Teaching and Teacher Education, 66*, 47-59. doi:http://dx.doi.org/10.1016/j.tate.2017.03.024
Menter, I. (2011). *A guide to practitioner research in education / Ian Menter ... [et al.]*.
Mercieca, B., & Kelly, N. (2017). Early career teacher peer support through private groups in social media. *Asia-Pacific Journal of Teacher Education*, 1-17. doi:10.1080/1359866X.2017.1312282
Mertens, D. M. (1998). *Research methods in education and psychology : integrating diversity with quantitative & qualitative approaches / Donna M. Mertens*. Sage Publications.
Mertens, D. M. (2010). *Research and evaluation in education and psychology : integrating diversity with quantitative, qualitative, and mixed methods / Donna M. Mertens* (3rd ed. ed.). Sage Publications.
Mertens, D. M., & Ginsberg, P. E. (2009). *The Handbook of Social Research Ethics*. London, California, New Delhi, Singapore: Sage Publications.
Meschede, N., Fiebranz, A., Möller, K., & Steffensky, M. (2017). Teachers' professional vision, pedagogical content knowledge and beliefs: On its relation and differences between pre-service and in-service teachers. *Teaching and Teacher Education, 66*, 158-170. doi:http://dx.doi.org/10.1016/j.tate.2017.04.010
Miles, M. B. (2013). *The role of participants in education research : ethics, epistemologies, and methods / edited by Warren Midgley, Patrick Alan Danaher, and Margaret Baguley,* Los Angeles, London, New York. Sage Publications.
Qualitative data analysis : a sourcebook of new methods / Matthew B. Miles, A. Michael Huberman. Los Angeles, London, New York. Sage Publications.
Miles, M. B., Huberman, M. A., & Saldaña, J. (2014). *Qualitative Data Analysis : A Methods Sourcebook* (3rd edition ed.). Los Angeles, London, New York: Sage Publications.
Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record, 108*(6), 1017-1054.
Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054. doi:10.1111/j.1467-9620.2006.00684.x
Morawski, J. G. (2005). Reflexivity and the psychologist. *History of the Human Sciences, 18*(4), 77.
Morris, D. (2010). Are teachers technophobes? Investigating professional competency in the use of ICT to support teaching and learning. *Procedia - Social and Behavioral Sciences, 2*(2), 4010-4015.
Moses, J., & Aknutsen, T. (2012). *Ways of Knowing* (Second edition ed.). UK: Palgrave Macmillan.

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Yilmaz Ozden, S., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education, 71*, 206-221. doi:10.1016/j.compedu.2013.09.020

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers & Education, 51*(4), 1523-1537. doi:10.1016/j.compedu.2008.02.003

Muis, K. R., & Duffy, M. C. (2013). Epistemic climate and epistemic change: Instruction designed to change students' beliefs and learning strategies and improve achievement. *Journal of Educational Psychology, 105*(1), 213-225. doi:10.1037/a0029690

Mulkeen, A. (2003). What can policy makers do to encourage integration of information and communications technology? Evidence from the Irish school system. *Technology, Pedagogy and Education, 12*(2), 277-293.

Mullings, B. (1999). Insider or outsider, both or neither: some dilemmas of interviewing in a cross-cultural setting. *Geoforum, 30*(4), 337-350. doi:10.1016/s0016-7185(99)00025-1

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342. doi:10.1080/14759390000200096

National Forum for the Enhancement of Teaching and Learning in Higher Education. (n.d.). Retrieved from https://www.teachingandlearning.ie/

National Forum for the Enhancement of Teaching and Learning in Higher Education (2015). *Teaching and Learning in Irish Higher Education : A Roadmap for the Enhancement in a Digital World 2015 - 2017.* Retrieved from Dublin: https://www.teachingandlearning.ie/wp-content/uploads/2015/03/Digital-Roadmap-V2-EXEC-SUMMARY.pdf

Ng, W., Nicholas, H., & Williams, A. (2010). School experience influences on pre-service teachers' evolving beliefs about effective teaching. *Teaching and Teacher Education, 26*(2), 278-289. doi:10.1016/j.tate.2009.03.010

Ní Chróinín, D., & O'Sullivan, M. (2014). From initial teacher education through induction and beyond: a longitudinal study of primary teacher beliefs. *Irish Educational Studies, 33*(4), 451-466. doi:10.1080/03323315.2014.984387

Nichols, A. L., & Maner, J. K. (2008). The Good-Subject Effect: Investigating Participant Demand Characteristics. *Journal of General Psychology, 135*(2), 151-166.

Niederhauser, D. S., & Perkmen, S. (2010). Beyond self-efficacy: Measuring pre-service teachers' Instructional Technology Outcome Expectations. *Computers in Human Behavior, 26*(3), 436-442. doi:10.1016/j.chb.2009.12.002

Nikleia, E. (2008). Evaluating computer technology integration in a centralized school system. *Computers & Education, 51*(2), 669-686. doi:10.1016/j.compedu.2007.07.004

Nistor, N., Lerche, T., Weinberger, A., Ceobanu, C., & Heymann, O. (2014). Towards the integration of culture into the Unified Theory of Acceptance and Use of Technology. *British Journal of Educational Technology, 45*(1), 36-55. doi:10.1111/j.1467-8535.2012.01383.x

O'Brien, C. (2016, 29.09.16). Smartphone use can hinder children's reading skills. *The Irish Times*.

O'Brien, C. (2017). More than one in 10 schoolchildren cyberbullied, research shows. *The Irish Times*.

Oblinger, D. G. (2004). The Next Generation of Educational Engagement. *Journal of Interactive Media in Education*, *2004*(1), Art. 10. DOI: http://doi.org/10.5334/2004-8-oblinger

O'Byrne, B., & Murrell, S. (2014). Evaluating multimodal literacies in student blogs. *45*(5), 926-940.

OECD. (1991). *Reviews of National Policies of Education : Ireland*. Retrieved from Paris: OECD website.

Office, C. S. (2011). *Statistical YearBook, 2011*. Dublin: www.cso.ie Retrieved from http://www.cso.ie/en/media/csoie/releasespublications/documents/statisticalyearbook/2011/c6education.pdf.

Oldham, E. (1998). The First Twenty-Five Years: Recollections of a Long Standing Member. *CESI History.* Retrieved from http://www.cesi.ie/history website.

Olofson, M. W., Swallow, M. J. C., & Neumann, M. D. (2016). TPACKing: A constructivist framing of TPACK to analyze teachers' construction of knowledge. *Computers & Education, 95*, 188-201. doi:http://dx.doi.org/10.1016/j.compedu.2015.12.010

Orne, M. T. (2002). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *Prevention & Treatment, 5*(1), 35. doi:10.1037/1522-3736.5.1.535a

Osborne, J., & Costello, A. B. (2005). Best Practices in Exploratory Factor Analysis : Four Recommendations for Getting the Most from Your Analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1-9.

Ottenbreit-Leftwich, A. T., Brush, T. A., Strycker, J., Gronseth, S., Roman, T., Abaci, S., . . . Plucker, J. (2012). Preparation versus practice: How do teacher education programs and practicing teachers align in their use of technology to support teaching and learning? *Computers & Education, 59*(2), 399-411. doi:10.1016/j.compedu.2012.01.014

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education, 55*(3), 1321-1335. doi:10.1016/j.compedu.2010.06.002

Pajares, F. (1996). *Assessing Self-Efficacy Beliefs and Academic Outcomes: The Case for Specificity and Correspondence*.

Papert, S. (1987a). Computer Criticism vs. Technocentric Thinking*, Educational Research* 16(1) pp. 22 - 30.

Papert, S. (1987b). Information Technology and Education: Computer Criticism vs. Technocentric Thinking. *Educational Researcher, 16*(1), 22-30. doi:doi:10.3102/0013189X016001022

Papert, S. (1996). *The Connected Family*: LongStreet Press.

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education, 50*(3), 1084-1091. doi:10.1016/j.compedu.2006.10.006

Park, S. Y. (2009). An Analysis of the Technology Acceptance Model in Understanding University Students' Behavioral Intention to Use e-Learning. *Journal of Educational Technology & Society, 12*(3), 150-162.

Peers, I. (1996). *Statistical Analysis for Education and Psychology Researchers*. London: Falmer Press.

Peirce, C. S. (1958). *Collected Papers*. Harvard University Press.

Peirce, C. S. (1999). Published Works I, electronic edition. Charles Sanders Peirce: Published Works I. Electronic Edition., from InteLex Corp.Texas Tech University Press

Perkmen, S., Antonenko, P., & Caracuel, A. (2016). Validating a Measure of Teacher Intentions to Integrate Technology in Education in Turkey, Spain and the USA. *Journal of Technology and Teacher Education, 24*(2), 215-241.

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). THE META-COGNITIVE MODEL (MCM) OF ATTITUDES: IMPLICATIONS FOR ATTITUDE MEASUREMENT, CHANGE, AND STRENGTH. *Social Cognition, 25*(5), 657-686.

Piaget, J. (1971). *Science of Education and the Psychology of the Child* (D. Coltman, Trans.). New York: Orion Press.

Pierson, M. E., & Cozart, A. (2004). Case Studies of Future Teachers. *Journal of Computing in Teacher Education, 21*(2), 59-63. doi:10.1080/10402454.2004.10784512

Plomp, T., Pelgrum, W., & Law, N. (2007). SITES2006–International comparative survey of pedagogical practices and ICT in education. *Education and Information Technologies, 12*(2), 83-92. doi:10.1007/s10639-007-9029-5

Plowman, L., Stevenson, O., Stephen, C., & McPake, J. (2012). Preschool children's learning with technology at home. *Computers & Education, 59*(1), 30-37. doi:10.1016/j.compedu.2011.11.014

Pollak, S. (2015). Electronic devices making children 'tired and cranky'. *The Irish Times*.

Pope, C. (2015). Teens in Ireland more likely cyberbullied than other countries. *The Irish Times*.

Pope, M., Hare, D., & Howard, E. (2002). Technology integration: closing the gap between what preservice teachers are taught to do and what they can do. *Journal of Technology & Teacher Education, 10*(2), 191-203.

Powers, J., & Musgrove, A. (2016). *Putting the "P" into TPACK: Using Digital Tools to Design 21st Century Lessons*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2016, Savannah, GA, United States. https://www.learntechlib.org/p/172124

Prensky, M. (2001). Digital Natives, Digital Immigrants. *On The Horizon, 9*(5).

Probert, E. (2009). Information literacy skills: Teacher understandings and practice. *Computers & Education, 53*(1), 24-33. doi:10.1016/j.compedu.2008.12.018

Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education, 58*(1), 449-458. doi:10.1016/j.compedu.2011.08.028

Puentedura, R. (2010). SAMR and TPCK: Intro to advanced practice. *Retrieved February, 12*, 2013.

Pynoo, B., Tondeur, J., van Braak, J., Duyck, W., Sijnave, B., & Duyck, P. (2012). Teachers' acceptance and use of an educational portal. *Computers & Education, 58*(4), 1308-1317. doi:10.1016/j.compedu.2011.12.026

Pynoo, B., & van Braak, J. (2014). Predicting teachers' generative and receptive use of an educational portal by intention, attitude and self-reported use. *Computers in Human Behavior, 34*, 315-322. doi:10.1016/j.chb.2013.12.024

Redecker, C., & Johannessen, Ø. (2013). Changing Assessment—Towards a New Assessment Paradigm Using ICT. *European Journal of Education, 48*(1), 79-96.

Redmond, P., & Albion, P. (2002). *In their own words: preservice teachers' perceptions of ICT integration*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2002, Nashville, Tennessee, USA. http://www.editlib.org/p/17708

Redmond, P., & Lock, J. (2013). *TPACK: Exploring a Secondary Pre-service Teachers' Context*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2013, New Orleans, Louisiana, United States. https://www.learntechlib.org/p/48940

Reyes, V. C., Reading, C., Doyle, H., & Gregory, S. (2017). Integrating ICT into teacher education programs from a TPACK perspective: Exploring perceptions of university lecturers. *Computers & Education, 115*, 1-19. doi:https://doi.org/10.1016/j.compedu.2017.07.009

Rizza, C. (2011). *ICT and Initial Teacher Education: National Policies*. OECD Working Papers.

Roberts, J. S., Laughlin, J. E., & Wedell, D. H. (1999). Validity Issues in the Likert and Thurstone Approaches to Attitude Measurement. *Educational & Psychological Measurement, 59*(2), 211.

Rohatgi, A., Scherer, R., & Hatlevik, O. E. (2016). The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education, 102*, 103-116. doi:10.1016/j.compedu.2016.08.001

Ros, S., Hernández, R., Caminero, A., Robles, A., Barbero, I., Maciá, A., & Holgado, F. P. (2015). On the use of extended TAM to assess students' acceptance and intent to use third-generation learning management systems. *British Journal of Educational Technology, 46*(6), 1250-1271. doi:10.1111/bjet.12199

Rovai, A. P., & Childress, M. D. (2002). Explaining and Predicting Resistance to Computer Anxiety Reduction among Teacher Education Students. *Journal of Research on Technology in Education, 35*(2), 226.

Roy, M., Giraldo-Garcia, R., Mathew, A. S., Matias, U., & Bommisetty, I. (2016). *Emerging Technologies for Face-to-face and online teachers: Use of Tablets*. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2016, Vancouver, BC, Canada. https://www.learntechlib.org/p/173293

Rubin, H. J., & Rubin, I. S. (2012). *Qualitative Interviewing: The Art of Hearing Data* (3rd edition ed.). United States of America: Sage Publications.

Russell, M., Bebell, D., O'Dwyer, L., & O'Connor, K. (2003). Examining Teacher Technology Use: Implications for Preservice and Inservice Teacher Preparation. *Journal of Teacher Education, 54*(4), 297-310. doi:10.1177/0022487103255985

Sadaf, A., Newby, T., & Ertmer, P. (2015). An investigation of the factors that influence preservice teachers' intentions and integration of Web 2.0 tools. *Educational Technology Research and Development, 64*(1), 1-28. doi:10.1007/s11423-015-9410-9

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012a). Exploring Factors that Predict Preservice Teachers' Intentions to Use Web 2.0 Technologies Using Decomposed Theory of Planned Behavior. *Journal of Research on Technology in Education (International Society for Technology in Education), 45*(2), 171-196.

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012b). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers & Education, 59*(3), 937-945. doi:10.1016/j.compedu.2012.04.001

Saldaña, J. (2011). *Fundamentals of qualitative research*: Oxford University Press, USA.

Saldaña, J. (2013). *The coding manual for qualitative researchers* (Second edition ed.): SAGE Publications Limited.

Sale, J. E. M., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the Quantitative-Qualitative Debate: Implications for Mixed-Methods Research. *Quality & Quantity, 36*(1), 43-53.

Salleh, S., & Albion, P. (2004). *Using the Theory of Planned Behaviour to Predict Bruneian Teachers' Intentions to Use ICT in Teaching*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2004, Atlanta, GA, USA. http://www.editlib.org/p/13671

Salomon, G. (1993). *Distributed Cognitions: Psychological and educational considerations.*: Cambridge University Press.

Sánchez Abril, P., Levin, A., & Del Riego, A. (2012). Blurred Boundaries: Social Media Privacy and the Twenty-First-Century Employee. *American Business Law Journal, 49*(1), 63-124. doi:10.1111/j.1744-1714.2011.01127.x

Sánchez, A. R., & Hueros, D. A. (2010). Motivational factors that influence the acceptance of Moodle using TAM. *Computers in Human Behavior, 26*(6), 1632-1640. doi:10.1016/j.chb.2010.06.011

Sang, G., Valcke, M., Braak, J. v., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education, 54*(1), 103-112. doi:10.1016/j.compedu.2009.07.010

Sapsford, R. (2007). *Survey Research* (2nd edition ed.). London: Sage Publications.

Sawang, S., Sun, Y., & Salim, S. A. (2014). It's not only what I think but what they think! The moderating effect of social norms. *Computers & Education, 76*, 182-189. doi:10.1016/j.compedu.2014.03.017

Scherer, R., Siddiq, F., & Teo, T. (2015). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Computers & Education, 88*, 202-214. doi:10.1016/j.compedu.2015.05.005

Schunk, D. H., & Ertmer, P. A. (1999). Self-regulatory processes during computer skill acquisition: Goal and self-evaluative influences. *Journal of Educational Psychology, 91*(2), 251.

Schutt, R. K. (2009). *Investigating the Social World : The Process and Practice of Research* (Sixth edition ed.). California: Pine Forge Press, an imprint of Sage Publications.

Science, Department of Education and (1997). *Schools IT 2000: A Policy Framework for the New Millennium*. Dublin: Department of Education & Science (DES).

Science, Department of Education and (2001). *Blueprint for the Future of ICT in Irish Schools: Three Year Strategic Action Plan, 2001 to 2003*. Dublin: Stationery Office.

Science, Department of Education and (2008a). *Investing Effectively in Information and Communications Technology in Schools, 2008 - 2013*. Dublin Retrieved from http://www.ncte.ie/media/Final ICT Strategy_group_report.pdf.

Science, Department of Education and (2008b). *Value for Money Review of the ICT Support Service for Schools*. Dublin: Stationery Office.

Science, Department of Education and (2009). *Smart Schools = Smart Economy: Report of the ICT in Schools Joint Advisory Group to the Minister for Education and Science*. Dublin: Stationery Office.

Science, Department of Education and. (2010). *Tanaiste announces €24 million in grants for high-tech classrooms in 3,300 Primary Schools*. Dublin: Department of Education website.

Selwyn, N. (2011a). *Education and technology : key issues and debates / Neil Selwyn*. London: Routledge.

Selwyn, N. (2011b). *Schools and schooling in the digital age : a critical analysis / Neil Selwyn*. London: Routledge.

Selwyn, N. (2013). *Education in a digital world : global perspectives on technology and education / Neil Selwyn*. London: Routledge.

Selwyn, N., & Bulfin, S. (2015). Exploring school regulation of students' technology use – rules that are made to be broken? *Educational Review, 68*(3), 1-17. doi:10.1080/00131911.2015.1090401

Senkbeil, M., & Ihme, J. M. (2017). Motivational factors predicting ICT literacy: First evidence on the structure of an ICT motivation inventory. *Computers & Education, 108*, 145-158. doi:10.1016/j.compedu.2017.02.003

Shank, G. D. (2007). *Exploring educational research literacy / Gary Shank, Launcelot Brown*. Sage Publications.

Sheil, G., & O'Flaherty, A. (2006). *NCTE 2005 Census on ICT Infrastructure in Schools : Statistical Report*. Retrieved from St. Patrick's College, Drumcondra, Dublin 9 website.

Shiel, G., Sofroniou, N., & Cosgrove, J. (2006). An overview of the main findings of PISA 2003 in Ireland. *The Irish Journal of Education/Iris Eireannach an Oideachais*, 5-26.

Shinas, V. H., Yilmaz-Ozden, S., Mouza, C., Karchmer-Klein, R., & Glutting, J. J. (2013). Examining Domains of Technological Pedagogical Content Knowledge Using Factor Analysis. *Journal of Research on Technology in Education, 45*(4), 339-360.

Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher, 15*(2), 4-14.

Sieber, V. (2009). Diagnostic online assessment of basic IT skills in 1st-year undergraduates in the Medical Sciences Division, University of Oxford. *British Journal of Educational Technology, 40*(2), 215-226. doi:10.1111/j.1467-8535.2008.00926.x

Silverman, D. (2010). *Doing Qualitative Research* (Third Edition ed.). London: Sage Publications Ltd.

Silverman, D. (2013). *Doing Qualitative Research* (Fourth Edition ed.). London: Sage Publications Ltd.

Sime, D., & Priestley, M. (2005). Student teachers' first reflections on information and communications technology and classroom learning: implications for initial teacher education. *Journal of Computer Assisted Learning, 21*(2), 130-142. doi:10.1111/j.1365-2729.2005.00120.x

Skills, Department of Education and (2011). *Literacy and Numeracy for Life:The National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020.* Dublin: Stationary Office.

Skills, Department of Education and (2015). *Digital Strategy for Schools 2015 - 2020 : Enhancing Teaching, Learning and Assessment*. Dublin Retrieved from https://www.education.ie/en/Publications/Policy-Reports/Digital-Strategy-for-Schools-2015-2020.pdf.

Skills, Department of Education and (1831). Stanley Letter, 1831. Retrieved from https://www.education.ie/en/Schools-Colleges/Information/Boards-of-Management/Stanley-letter-1831-Boards-Of-Management.pdf

Slay, H., Siebörger, I., & Hodgkinson-Williams, C. (2008). Interactive whiteboards: Real beauty or just “lipstick”? *Computers & Education, 51*(3), 1321-1341. doi:10.1016/j.compedu.2007.12.006

Smarkola, C. (2008). Efficacy of a planned behavior model: Beliefs that contribute to computer usage intentions of student teachers and experienced teachers. *Computers in Human Behavior, 24*(3), 1196-1215. doi:10.1016/j.chb.2007.04.005

Smith, E. E. (2016). “A real double-edged sword:” Undergraduate perceptions of social media in their learning. *Computers & Education, 103*, 44-58. doi:10.1016/j.compedu.2016.09.009

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour, Editorial. *Health Psychology Review,* pp. 1-7. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=93926929&site=ehost-live

Šorgo, A., Bartol, T., Dolničar, D., & Boh Podgornik, B. (2017). Attributes of digital natives as predictors of information literacy in higher education. *British Journal of Educational Technology, 48*(3), 749-767. doi:10.1111/bjet.12451

Spaulding, M. (2016). *Does a Web 2.0 based technology integration course develop TPACK ready preservice teachers?* Paper presented at the Society for Information Technology & Teacher Education International Conference 2016, Savannah, GA, United States. https://www.learntechlib.org/p/172128

Stevens, S. S. (1946). On the theory of scales of measurement.

Stuart, L. H., Mills, A. M., & Remus, U. (2009). School leaders, ICT competence and championing innovations. *Computers & Education, 53*(3), 733-741. doi:10.1016/j.compedu.2009.04.013

Svendsen, G. B., Johnsen, J.-A. K., Almås-Sørensen, L., & Vittersø, J. (2013). Personality and technology acceptance: the influence of personality factors on the core constructs of the Technology Acceptance Model. *Behaviour & Information Technology, 32*(4), 323.

Tang, S. Y. F., Wong, A. K. Y., & Cheng, M. M. H. (2016). Configuring the three-way relationship among student teachers' competence to work in schools, professional learning and teaching motivation in initial teacher education. *Teaching and Teacher Education, 60*, 344-354. doi:http://dx.doi.org/10.1016/j.tate.2016.09.001

Taoiseach, Department of an (2006). *Towards 2016: Ten Year Framework Social Partnership Agreement 2006 - 2015*. Dublin: Stationery Office.

Tapscott, D. (1998). *Growing up Digital - The Rise of the Net Generation*. USA: McGraw Hill.

Tapscott, D. (1999). Educating the Net Generation. *Educational Leadership, 56*(5), 6-11.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53-55. doi:10.5116/ijme.4dfb.8dfd

Taylor, S., & Todd, P. (1995). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International journal of research in marketing, 12*(2), 137-155.

The Teaching Council Act, 8/2001, Irish Statute Book, 8/2001 Stationery Office Dublin. (2001).

Teddlie, C., & Yu, F. (2007). Mixed methods sampling a typology with examples. *Journal of mixed methods research, 1*(1), 77-100.

Teo, T. (2009a). Is there an attitude problem? Reconsidering the role of attitude in the TAM. *British Journal of Educational Technology, 40*(6), 1139-1141. doi:10.1111/j.1467-8535.2008.00913.x

Teo, T. (2009b). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*(2), 302-312. doi:10.1016/j.compedu.2008.08.006

Teo, T. (2010). A path analysis of pre-service teachers' attitudes to computer use: applying and extending the technology acceptance model in an educational context. *Interactive Learning Environments, 18*(1), 65-79. doi:10.1080/10494820802231327

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education, 57*(4), 2432-2440. doi:10.1016/j.compedu.2011.06.008

Teo, T. (2012). Examining the intention to use technology among pre-service teachers: an integration of the Technology Acceptance Model and Theory of Planned Behavior. *Interactive Learning Environments, 20*(1), 3-18. doi:10.1080/10494821003714632

Teo, T. (2013a). Digital Nativity: A Definitional Framework. *World Journal on Educational Technology, 5*(3), 389-394.

Teo, T. (2013b). An initial development and validation of a Digital Natives Assessment Scale (DNAS). *Computers & Education, 67*(0), 51-57. doi:10.1016/j.compedu.2013.02.012

Teo, T. (2014). Unpacking teachers' acceptance of technology: Tests of measurement invariance and latent mean differences. *Computers & Education, 75*(0), 127-135. doi:10.1016/j.compedu.2014.01.014

Teo, T. (2015). Comparing pre-service and in-service teachers' acceptance of technology: Assessment of measurement invariance and latent mean differences. *Computers & Education, 83*, 22-31. doi:10.1016/j.compedu.2014.11.015

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia-Pacific Journal of Teacher Education, 36*(2), 163-174. doi:10.1080/13598660801971641

Teo, T., Ching Sing, C., David, H., & Chwee Beng, L. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia-Pacific Journal of Teacher Education, 36*(2), 163-174.

Teo, T., Lee, C. B., & Chai, C. S. (2007). Understanding pre-service teachers' computer attitudes: applying and extending the technology acceptance model. *Journal of Computer Assisted Learning, 24*(2), 128-143.

Teo, T., Milutinović, V., & Zhou, M. (2016). Modelling Serbian pre-service teachers' attitudes towards computer use: A SEM and MIMIC approach. *Computers & Education, 94*, 77-88. doi:10.1016/j.compedu.2015.10.022

Teo, T., & Noyes, J. (2011). An assessment of the influence of perceived enjoyment and attitude on the intention to use technology among pre-service teachers: A structural equation modeling approach. *Computers & Education, 57*(2), 1645-1653. doi:10.1016/j.compedu.2011.03.002

Teo, T., & Noyes, J. (2012). Explaining the intention to use technology among pre-service teachers: a multi-group analysis of the Unified Theory of Acceptance and Use of Technology. *Interactive Learning Environments, 22*(1), 1-16. doi:10.1080/10494820.2011.641674

Teo, T., & Noyes, J. (2014). Explaining the intention to use technology among pre-service teachers: a multi-group analysis of the Unified Theory of Acceptance and Use of Technology. *Interactive Learning Environments, 22*(1), 51-66.

TES. (n.d.). TES website.

Thibaut, L., Knipprath, H., Dehaene, W., & Depaepe, F. (2018). The influence of teachers’ attitudes and school context on instructional practices in integrated STEM education. *Teaching and Teacher Education, 71*, 190-205. doi:https://doi.org/10.1016/j.tate.2017.12.014

Thinyane, H. (2010). Are digital natives a world-wide phenomenon? An investigation into South African first year students’ use and experience with technology. *Computers & Education, 55*(1), 406-414. doi:10.1016/j.compedu.2010.02.005

Thomas, K. M., O’Bannon, B. W., & Britt, V. G. (2014). Standing in the Schoolhouse Door: Teacher Perceptions of Mobile Phones in the Classroom. *Journal of Research on Technology in Education, 46*(4), 373-395. doi:10.1080/15391523.2014.925686

Thomas, M. (2011). *Deconstructing Digital Natives - Young People, Technology and New Literacies* (M. Thomas Ed.): Routledge.

Thompson, A., & Mishra, P. (2007). Breaking news: TPCK becomes TPACK! *Journal of Computing in Teacher Education, 24*(2), 38.

Thompson, P. (2013). The digital natives as learners: Technology use patterns and approaches to learning. *Computers & Education, 65*(0), 12-33. doi:10.1016/j.compedu.2012.12.022

Tondeur, J., Aesaert, K., Pynoo, B., van Braak, J., Fraeyman, N., & Erstad, O. (2017). Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. *British Journal of Educational Technology, 48*(2), 462-472. doi:10.1111/bjet.12380

Tondeur, J., De Bruyne, E., Van Den Driessche, M., McKenney, S., & Zandvliet, D. (2015). The physical placement of classroom technology and its influences on educational practices. *Cambridge Journal of Education, 45*(4), 537-556. doi:10.1080/0305764x.2014.998624

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2016). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational Technology Research and Development*, 1-21. doi:10.1007/s11423-016-9481-2

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59*(1), 134-144. doi:10.1016/j.compedu.2011.10.009

Tondeur, J., van Braak, J., Siddiq, F., & Baran, E. (2016). *Enhancing Pre-Service Teachers' TPACK - How Teacher Education Matters*. Paper presented at the Educational Technology World Conference, Bali, Indonesia. Presentation retrieved from https://www.researchgate.net/publication/305986597_Enhancing_Preservice_Teachers%27_Technological_Pedagogical_Content_Knowledge_How_Teacher_Education_Matters

Tondeur, J., van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education, 94*, 134-150. doi:10.1016/j.compedu.2015.11.009

Tondeur, J., van Keer, H., van Braak, J., & Valcke, M. (2008). ICT integration in the classroom: Challenging the potential of a school policy. *Computers & Education, 51*(1), 212-223. doi:10.1016/j.compedu.2007.05.003

Travers, P., Coolahan, J., Egan, E., Kellaghan, T., Cannon, P., Drudy, S., . . . Jeffers, G. (2004, 2004). *Teacher Education in the Republic of Ireland : Retrospect and Prospect.* Paper presented at the Standing Conference on Teacher Education, North & South [SCOTENS], St Patrick's College, Dublin.

Trevethan, H. (2017). Educative mentors? The role of classroom teachers in initial teacher education. A New Zealand study. *Journal of Education for Teaching, 43*(2), 219-231. doi:10.1080/02607476.2017.1286784

Turel, V. (2014). Teachers' Computer Self-Efficacy and Their Use of Educational Technology. *Turkish Online Journal of Distance Education, 15*(4), 130-149.

Uerz, D., Volman, M., & Kral, M. (2018). Teacher educators' competences in fostering student teachers' proficiency in teaching and learning with technology: An overview of relevant research literature. *Teaching and Teacher Education, 70*, 12-23. doi:https://doi.org/10.1016/j.tate.2017.11.005

Ugras, M., Altunbas, S., Ay, K., & Cil, E. (2012). Determination of the Pre-Service Science and Classroom Teachers' Attitudes Towards Science Teaching and Technology and Relationship Between These Attitudes. *Procedia - Social and Behavioral Sciences, 47*, 1549-1553. doi:10.1016/j.sbspro.2012.06.859

Umar, I. N., & Hussin, F. K. (2014). ICT Coordinators' Perceptions on ICT Practices, Barriers and its Future in Malaysian Secondary Schools: Correlation Analysis. *Procedia - Social and Behavioral Sciences, 116*, 2469-2473. doi:10.1016/j.sbspro.2014.01.593

Ursavaş, Ömer Faruk (2013). Reconsidering the role of attitude in the TAM: An answer to Teo (2009) and Nistor and Heymann (2010), and Lopez-Bonilla and Lopez-Bonilla (2011). *British Journal of Educational Technology, 44,* E23-E25.

Valtonen, T., Kukkonen, J., Kontkanen, S., Sormunen, K., Dillon, P., & Sointu, E. (2015). The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning. *Computers & Education, 81*, 49-58. doi:10.1016/j.compedu.2014.09.008

van Braak, J. (2001). Factors influencing the use of computer mediated communication by teachers in secondary schools. *Computers & Education, 36*(1), 41-57. doi:10.1016/s0360-1315(00)00051-8

van den Beemt, A., & Diepstraten, I. (2016). Teacher perspectives on ICT: A learning ecology approach. *Computers & Education, 92-93*, 161-170. doi:10.1016/j.compedu.2015.10.017

van Manen, M. (1990). *Researching Lived Experience : Human Science for an action sensitive pedagogy*. Ontario, Canada: The Althouse Press.

Vanderlinde, R., Aesaert, K., & van Braak, J. (2014). Institutionalised ICT use in primary education: A multilevel analysis. *Computers & Education, 72*, 1-10. doi:10.1016/j.compedu.2013.10.007

Varma, S., & Marler, J. H. (2013). The dual nature of prior computer experience: More is not necessarily better for technology acceptance. *Computers in Human Behavior, 29*(4), 1475-1482. doi:10.1016/j.chb.2013.01.029

Veen, W., & Vrukking, B. (2006). *Homo Zappiens - Growing up in a Digital Age* (S. Nunn Ed.): The Continuum International Publishing Group.

Vega-Hernandez, M.-C., Patino-Alonso, M.-C., & Galindo-Villardon, M.-P. (2018). Multivariate characterization of university students using the ICT for learning *Computers & Education, 121*(3), 124-130.

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences, 39*(2), 273-315. doi:10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186 - 204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27*(3), 425-478.

Verdegem, P., & De Marez, L. (2011). Rethinking determinants of ICT acceptance: Towards an integrated and comprehensive overview. *Technovation, 31*(8), 411-423. doi:10.1016/j.technovation.2011.02.004

Vermeulen, M., Kreijns, K., van Buuren, H., & Van Acker, F. (2017). The role of transformative leadership, ICT-infrastructure and learning climate in teachers' use of digital learning materials during their classes. *British Journal of Educational Technology, 48*(6), 1427-1440. doi:10.1111/bjet.12478

Viherä, M.-L., & Nurmela, J. (2001). Communication capability as an intrinsic determinant for information age. *Futures, 33*(3-4), 245-265. doi:10.1016/s0016-3287(00)00070-7

Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education, 118*, 70-81. doi:https://doi.org/10.1016/j.compedu.2017.11.009

Voogt, J., Mishra, P., Thompson, A., Crawford, D., Wang, W., Niederhauser, D., . . . Agyei, D. (2013). *Measuring TPACK: Part 2*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2013, New Orleans, Louisiana, United States. https://www.learntechlib.org/p/48475

Vrasidas, C. (2015). The rhetoric of reform and teachers' use of ICT. *British Journal of Educational Technology, 46*(2), 370-380. doi:10.1111/bjet.12149

Wahyuni, D. (2012). The Research Design Maze: Understanding Paradigms, Cases, Methods and Methodologies. *Journal of Applied Management Accounting Research, 10*(1), 69-80.

Walsh, B. (2011). History of Education in Ireland. In B. Walsh (Ed.), *Education Studies in Ireland : The Key Disciplines* (pp. 34-66). Dublin: Gill & Macmillan.

Wang, S.-K., Hsu, H.-Y., Campbell, T., Coster, D. C., & Longhurst, M. (2014). An investigation of middle school science teachers and students use of technology inside and outside of classrooms: considering whether digital natives are more technology savvy than their teachers. *Educational Technology Research and Development, 62*(6), 637-662. doi:10.1007/s11423-014-9355-4

Watts, R. (2009). *Predicting Technology Use in K-12 Classrooms*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2009, Charleston, SC, USA. http://www.editlib.org/p/31318

Waycott, J., Bennett, S., Kennedy, G., Dalgarno, B., & Gray, K. (2010). Digital divides? Student and staff perceptions of information and communication technologies. *Computers & Education, 54*(4), 1202-1211. doi:10.1016/j.compedu.2009.11.006

Weber, M. (1993). *Basic concepts in sociology*: Citadel Press.

Weber, M. (2015). The Biography.com website. *Biography.com.* Retrieved from http://www.biography.com/people/max-weber-9526066.

Weber, R. K., Millwood, R., Kumpulainen, K., Freeman, E., O Murchu, D., FitzGibbon, A., . . . Sorensen, E. (2004). *Addressing Barriers of Information Technology from a Multi-National View: A New Message for Teacher Education*. Paper presented at the Society for Information Technology & Teacher Education International Conference 2004, Atlanta, GA, USA. http://www.editlib.org/p/13700

Weber, S. J., & Cook, T. D. (1972). Subject effects in laboratory research: An examination of subject roles, demand characteristics, and valid inference. *Psychological Bulletin, 77*(4), 273-295. doi:10.1037/h0032351

Wilson, S., & MacLean, R. (2011). *Research Methods and Data Analysis for Psychology*: McGraw Hill.

Winner, L. (1986). *The whale and the reactor: a search for limits in an age of high technology*. United States of America: University of Chicago Press.

Wong, G. (2015). Understanding technology acceptance in pre-service teachers of primary mathematics in Hong Kong. *Australasian Journal of Educational Technology, 31*(6).

Wood, E., Mueller, J., Willoughby, T., Specht, J., & Deyoung, T. (2005). Teachers' Perceptions: barriers and supports to using technology in the classroom. *Education, Communication & Information, 5*(2), 183-206. doi:10.1080/14636310500186214

Wu, J.-H., Chen, Y.-C., & Lin, L.-M. (2007). Empirical evaluation of the revised end user computing acceptance model. *Computers in Human Behavior, 23*(1), 162-174.

Yang, H.-d., & Yoo, Y. (2004). It's all about attitude: revisiting the technology acceptance model. *Decision Support Systems, 38*(1), 19-31.

Yen, D. C., Wu, C.-S., Cheng, F.-F., & Huang, Y.-W. (2010). Determinants of users' intention to adopt wireless technology: An empirical study by integrating TTF with TAM. *Computers in Human Behavior, 26*(5), 906-915.

Yeung, A. S., Lim, K. M., Tay, E. G., Lam-Chiang, A. C., & Hui, C. (2012). Relating use of digital technology by pre-service teachers to confidence: A Singapore survey. *Australasian Journal of Educational Technology, 28*(8), 1317-1332.

Yeung, A. S., Taylor, P. G., Hui, C., Lam-Chiang, A. C., & Low, E.-L. (2012). Mandatory use of technology in teaching: Who cares and so what? *British Journal of Educational Technology, 43*(6), 859-870. doi:10.1111/j.1467-8535.2011.01253.x

Yilmaz, O., & Bayraktar, D. M. (2014). Teachers' Attitudes towards the Use of Educational Technologies and their Individual Innovativeness Categories. *Procedia - Social and Behavioral Sciences, 116*, 3458-3461. doi:10.1016/j.sbspro.2014.01.783

Yin, R. K. (2009). *Case study research : design and methods / Robert K. Yin* (4th ed. ed.).Sage Publications.

Young, A.-M., O'Neill, A., & Mooney Simmie, G. (2015). Partnership in learning between university and school: evidence from a researcher-in-residence. *Irish Educational Studies, 34*(1), 25-42. doi:10.1080/03323315.2014.1001203

Zajacova, A., Lynch, S. M., & Espenshade, T. J. (2005). Self-efficacy, stress, and academic success in college. *Research in higher education, 46*(6), 677-706.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for Classroom Technology Innovations. *Teachers College Record, 104*(3), 482.

Appendices

Appendix One Survey

Attitudes and Use of Technology Questionnaire, January 2013

1. Introduction to Research Project, January 2013

You are asked to participate in a "longitudinal" research project being conducted by Alison Egan, about your attitudes to and use of technology, during your time in Marino Institute of Education.

During the study participants will be asked to complete various questionnaires and/or participate in focus groups, and be interviewed, over the next three years.

All data collected will be anonymised for the purposes of publications, theses and conference papers. Participation in the project will have no bearing on your academic grades, as the data collected is for research purposes only.

If you have any questions about the project, please contact me by email (alison.egan@mie.ie).

This survey usually takes about fifteen minutes to complete.
Many thanks for taking the time.
Alison

* 1. Please submit your email address here. Please use your momail.mie.ie address - this information is required so I can match up responses over the duration of the research - it will not be used for any other purpose.

2. If you would rather NOT participate, please indicate here

- [ ] No thanks.

2. Profile Information (background data)

* 3. Age

◯ <21 ◯ 21-25 ◯ 26-30 ◯ 31-35 ◯ 36-40 ◯ 46+

* 4. Gender

◯ Male

◯ Female

* 5. Please indicate the course you are attending

◯ PG Dip (MIE) ◯ B.Ed (MIE)

3. Technology Experience

6. At what age did you first use technology?

7. At what age did you first use technology in school?

8. At what age did you first see technology used by a teacher?

9. Rate your expertise in using technology

- Very good
- Good
- Somewhat good
- Poor
- Very Poor

4. Use of Technology (Section 2 - Self Efficacy Statements)

10. I am able to

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Use my knowledge of technology to help my classmates	◯	◯	◯	◯	◯
Adopt and adapt technology resources for assignments	◯	◯	◯	◯	◯
Integrate technology in my college work creatively	◯	◯	◯	◯	◯
Integrate technology in my college work with minimal help	◯	◯	◯	◯	◯
Search, evaluate and select appropriate technology resources	◯	◯	◯	◯	◯
Navigate the contents of a computer	◯	◯	◯	◯	◯
Use technology without needing to be told how it works	◯	◯	◯	◯	◯
Use technology if there are user manuals available	◯	◯	◯	◯	◯
Complete a job or task using technology	◯	◯	◯	◯	◯
Complete a job or task using technology if shown how to first	◯	◯	◯	◯	◯

5. Personal Use of Technology - Section 3

11. How frequently do you use technology in your personal life?

	Very often (many times a day)	Often (once a day,everyday)	Sometimes (now and again during a week)	Rarely (about once a month)	Never
Laptop	○	○	○	○	○
Desktop PC	○	○	○	○	○
Social networking site (e.g. Facebook/Twitter)	○	○	○	○	○
Email	○	○	○	○	○
Mobile phone (phone calls/sms only)	○	○	○	○	○
Smart phone (e.g. iPhone)	○	○	○	○	○
Digital camera	○	○	○	○	○
Photo sharing sites (e.g. Flickr)	○	○	○	○	○
Video camera	○	○	○	○	○
Video sharing sites (e.g. YouTube/Vimeo)	○	○	○	○	○
Online Games	○	○	○	○	○
Computer/games console (e.g. xBox)	○	○	○	○	○
Mp3/iPod music player	○	○	○	○	○
Search Engine (e.g. Google/ Bing)	○	○	○	○	○
Online booking engines (e.g. Flights/cinema tickets)	○	○	○	○	○
Blogging	○	○	○	○	○
Accessing digital books (e.g. Google Books)	○	○	○	○	○
Online news sites (e.g. Independent news/ The Journal)	○	○	○	○	○

	Very often (many times a day)	Often (once a day,everyday)	Sometimes (now and again during a week)	Rarely (about once a month)	Never
Online banking	◯	◯	◯	◯	◯
Storing personal information (e.g. Google drive/ Slideshare)	◯	◯	◯	◯	◯
eBook reader (Kindle, for example)	◯	◯	◯	◯	◯
Skype	◯	◯	◯	◯	◯
FaceTime	◯	◯	◯	◯	◯
WhatsApp?	◯	◯	◯	◯	◯
iPad/Tablet pc	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

6. Statements on Technology in the Classroom (Section 4 - TAM statements)

12. Please indicate your level of agreement/disagreement with the following sentences

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1 Online journals are convenient, but I prefer the printed version	○	○	○	○	○
2 Information should be delivered to students in a controlled manner	○	○	○	○	○
3 Text should be provided first, rather than pictures, sound or video	○	○	○	○	○
4 Learning on computers is fun	○	○	○	○	○
5 Technology is rigid and inflexible to interact with	○	○	○	○	○
6 Using technology is a good idea	○	○	○	○	○
7 Using the computer involves too much time	○	○	○	○	○
8 Technology provides an attractive way to learn	○	○	○	○	○
9 I like using technology	○	○	○	○	○
10 Keeping up with technological developments takes too much of my time	○	○	○	○	○
11 Computers make work more interesting	○	○	○	○	○
12 I get new software/software upgrades every year	○	○	○	○	○
13 I make errors frequently when using technology	○	○	○	○	○

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
14 If I heard about a new technology, I would looks for ways to experiment with it in my teaching	○	○	○	○	○
15 Using computers will enhance my teaching	○	○	○	○	○
16 Colleagues in my class have been helpful in the use of technology	○	○	○	○	○
17 Using technology will help my students gain success in the future	○	○	○	○	○
18 I find computers easy to use	○	○	○	○	○
19 My job would be difficult without technology	○	○	○	○	○
20 Among my peers, I am usually the first to try our a new piece of technology	○	○	○	○	○
21 Technology enables me to accomplish tasks more quickly	○	○	○	○	○
22 Learning is best when the teacher takes a leading role	○	○	○	○	○
23 If you do not want to be left behind, adoption of new technologies is necessary	○	○	○	○	○
24 In general, my school has supported the use of technology	○	○	○	○	○
25 I often become confused when I use technology	○	○	○	○	○
26 Using technology helps me to realise my future aims for my students	○	○	○	○	○
27 Interacting with technology is often frustrating	○	○	○	○	○

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
28 I find it easy to recover from errors encountered when using technology	◯	◯	◯	◯	◯
29 I find it easy to get the computer to do what I want it to do	◯	◯	◯	◯	◯
30 Technology often behaves in unexpected ways	◯	◯	◯	◯	◯
31 It was easy for me to become skilful at using a computer	◯	◯	◯	◯	◯
32 Learning to use the computer takes too much of my time	◯	◯	◯	◯	◯
33 Most people in my class are certainly enthusiastic about using technology	◯	◯	◯	◯	◯
34 Even if I were interested, I would not use technology if my school was negative about it	◯	◯	◯	◯	◯
35 When everyone in my social environment is using technology at home, I will consider it then	◯	◯	◯	◯	◯
36 People in my class certainly come to me for advice concerning technology usage	◯	◯	◯	◯	◯
37 I intend to increase my use of technology in the future	◯	◯	◯	◯	◯
38 I need to consult the user manual often when using technology	◯	◯	◯	◯	◯
39 Assuming wireless technology would be available in my classroom, I predict that I would use it on a regular basis	◯	◯	◯	◯	◯

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
40 Focussed textbooks are essential	○	○	○	○	○

7. Finally....

13. If you have any additional comments on your attitude to technology or your experience of using technology in the classroom, please feel free to add them here...

Appendix Two Survey II & III

Use of Technology while on School Placement

1. Questionnaire II - April 2015

This is Questionnaire II of a research study your class started last year. This questionnaire is shorter than the first questionnaire you answered.

This is being conducted by Alison Egan, about your attitudes to and use of technology, during your time in Marino Institute of Education.

All data collected will be anonymised for the purposes of publications, theses and conference papers. Participation in the project will have no bearing on your academic grades, as the data collected is for research purposes only.

If you have any questions about the project, please contact me by email (alison.egan@mie.ie).

This survey usually takes about fifteen minutes to complete.
Many thanks for taking the time.
Alison

* 1. Please submit your email address here. Please use your momail.mie.ie address - this information is required so I can match up responses over the duration of the research - it will not be used for any other purpose.

Institiúid Oideachais
MARINO
Institute of Education
An Associated College of The University of Dublin, Trinity College

Use of Technology while on School Placement

2. Use of Technology while on School Placement (Section 2)

2. Which of the following technologies did you use, IN THE CLASSROOM for teaching and learning purposes, while on school placement?

	Very often (a few times a day)	Often (once a day)	Sometimes (now and again)	Rarely (infrequently)	Never	Not available in the classroom
Internet	○	○	○	○	○	○
Social network (Facebook/Twitter)	○	○	○	○	○	○
Email	○	○	○	○	○	○
Mobile phone (phone calls/sms only)	○	○	○	○	○	○
Smart phone (e.g. iPhone)	○	○	○	○	○	○
Digital projector/Data projector to display	○	○	○	○	○	○
Laptop	○	○	○	○	○	○
Desktop machine (not a laptop)	○	○	○	○	○	○
MS PowerPoint (for presentations)	○	○	○	○	○	○
Prezi (for online presentations)	○	○	○	○	○	○
MS Word (Word processing)	○	○	○	○	○	○
MS Excel (Spreadsheets)	○	○	○	○	○	○
Wiki (wikipedia, or other wikis)	○	○	○	○	○	○
Instant Messaging (IM)	○	○	○	○	○	○

	Very often (a few times a day)	Often (once a day)	Sometimes (now and again)	Rarely (infrequently)	Never	Not available in the classroom
Online Discussion Group	○	○	○	○	○	○
Interactive Whiteboard (IWB)	○	○	○	○	○	○
Digital camera	○	○	○	○	○	○
Photo sharing sites (e.g. Flickr)	○	○	○	○	○	○
Video camera	○	○	○	○	○	○
Video sharing sites (e.g. YouTube/Vimeo)	○	○	○	○	○	○
Online Games	○	○	○	○	○	○
Games console (e.g. xBox/Kinect)	○	○	○	○	○	○
Mp3/iPod music player	○	○	○	○	○	○
Tape-recorder	○	○	○	○	○	○
Online music site (Spotify)	○	○	○	○	○	○
Search Engine (e.g. Google/ Yahoo/Bing)	○	○	○	○	○	○
Blogging site (creating)	○	○	○	○	○	○
Blogging site (looking/viewing)	○	○	○	○	○	○
Accessing digital books (e.g. Google Books)	○	○	○	○	○	○
Online news sites (e.g. Independent news/ The Journal)	○	○	○	○	○	○
Professional websites (e.g. Scoilnet)	○	○	○	○	○	○
Curriculum software packages (e.g. WordShark)	○	○	○	○	○	○
Storing personal information (e.g. Google drive/ Slideshare/DropBox)	○	○	○	○	○	○
eBook reader (e.g. Kindle)	○	○	○	○	○	○
Skype	○	○	○	○	○	○
WhatsApp	○	○	○	○	○	○

	Very often (a few times a day)	Often (once a day)	Sometimes (now and again)	Rarely (infrequently)	Never	Not available in the classroom
Viber	○	○	○	○	○	○
iPad/Tablet Device	○	○	○	○	○	○
Document camera/Visualiser	○	○	○	○	○	○
Classroom 'clicker' system	○	○	○	○	○	○
ePortfolio (e.g. Mahara)	○	○	○	○	○	○
Virtual Learning Environment (e.g. Moodle)	○	○	○	○	○	○
Attendance management system - entering data	○	○	○	○	○	○
Grade management system - entering students' exam results	○	○	○	○	○	○
Drill/Practice websites	○	○	○	○	○	○
Data Logger	○	○	○	○	○	○

3. Did you use any 'other' technologies while on school placement, that are not mentioned here?

Use of Technology while on School Placement

3. How you used technology for teaching and learning in the school placement classroom

4. Please state HOW you used technology, while on your recent school placement?

	Very often (a few times a day)	Often (once a day)	Sometimes (now and again)	Rarely (infrequently)	Never	Not available in the classroom
Looked for material online to help you create/prepare lesson plans	○	○	○	○	○	○
Used applications to prepare presentations for lessons (e.g. PowerPoint; Word; Prezi)	○	○	○	○	○	○
Prepared exercises and tasks for students (non-digital e.g. paper handouts)	○	○	○	○	○	○
Teacher-student communication (response to written work, posting homework)	○	○	○	○	○	○
Teacher- parent communication (email, class webpage)	○	○	○	○	○	○
Created my own digital learning materials for students (e.g. Webquests or 'other' requiring online interaction)	○	○	○	○	○	○
Downloaded/uploaded/browsed material from the school's website or VLE	○	○	○	○	○	○
Downloaded/browsed material from MIE's VLE/website	○	○	○	○	○	○
Demonstrated science and other experiments	○	○	○	○	○	○
Used the school's record keeping system(grades/attendance etc.)	○	○	○	○	○	○

	Very often (a few times a day)	Often (once a day)	Sometimes (now and again)	Rarely (infrequently)	Never	Not available in the classroom
Used broadcasting tools (e.g. published a podcast/uploaded a video to YouTube)	○	○	○	○	○	○
Used data logging tools (e.g.temperature rise)	○	○	○	○	○	○
Used digital books/textbooks (e.g. Folens, Ed Co etc.)	○	○	○	○	○	○
Used multimedia production tools (video editing/digital recording)	○	○	○	○	○	○
Used digital learning games/video games for education (e.g. drill & practice, WordShark)	○	○	○	○	○	○
Looked online for the latest research in subjects I was teaching during school placement (e.g. EBSCO, Google Scholar)	○	○	○	○	○	○
Used social networking (Twitter) to exchange ideas with my class colleagues while on school placement	○	○	○	○	○	○
Used social networking (Facebook) to exchange ideas with my class colleagues during school placement	○	○	○	○	○	○
Used social networking (WhatsApp) to exchange ideas with my class colleagues during school placement	○	○	○	○	○	○

5. Did you use technology in any OTHER ways, that are not mentioned here?
If so, please be as specific as possible in your answer outlining 'what' technology was used and 'how' the technology was used.

Institiúid Oideachais MARINO Institute of Education

An Associated College of The University of Dublin, Trinity College

Use of Technology while on School Placement

4. Barriers, if any, experienced on School Placement

6. Please state your level of agreement with the following statements about your USE of technology on school placement:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Nothing prevented me using technology during school placement	○	○	○	○	○
The school did not expect me to use technology	○	○	○	○	○
I do not believe technology integration is useful in the primary classroom	○	○	○	○	○
I do not think technology fits my beliefs about teaching & learning	○	○	○	○	○
I have difficulty managing the classroom when students are on computers	○	○	○	○	○
I do not know how to use technology effectively	○	○	○	○	○
There was a lack of technical support in the school	○	○	○	○	○
I do not think technology is reliable	○	○	○	○	○
I do not know how to incorporate technology into curriculum subjects	○	○	○	○	○

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
There were no incentives to use technology	○	○	○	○	○
I had difficulty controlling what information students accessed online	○	○	○	○	○
I do not know how to assess students' work when they do it online	○	○	○	○	○
I do not have time to integrate technology into my teaching, while on school placement	○	○	○	○	○
There was a lack of access to technology in classrooms	○	○	○	○	○
The school computers were out of date/in need of repair	○	○	○	○	○
There was insufficient pedagogical support for teachers	○	○	○	○	○
There was a lack of adequate material/content for teaching available online	○	○	○	○	○
It was too difficult to integrate ICT into the curriculum	○	○	○	○	○
There are a lack of pedagogical models on how to use ICT for teaching	○	○	○	○	○
Most parents were not in favour of the use of ICT at school	○	○	○	○	○
Most teachers were not in favour of the use of ICT at school	○	○	○	○	○
Most supervisors were not in favour of the use of ICT during school placement	○	○	○	○	○

Were there any other reasons you could not use technology in the classroom, while on School Placement?

7. If you have any additional comments on your experience of using technology in the classroom, while on school placement, please feel free to add them here...

Appendix Three Interview Questions

Interview Questions – April 2015

Personal Use of Technology:

1. What type of technology (s) did you have at home growing up? Examples.

What did you use them for? Do you think this had an influence on your use of technology during your time in college? Please explain.

2. In a survey you completed in first year B.Ed, you were a *USER TYPE* – how would you describe your personal use of technology, now, nearly 3 years later?

Can you give examples of (personal) technologies you use now, that you didn't then? Name a few examples.

Use of Technology in Schools (while on School Placement):

3. Can you explain what types of technologies you have used in schools, while on your various School Placements?

What/How did you use these technologies?

4. What types of lessons did you teach using technology - examples?

Why did you use technology in the classroom – what was your motivation?

5. Do you think the schools you have been in were generally in favour of using technology? Explain.

Were the other teachers in the school using technology – how were they using technology?

6. When you used technology in the class – did you generally look for content on the web that was there already and share it with the class, or have you created/uploaded/shared your own content on the web?

Examples of this?

Attitude – self, school, supervisor:

7. How would you describe your own attitude (s) to technology?

What is your own attitude to technology in teaching/learning?

Does it differ (if it does – probe re. personal attitude and PEU/PU)

8. What would you describe as 'effective use' (tech integration) of technology in a classroom?

How confident are you that you know how to use (integrate) technology in the classroom? Example?

9. Generally speaking did you have enough resources and support to use technology effectively while on SP?

<u>Challenges of using technology – is it worth it?</u>

10. Did you face any challenges when trying to use technology in the classroom?

    What type of challenges or difficulties specifically did you face? How did you get around these challenges?

11. Do you think using technology is worth it – the effort?

    Why?

12. Was your SP supervisor in favour (supportive) of you using technology in the class?

    Was the class teacher in favour?

    Did they like/dislike technologies you used – do you have any examples?

<u>Models of good practice – where, college, school, other:</u>

13. Where have you learned about using technology in the classroom?

    Is it just from your course (Creative Technologies Bed2) in MIE or have you learned about using technology in a class from anywhere else?

14. Have you seen any other 'models' of good practice while in college?

    From other lecturers or modules? Or while out on School Placement, in the schools you were in? Anywhere else? During your own primary or post primary education?

End/.