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Examining digital natives: an investigation of university students' engagement with technology

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EXAMINING DIGITAL NATIVES:
AN INVESTIGATION OF UNIVERSITY STUDENTS' ENGAGEMENT WITH TECHNOLOGY

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CERTIFICATION

I, Linda Elizabeth Corrin, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Education, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

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Life can only be understood backwards; but it must be lived forwards.
~ Søren Kierkegaard

This quotation came to mind when I was thinking back over all the things I have learnt during my time as a PhD student – and all the things I wish I'd known when I started. This whole experience has been about so much more than just research. The two most significant people on this journey have been my supervisors, Associate Professor Sue Bennett and Professor Lori Lockyer. I am so grateful for all the guidance and advice they have given me. Their support and encouragement has been incredible, and highly appreciated.

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ABSTRACT

The expanding role of technology in supporting teaching and learning in higher education has prompted educators to consider how young people engage with technology across the multiple contexts of their lives. Early discussion of this topic was heavily influenced by generational assumptions, based primarily on anecdotal evidence. Labels such as 'digital natives' and the 'Net Generation' were used to refer to a generation of young people who were said to have a natural ability with and motivation to use technologies in all aspects of their lives (Prensky, 2001; Tapscott, 1998). Over time, the homogenous nature of this group was challenged by several large studies that found diversity in the patterns of students' access to and use of technology (Kennedy et al, 2006; Kvavik, Caruso & Morgan, 2004; Oliver & Goerke, 2007). From these findings, researchers advised caution in relying upon rhetoric about a set of common technology-related characteristics of this generation of students (Bennett, Maton & Kervin, 2008; Helsper & Eynon, 2009).

This study investigated how first year university students engage with technology in their everyday and academic lives with a view to informing learning and teaching practices in higher education. It examined the extent to which the patterns of technology use of university students reflect the notion of digital natives and how students select and adapt technologies to support their learning goals and strategies. It also considered how students' uses and preferences for particular technologies related to the identities they adopt in everyday and academic life contexts. The design of this research was informed by a theoretical framework incorporating theories of technology appropriation and identity to advance understanding of what motivates students to engage with technology.

A mixed methods approach was used to allow an in-depth examination of the diversity and complexity of students' technology-based activities. The research was conducted in two phases during the 2008 academic year. The first phase involved the administration of a survey of students' access to and use of technology across the contexts of their everyday lives and academic study to 470 students. This survey was used to identify trends and patterns of students' technology engagement and to identify participants with different levels of technology access, activities and ability for the second phase of the research. Phase 2 involved 14 case studies examining the nuances of participants' technology engagement in detail. Participants were first interviewed about their engagement with technology. They then took part in a three-week experience sampling method activity. During those three weeks, participants were prompted three times a day to record the

activity they were doing at that time and whether technology played a role in the activity. Then at the end of each day they were asked to complete ya short survey summarising all their daily technology-related activities. Observation of participants' online social networking activities was also undertaken throughout the three-week period. This was followed by a second interview which took place a week after the three-week experience sampling method activity during which they were asked to comment on their activities throughout the data collection period.

The research found that students engage with technology in their everyday and academic lives in very diverse ways, influenced by their lifestyles, personal interests, social priorities, career aspirations and personal values. The key differences were that for their everyday life students had developed for themselves a customised set of technology practices whereas in their academic lives they relied almost exclusively on technologies and practices directed by their instructors. and the requirements of their course. Participants were not found to be using technology in new or innovative ways to support their study, instead using technology to supplement common study practices. These findings suggest the need to move away from the assumptions inherent in the notion of digital natives, towards a more nuanced and sophisticated understanding of young people's technology use that moves beyond labels.

The findings from this research provide in-depth insights into the motivations and influences on the diverse range students' engagement with technology. While few previous studies have used theory in considering young people's technology use, this study used the theoretical constructs of technology appropriation and identity to provide new perspectives that extend the current knowledge in the area. The study also makes a methodological contribution to research in this area by demonstrating the usefulness of a mixed methods research design and to reduce reliance on retrospective, self-reported data and account for the dynamic nature of technology engagement by collecting data over time. The outcomes of this research provide evidence that can be used by teachers and administrators in higher education to support decisions about the effective integration of technology into teaching and learning practices.

CHAPTER 1

INTRODUCTION

Introduction

The impact of young people's engagement with technology on teaching and learning in higher education is a topic that has prompted a great deal of discussion in recent times. Much of this discussion has been framed by the notion of a homogeneous generation of young people who use technology in notably different ways than older people. Labelled 'digital natives' or the 'Net Generation', this group of young people were assumed to have a natural ability and motivation to adopt, understand and integrate technologies into all aspects of their lives, especially within their educational contexts. Over time, empirical evidence has emerged which challenges the assumption of the homogeneous nature of young people's technical competency and use of technology. Instead a diversity of technology attitudes, access and use has been observed. This evidence reinforced the views of those who recommended caution against relying on the rhetoric of generational generalisations as the basis for decision making about the role of technology in higher education (Bennett, Maton & Kervin, 2008; Helsper & Eynon, 2009).

The diversity of technology use found in large survey studies prompted suggestions for more in-depth research into the nature of young people's technology engagement to explore motivations, attitudes and adoption of technology across different contexts of their lives. A better understanding of students' perspectives on technology is needed to inform the development of policies and strategies for learning and teaching in higher education. This thesis presents an in-depth investigation of first year students' technology adoption and use at an Australian university. The study used a mixed methods approach which brought together methodological techniques from across the social sciences to build case studies of students' engagement with technology and education. These case studies provided detailed insights into the diversity of students' technology engagement across the contexts of their everyday lives and academic study.

Background and rationale for the study

In the late 1990s and early 2000s claims emerged about distinctive technology-related abilities and attitudes of the new generation of students entering education. These students were labelled 'digital natives' (Prensky, 2001), the 'Net Generation' (Tapscott,

1998) or ‘millenials’ (Howe & Strauss, 2000). Born in or after 1980, this generation were said to be unique because they had grown up immersed in technology. In addition to a high level of technological literacy, they were said to possess a set of common technology-related characteristics. These included an aptitude for multitasking, the need to be constantly connected, a willingness to share information, and a need for speed of information delivery (Barnes, Marateo & Ferris, 2007; Dede, 2005; Oblinger & Oblinger, 2006; Prensky, 2004).

The effectiveness of traditional teaching methods was questioned in light of these new attitudes and skills of the digital native generation (Tapscott, 1998). It was suggested that since young people made such extensive use of technology in their everyday lives, they required more technology in the classroom in order to be fully engaged.

> Students are clamouring for these technologies to be used as part of their education, in part because they are things that the students have already mastered and use in their daily lives, and in part because they realise just how useful they can be. (Prensky, 2007, p.41)

It was also suggested that teaching strategies needed to change in order to cater for this generation’s need for immediate information and preference for sharing and social networking. The claim was made that young people were forcing change in educational approaches from teacher-focused, instructional models of pedagogy towards student-focused, collaborative models (Tapscott, 2009).

Consequently, calls for radical change in education emerged, despite the lack of empirical evidence to support these original claims. The common-sense nature of the digital natives’ notion and the anecdotal evidence offered in the media and literature led many in higher education to push for a greater role for technology in the classroom (Dede, 2005; Gibbons, 2007; Palfrey & Gasser, 2008). The rhetoric around these claims created what Bennett, Maton and Kervin (2008) later labelled an academic form of ‘moral panic’. This occurs when a group in society is portrayed as posing a threat to societal values and norms. In the case of digital natives, the threat was to established approaches to teaching and student support across higher education. The idea that young people’s attitudes and behaviours were changing as a result of their exposure to technology spread rapidly throughout the higher education community.

In the mid-2000s questions began to arise about the homogeneous nature of this new generation. Several large survey-based studies of young people's engagement with technology showed a much more diverse picture (Brown & Czerniewicz, 2008; Lusoli & Miltgen, 2009; Kennedy et al, 2006; Kvavik, Caruso & Morgan, 2004; Nagler & Ebner, 2009; Oliver & Goerke, 2007; Schulmeister, 2010; Shao, Jones & Richardson, 2010). These studies found that while there was a high frequency of adoption of a few core technologies (e.g. mobile phones, desktop/laptop computers, Internet) there was significant diversity in the adoption of other technologies (e.g. electronic organisers). Diversity was also found in the range and frequency of technology-based activities undertaken in students' everyday life and as part of their studies. When examining the technologies students used in the educational context, limited examples were found of students adapting the technologies they used in their everyday lives to support their academic studies (Kennedy et al., 2007; Margaryan, Littlejohn & Vojt, 2011).

While these studies were useful in demonstrating general levels and patterns of technology access and use, several researchers recognised that more in-depth investigations were required in order to gain a better understanding of young people's motivations and engagement with technology (Fitzgerald, 2006; Hargittai, 2007). In particular, little was known about students' approaches to study and their adaption of technology to support their personal study processes. There were also questions about the accuracy of survey methods to adequately study the dynamic nature of technology use. As a result, calls were made for further studies incorporating qualitative data to provide more detail about the factors that influence young people's adoption and use of technology (Bennett, Maton & Kervin, 2008; Helsper & Eynon, 2009; Selwyn, 2009). It was in this context that the study in this thesis was developed.

Significance of the research

The effective integration of technology to support student engagement and learning is a significant challenge in higher education. It is important that decisions about technology use and implementation are informed by research. As Kennedy et al. (2008, p. 109) suggest "an evidence-based understanding of students' technological experiences is vital to informing higher education policy and practice". Initially the digital natives debate provoked extensive discussion and a multitude of anecdotal evidence, but few detailed empirical studies. Over time more empirical research has emerged from large scale surveys, but there is still a need for more detail in investigating the diversity of students'

technology practices. Specifically, more needs to be known about why students use technologies in the ways they do across different settings. In order to make informed choices about the role of technology in education, decision makers need to understand more about how students use technology and how technologies can add value to the educational environment. This study provides evidence that can be used by teachers and administrators in higher education to support decisions about the effective integration of technology into teaching and learning practices.

Despite substantial discussion and debate about digital natives as a new generation of learners, there is still little empirical evidence that specifically addresses student perspectives of adoption of technologies and their application to learning and teaching in university. Several studies have considered students' general ownership and use of technology, and their opinions to the use of specific technologies as part of evaluations. Few have considered the impact of context and identity on students' choices of technologies and the adaption of technologies between contexts. Specifically, there have been few studies investigating the differences between technology use in everyday and academic settings. Context and identity are important to study because they led to personalised patterns of technology engagement. The findings from this research provide an in-depth account of students' engagement with technology that goes beyond the scope of previous studies by identifying specific differences. It provides fresh insights into the motivations and influences on students' decision making and attitudes towards technology.

This study extends the current knowledge in the area by using theoretical constructs to provide new perspectives through which to consider young people's technology engagement. To date, few studies have used theory to facilitate new understandings of students' engagement with technology, despite suggestions from several researchers that the use of theory is necessary to move research in this area forward (Bennett & Maton, 2010; Jones & Czerniewicz, 2011). The theoretical framework used in the current study included theories of identity and technology appropriation. These theories were used to consider the personal and social influences on students' adoption and use of technology across the contexts of their lives. Technology appropriation was used to help us understand why young people choose particular technologies and particular functions of technologies, and the factors that influence whether they continue to use these technologies or disappropriate them. Identity theory was used to help us understand how young people use technology to support the different roles they adopt in society as well as

the ways that they portray themselves in online environments. Another contribution that this study makes is in the comparison of technology-based activities across contexts. Many studies have focused on particular activities with technologies in particular contexts, but few have investigated the same activities across students' everyday and academics lives. This approach provided insights into how students adapt technologies to different contexts. A better understanding of this process can inform strategies for supporting the use of technologies from students' everyday lives in educational activities.

The study also makes a methodological contribution by demonstrating the usefulness of a mixed methods approach to the investigation of technology adoption and use. To date there has been a heavy reliance on retrospective, self-reported data collected via survey methods. However, the reliability of these measures have since been questioned (Schwarz, 2007). This study employed methods that improved the quality of data through the triangulation of diverse sources. Most previous studies have only made use of surveys and interviews to collect data at a single point in time. As technology engagement is dynamic, it is difficult to gauge the type and extent of activity from only one point of data collection. Therefore methods that allow for observation of changes in technology engagement over time, across contexts, and in light of different life occasions and events were needed. The methodology adopted in this study explored technology use over time through the use of the modified experience sampling method over a three-week period. This was also combined with observations of participants' online activities via social networking sites and online discussion forums. This approach captured some of the natural variability in technology engagement, especially in relation to technology used in students' academic study as they completed classes, assignments and exams.

Purpose of the research

The purpose of this research was to investigate how first year university students engage with technology in their everyday and academic lives with a view to informing learning and teaching practices in higher education. First year students were chosen for this study as a large number of students could be accessed through the core first year subjects, providing participants from a range of disciplines and majors. A key goal of the research was to advance the basic understanding of students' technology use. The level of detail of the examination of students' technological experiences goes beyond that of other similar studies, collecting real-time data on participants' activities over a three-week period and combining this with observations of participants' online activities. The findings from the

study will add to the knowledge in the area of students' engagement with technology leading to practical advice for policy leaders and educators in higher education. This greater understanding can inform how teachers can make effective use of technology to support educational outcomes.

Research questions

The research was guided by three main research questions, each of which is discussed in detail as follows.

1. To what extent do the patterns of technology use of university students reflect the notion of digital natives?

This research question explores the reality of students' technology access and use in comparison with the many claims made about a new homogeneous generation of 'digital native' students. Previous studies had found a diversity of university students' access and use of technology (Kennedy et al., 2006; Kvavik et al., 2005; Oliver & Goerke, 2007). This question was designed to prompt further, more detailed exploration of the diversity of students' technology engagement.

2. How do students select and adapt technologies to suit their learning goals and strategies?

This research question examines the motivations and influences on students when selecting and adapting technologies to suit their learning goals and strategies. Students' learning goals and approaches to study were examined to get a better understanding of the role that technology plays in supporting their study. Students' comfort with the current level of technology incorporated into teaching and learning in their classes was explored and it was asked if they would like to see less, more or the same level in the future. The model of technology appropriation (Carroll, Howard, Vetere, Peck & Murphy, 2002) was used as a framework for exploring the factors that influenced students' decisions about their adoption and adaption of technology in their academic context.

3. How does students' use and preference for particular technologies relate to the identities they adopt in everyday and academic life contexts?

This research question examines the role of identity in influencing students' use and preference for technologies across the contexts of their lives. The choice of the variable of identity in this question was influenced by the theoretical framework of the study. In

particular, the need for a stronger perspective social influences that impact young people's appropriation of technology across the different contexts of their lives. Identity theory (Stryker & Burke, 2000) was used to provide a perspective on students' technology engagement that considers the multiple roles that people play in contemporary societies. Previous studies have found a reciprocal link between young people's use of technology and their identity (Turkle, 1984). Related to this connection is the concept that some young people may have multiple identities online increasing the complexity of their interactions with technology (Tapscott, 1998; Thurlow, Lengel & Tomic, 2004).

This research question is important in considering the influence of context on students' decisions to adopt and use technologies. It also supports the consideration of the various purposes for which students may use the same technology across different settings. In particular there was a focus on students' identity as a learner and how that related to their technology use. Previous studies had observed that young people who demonstrated a strong identity as a student were more likely to adopt and be comfortable with technology (Benson & Mekolichick, 2007). In this study the participants' identity as a learner was considered across formal and informal educational contexts.

Research design

In order to explore the diversity and complexity of students' technology engagement a mixed methods approach was used in this research study. The multiple methods made it possible to offset the gaps or weakness of one method with the strengths of others (Bryman, 2006). Combining methods also allowed the findings of one method to be confirmed or further explored by a subsequent method. The particular combination and timing of methods in this study was employed to address two main challenges of researching such a dynamic phenomenon. The first was to reduce reliance on the use of retrospective self-reported data, which has been recognised to impact data reliability (Schwarz, 2007). The second challenge was to enable the exploration of changes in technology engagement over a period of time.

The research was conducted in two phases during the second semester of the 2008 academic year. The design of the study and the relationship between the methods, analysis and research questions is represented in Figure 1 below. The first phase involved the administration of a survey to identify trends and patterns in first year students' access to and use of technology in their everyday lives and as part of their academic study. The survey was also used to select participants for the second phase of the research. Students

who filled in the survey were asked to indicate if they would be willing to participate in the next phase of the study and, if so, their data was included in an analysis from which a diverse range of participants were selected for Phase 2.

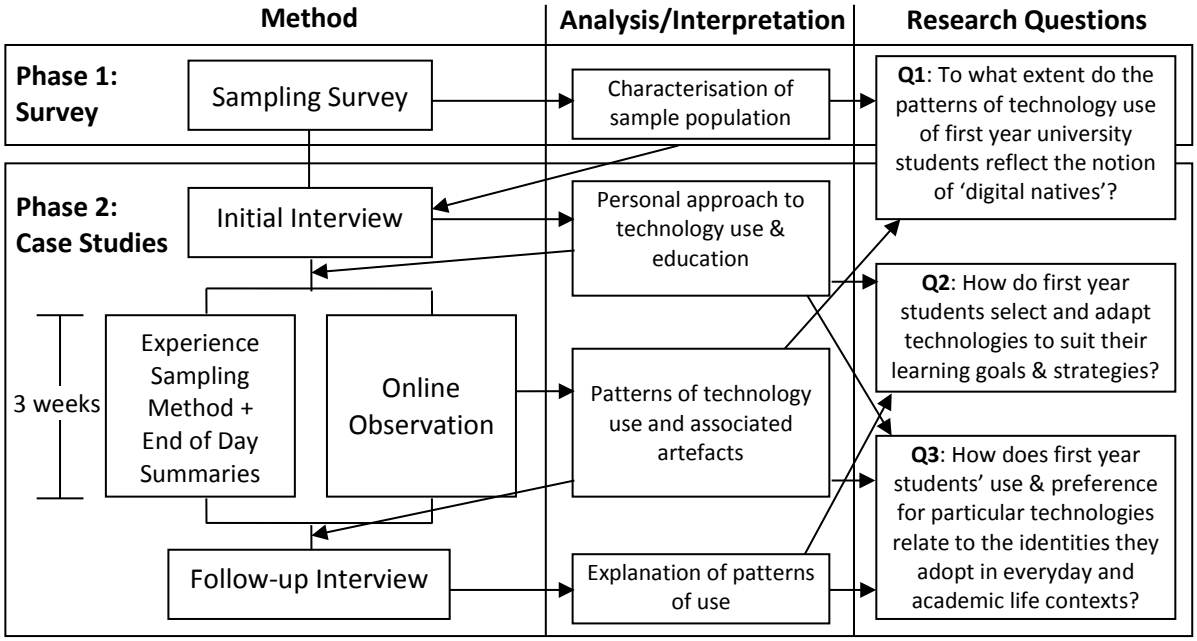

Figure 1: Overview of the methodological design

The design of the survey was guided by the findings of previous studies of digital natives (Kennedy et al., 2007; Trinder, Guiller, Margaryan, Littlejohn & Nicol, 2008) and collected data on students' access to technology, technology activities undertaken in everyday life, technology activities related to the students' academic study, and demographic data (see Appendix B: Sampling Survey). The demographic data was used to limit the sample to those students who reflected the profile of the typical first year student at the university in which the research was being conducted. The sample included full time, domestic students who were born in or after 1980. The age restriction was applied so that the participants fell within the age range specified by the literature on digital natives (Palfrey & Gasser, 2008; Tapscott, 1998).

A total of 547 students completed the survey and 470 of these students met the participant criteria, representing 16.5% of the university enrolment of students who met these criteria in 2008. Within this sample, 85.3% of respondents were born between 1988 and 1990 having just finished high school or entering university after taking a gap year. In terms of gender, the sample was made up of 64% females and 35.7% males. The distribution of faculties in which the students were enrolled was 44% Humanities and Social Sciences (Arts, Commerce, Creative Arts, Education and Law) and 56% Science

(Science, Informatics, and Health and Behavioural Sciences). When asked to self-rate their own ability with technology, 23.2% classified themselves as advance users of technology, 67% as intermediate, and 8.5% classified themselves as beginners.

Phase 2 of the study involved the development of multiple case studies of individual students' technology experiences which enabled within-case and cross-case analysis (Creswell, 1998). This phase took place in August/September 2008. A purposive sampling process was used to include participants who reflected the diversity of the population being investigated. Participants were chosen to represent different levels of technology access, activities and their self-rated ability with technology. To do this a selection matrix was developed comprising of gender, degree/faculty, living arrangements, travel time, level of ability, and averages of frequency of the technology access and activities fields. The data for the 130 volunteers for the second phase of the study were entered and 20 students approached to participate. Due to attrition during the data collection period, the total number of cases in the study was 14. Each case study was developed using several different research methods. Initially participants were interviewed to explore their technology access and use in more detail (see Appendix G: First Interview Protocol). These interviews were also used to investigate the participants' approaches to academic study and their motivation and influences in relation to their appropriation of new technologies.

The interviews were followed by a three-week modified experience sampling method (ESM) activity to examine students' everyday and academic activities. The participants were prompted via text message three times a day to record their activities and indicate whether they were using technology (for more detail see Chapter 3: Experience Sampling Method and Appendix H: ESM Booklet). At the end of each day participants were asked to complete a short End Of Day (EOD) survey which summarised their daily technology-related activities (e.g. the number of text messages they had sent, whether they had logged onto any social networking sites, etc.) (see Appendix H: ESM Booklet).

Concurrent to the ESM activity, participants' online activities were observed, with their explicit consent, including their use of social networking sites and participation on online discussion forums (see Appendix J: Online Observation Protocol). At the end of the three weeks, the participants were invited to a second interview where they were shown a summary of the data collected during the ESM/EOD/online observation period and asked to comment on their activities, especially any trends or anomalies (see Appendix K: Second Interview Protocol).

Each participant's data was analysed and case summaries constructed. Cross-case analysis was then undertaken to identify commonalities and differences in participants' engagement with technology in their everyday life and academic study contexts.

While the mixed methods approach provides many benefits to exploring students' engagement with technology, there were several challenges that were identified through using this approach. The combination of sequential and concurrent research methods created a complex data collection process that required strict coordination (Youngs & Piggot-Irvine, 2012). This approach was very time-consuming for the researcher. Another challenge arose from the use of a diverse range of data sources. The large amount of different forms of data made analysis more difficult, especially since the data could corroborate, complement or contradict itself between the different sources (DeCuir-Gunby, Marshall, & McCulloch, 2012).

Definitions used in this study

In the context of this study the following terms have been used:

Academic Study	In this research the phrase 'academic study' was defined as the environment in which young people learn as part of a formal degree qualification. It includes activities that are undertaken as part of learning tasks associated with students' degree program as well as personal study in preparation for assessments. It also includes informal learning about the topic of students' formal study.
Appropriation	In the context of this study 'appropriation' was defined as the way people select, explore and modify technology to become a part of their lives (Carroll, 2004).
Digital Native	It is common for digital natives to be defined primarily by their age which is said to imply a high level of digital literacy (Barnes, Marateo & Ferris, 2007; Prensky, 2001). Alternatively, some argue that there is significant variance in levels of digital ability among people of all ages and that instead digital natives should be defined by their levels of interest and use of technologies rather than their age (Dede, 2005; Siemens, 2007). For the purposes of this study, and in light of these two perspectives, digital natives are defined as

young people born in or after 1980 who display significant levels of interest and ability with technology and make use of technology across the multiple contexts of their lives. This definition does not assume that all young people are digital natives. The term 'digital native' is considered to be equivalent to other generational labels such as 'Net Generation' (Tapscott, 1998) or 'Millennial' (Howe & Strauss, 2000).

Everyday Life

In this study the phrase 'everyday life' is defined as the environments that are external to the educational environment. It encompasses home, work and social environments and includes the non-academic activities that take place in these environments. This definition differs from other studies of young people's technology use which consider learning activities that take place outside traditional educational settings (e.g. schools, universities, etc.) to be part of everyday life (Sefton-Green, 2004). For example, for the purposes of this study an activity where a student is using technology to study in a home, work or social environment is considered to be an academic study activity not an everyday life activity.

Identity

The definition of identity that was used in this study was: "parts of the self composed of the meaning that persons attach to the multiple roles they typically play in highly differentiated contemporary societies" (Stryker & Burke, 2000, p. 284). This definition covers both the social roles of the person in their physical social networks and the way that people create representations of themselves in online social environments. For example, a person's identity could relate to the social role of being a university student or being a member of a group of people pursuing a particular hobby. That same person could also have an identity in an online social environment that may reflect their real-world social roles (e.g. student, musician, etc.) or it could be a representation of themself that is quite different to the roles they play in other aspects of their social lives (e.g . portraying themselves as another gender, age or interest group).

Technology

Despite the large number of studies examining the use of technology in education, a common definition of what constitutes 'technology' in educational research remains unclear (Jones, 2012; Oliver, 2013). In other fields of research, it is argued that technology cannot be thought of as technical devices alone. Instead technology is considered to be a complex combination of social and technical factors including a means to fulfil a particular purpose, a human activity, an assemblage of practices, and a collection of devices and engineering practices (Arthur, 2009; Heidegger, 1993). For the purposes of this research it was necessary to provide the participants with a more simplified definition of technology to facilitate the practical exercise of data collection. Therefore 'technology' was used to refer to digital hardware, software and online services. While this definition doesn't adequately address the social aspects of technology, it provided clear guidance for the purpose of measuring access, appropriation and use.

Structure of the thesis

This thesis comprises a compilation of papers which present the main aspects of the research study. Each of these papers has either been published, is currently in review, or has been prepared for submission for review. The publication status of each paper is noted at the beginning of each chapter. Each paper was drafted by the first author and then reviewed by the other authors, with the exception of the paper in Chapter Six where the second author drafted the methodology section and the third author drafted the introduction section.

Chapter Two presents a review of the empirical literature published since the digital natives claims began to be critically questioned and the data for this study was collected. This paper examines the developments in empirical studies that explore the characteristics of digital natives over the last ten years and makes suggestions for the future direction of research in this area.

The methodology of the study is presented in Chapter Three. The chapter explores the use of a mixed methods approach to offer multiple perspectives on the diversity of students' experiences with technology to provide a more holistic and reliable picture of adoption, adaption and use.

This is followed in Chapter Four by an examination of the theoretical framework adopted in the study. The chapter outlines how the framework informed the design and analysis of the research, and considers the strengths and weakness of this approach in light of the research findings.

Chapter Five presents the findings from the first phase of the research study, the sampling survey. This chapter establishes the technological engagement patterns and trends of a first year university student population. It reconfirms findings from similar large survey-based studies of a wide diversity in students' adoption and use of technologies and the disparity of technology usage between everyday life and academic study contexts.

Findings from Phase Two of the research project are presented in chapters Six and Seven. Chapter Six presents an exploration of the common assumed characteristics of digital natives through a comparison of two student case studies. The detailed examination of these two cases emphasises the nuances of students' technology engagement even when their general behaviour would appear to be consistent with common digital natives' assumptions.

Chapter Seven presents eight student case studies to further explore the diversity of technology engagement in their everyday and academic lives. This chapter considers the diversity of students' motivations, attitudes and experiences and the implications for educators when using technology in the classroom.

The final chapter responds to the research questions of the study and considers the implications of the findings for the use of technology in higher education. Limitations to the study are outlined and suggestions made for future research.

In addition to the journal articles incorporated in the main thesis document, two further peer-reviewed conference papers have been included in the appendices. The first of these papers (Appendix L) presents a summary of the quantitative data collected through the sampling survey and explores the diversity of students' engagement with technology. This paper presents a more detailed history of the development of the generational assumptions relating to young students and technology. It contains a detailed look at the statistics from the survey that complements the findings presented in chapter Five. This paper was the first work from this study to be published and aimed to support calls in the

literature (Bennett et al., 2008; Helsper & Eynon, 2009) that generational assumptions should not be the primary driver for educational change in higher education.

The second paper (Appendix M) profiles a single student's technological engagement, exploring the diversity of their technological experience and highlighting the importance of investigating the motivations and influences behind students' technology adoption and use. This focus on a single case allowed a more in-depth presentation of the technology engagement of the student and facilitated a comparison of the student's behaviour to many of the assumptions that form the basis of the digital native notion. The findings in this paper prompted areas for further consideration which are addressed in chapters Six and Seven.

CHAPTER 2

QUESTIONING THE CHARACTERISTICS OF DIGITAL NATIVES: A REVIEW OF RESEARCH INTO UNIVERSITY STUDENTS' ENGAGEMENT WITH TECHNOLOGY

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Abstract

There have been many assumptions presented in the literature about young people's engagement with technology in everyday and academic contexts. This review of current literature explores the research into university students' adoption and use of technology in light of generational claims about young people's technological abilities. It considers the progress that has been made in the study of students' technology engagement since the claims about a generation of digital natives were questioned. The review investigates the extent to which the research has found patterns that reflect the alleged characteristics of digital natives as well as students' preferences for the use of technology in education. The findings indicate that students' patterns of technology use and educational preferences show greater diversity than is suggested by generational assumptions. The paper considers what the findings of these research studies mean for how we understand young people's technology engagement and the implications for how technology is integrated into higher education.

Introduction

In the mid-1990s observations about a technological disparity between young people and their teachers and parents began to emerge (Barlow, 1996). By the early 2000s these ideas had developed and become popularised, most notably by Prensky (2001) who called these young people 'digital natives' and Tapscott (1998) who labelled them the 'Net Generation'. The common foundation of these claims was the idea that because young people had grown up surrounded by contemporary digital technologies they shared a set of common technology-related characteristics. This paper presents a review of empirical literature that has since investigated technology use by university students to evaluate the veracity of the original claims.

As the role of technology to support teaching and learning practices expands in higher education, it is important that educators are able to base strategic and pedagogic decisions on empirical evidence of how young people engage with technology, rather than unsupported generational assumptions. This review of recent empirical studies provides insight into how the research agenda has progressed in this field including the significant findings that have emerged from this research and the implications of these finding for teaching and learning in higher education. In considering the findings of this research together, new directions for future research can be identified.

Summary of original claims about digital natives

The digital natives generation was said to include young people born in or after 1980, although the starting age varies across the literature from 1977 (Tapscott, 2009) to 1983 (Ramanau, Hosein, & Jones, 2010). The primary characteristic of young people in this age range was said to be a high level of digital literacy resulting from their life-long exposure to digital technology. Various other characteristics have been attributed to this generation over time including constant connectivity, a need for instant delivery of information, an aptitude for multitasking, and a culture of sharing (Barnes, Marateo, & Ferris, 2007; Dede, 2005; Frand, 2000; Oblinger & Oblinger, 2005; Prensky, 2001).

Most significantly, young people were said to have a different attitude towards education than previous generations. Prensky (2001) went as far as to claim a discontinuity existed between young people and the education system. He argued that "today's students think and process information fundamentally differently from their predecessors" (Prensky, 2001, p. 1), creating a barrier between 'digital native' students and their 'digital immigrant' teachers. Tapscott (2009) claimed that the Net Generation were forcing a change in pedagogical models from teacher-focused instruction to student-focused collaboration. Key to this educational change was said to be demands by students for more technology in the classroom, particularly the technologies that they had already mastered as part of their everyday lives (Prensky, 2007).

It was further proposed that greater use of technology was needed in education to support the radically different approaches to learning students had developed because of their exposure to and fluency in using technology (Palfrey & Gasser, 2008; Prensky, 2004; Tapscott, 1998). A raft of claims were made about young people's approach to learning including preferences for active and experimental learning, non-linear access to material, immediate access to information, multitasking, more social and collaborative methods of

learning, visual materials, and simulation and game-based activities (Dede, 2005; Howe & Strauss, 2000; Oblinger & Oblinger, 2005; Palfrey & Gasser, 2008; Prensky, 2001; Tapscott, 1998). Such claims about students' changing educational preferences influenced many of the subsequent calls for major change in the higher education (Dede, 2005; Gibbons, 2007; Tapscott, 1998).

Questioning the claims

Much of the early literature about the characteristics of the digital native generation was based on anecdotal observations. With the emergence of several large empirical studies of student technology ownership and engagement (Brown & Czerniewicz, 2008; Garcia & Qin, 2007; Kennedy et al., 2006; Kvavik, Caruso, & Morgan, 2004; Lusoli & Miltgen, 2009; Nagler & Ebner, 2009; Oliver & Goerke, 2007; Schulmeister, 2010; Shao, Jones & Richardson, 2010), a change in the direction of the digital natives debate occurred. There was now empirical evidence to challenge the idea of a homogeneous generation of highly digitally literate students. These studies found diversity in the patterns of students' access to and use of technology across the contexts of their lives. It was discovered that some technologies had a high level of adoption and use (e.g. mobile phones, laptops), while other technologies had low levels of adoption (e.g. PDAs, wikis). Several studies also compared technology engagement between digital natives and digital immigrants and found no significant difference between the two groups (Bullen, Morgan, & Qayyum, 2011; Waycott, Bennett, Kennedy, Dalgarno, & Gray, 2010). Moreover, these findings were common to all these studies, despite the fact that they were conducted across many different countries (including Australia, Austria, China, France, Germany, South Africa, UK, and the US). The substantial variation in technological engagement found in these studies suggests that categorisation of homogenous groups by age, or even by technological expertise, is flawed.

As the empirical evidence painted a much more diverse picture of young people's engagement with technology, the idea of a digital native generation began to be questioned in the literature. Bennett, Maton and Kervin (2008) raised a number of concerns over the validity of the digital natives concept and its uncritical acceptance by many in higher education. They likened the situation to a 'moral panic' in which sensationalised claims depicted the younger generation as a threat to societal values and norms, or more specifically, a threat to teaching practices in higher education. Helsper & Eynon (2009) echoed the call for a move away from rhetoric towards claims based on

empirical evidence. These articles were influential in directing inquiry away from studies of technology use towards research that could provide a more nuanced understanding of students' technology engagement (Bennett & Maton, 2010; Bullen, Morgan, & Qayyam, 2011).

As evidence of diversity in young people's technology engagement emerged, there was some evolution of the original ideas about digital natives. Prensky (2009, p. 1) acknowledged that as technology becomes a more significant part of life for people of all ages, "the distinction between digital natives and digital immigrants will become less relevant". Instead, he proposed that all people are capable of developing 'digital wisdom' through their interaction with technology. This notion aligns with the established idea that a digital divide has emerged separating people who have the skills and knowledge to use technology effectively from those who do not (Selwyn, 2004; Warschauer, 2002). This divide is thought to depend more on socio-economic status than on a person's age as a proxy for exposure to technology and thus digital literacy. Regardless of this more recent nuance, the idea of the digital native is still influential in the way young people's technology use is perceived.

Researchers have tried to reclassify the digital natives/immigrants into new groups based on technology use rather than age (Ferri et al., 2008; Green & Hannon, 2007; Kennedy et al, 2010; Morgan & Bullen, 2011; van den Beemt, Akkerman, & Simons, 2011; White & Le Cornu, 2011). Some have even attempted to resuscitate the digital natives/immigrants labels by adding new categories such as the 'digital settler' (Palfrey & Gasser, 2008). However, researchers have struggled to devise alternative classifications that accurately reflect the diversity of students' engagement with technology. This suggests that such an approach is not constructive in advancing our understanding of young people's technology use to inform teaching and learning practices.

This literature review critically analyses the empirical research into university students' adoption and use of technology since the claims about a generation of digital natives were questioned. The review investigates the extent to which this research has identified patterns that reflect the alleged characteristics of digital natives. In particular, it examines findings about students' preferences for the use of technology in education. After examining the empirical research conducted in this area, suggestions for the future direction of research into students' engagement with technology are presented.

Methodology

This literature review was guided by two research questions:

1. To what extent do the patterns of technology use by university students reflect the notion of the 'digital native'?

2. How do university students select and adapt technologies to suit their learning goals and strategies?

To address these questions, a search was conducted using the Scopus database to identify publications which reported on young people's engagement with technology. Scopus was chosen because it provides access to a significant number of peer-reviewed journals (19,500). The initial results were obtained by searching for articles containing the key phrases "digital natives" or "net generation". The abstract from each article was read and the following inclusion criteria applied:

a. The article reports on the results of an empirical research study. This criterion was applied to ensure claims made in the articles were supported by data.

b. The study was conducted in the context of higher education. The focus on university students provides access to a population the majority of which fall within the age range of the digital natives. Higher Education is also of interest as university graduates are likely to be future 'knowledge workers' and leaders in a world increasingly pervaded by digital technology. Furthermore, universities have become increasingly reliant on online technologies to support learning, providing scope to compare everyday and academic technology use.

c. The article was published in a peer-reviewed journal. The requirement of peer-review was used to ensure the quality of the publications included in the review.

d. The year of publication is 2004 or after. 2004 represents the year that large empirical studies began to emerge providing evidence challenging the idea of a homogenous generation (e.g. Kvavik, Caruso, & Morgan, 2004).

e. The research specifically examines the technology-related characteristics of students, rather than making a passing reference to the idea of digital natives or Net Generation. This criterion was applied to exclude studies that had uncritically used the notion of digital natives as the justification for a technological implementation in the classroom.

f. The study investigates students' technology use across several tools or contexts rather than a specific application to a specific context (e.g. the use of a blog in a particular learning activity). This criterion was applied in order to identify research that examined the technological use of students beyond a single task.

The initial search returned 630 articles. After the inclusion criteria had been applied this was reduced to 37. To address the first research question each article was read and findings related to the characteristics of the digital natives concept were analysed thematically. Findings relating to students' attitudes towards education and the ways they selected and adapted technologies to suit their learning goals and strategies were then analysed to address the second research question.

Results

Research question 1: To what extent do the patterns of technology use by university students reflect the notion of the 'digital native'?

Across all the empirical studies in this review various levels of diversity were found in students' ability and engagement with technology. Contrary to the claim of a homogenous generation who possess advanced technological skills, these studies identified variance in students' confidence, ability and approach with technology both in the contexts of their everyday lives and academic studies. Several studies observed that young people tended to use a fairly limited range of technologies (Freeman, 2010; Margaryan, Littlejohn, & Vojt, 2011; So, Choi, Lim, & Xiong, 2012; Thompson, 2013; Valtonen et al., 2011). One example found that young people tended to confine themselves to more mainstream technologies and tools such as instant messaging, email, computers and mobile phones, and had a limited knowledge of the application and potential uses of newer technologies such as many of those identified as Web 2.0 technologies (Oojorah & Udhin, 2012). The exception to this limited use of Web 2.0 technologies was a high use of social networking (Judd & Kennedy, 2010). Rather than using a wide variety of technology, young people were found to prefer specific applications for specific tasks or in specific contexts (van den Beemt et al., 2011).

Certain technologies such as computers, mobile phones, Internet access, and email are accessible by very high percentages of students examined in the research (Jones & Healing, 2010a; Kennedy, Gray, & Tse, 2008; Kennedy, Judd, Churchwood, Gray, & Krause, 2008; Thompson, 2013; Waycott et al., 2010). These statistics were fairly consistent for

countries such as Australia, the United Kingdom and the United States. In South Africa access to computers was lower, but nearly 100% of students owned and made substantial use of mobile phones (Brown & Czerniewicz, 2010; Thinyane, 2010). This high level of usage was attributed to the lower cost of purchase and Internet access on mobile devices in South Africa that enabled ownership across socio-economic groups. Over recent years it has been observed that the use of social networking tools is increasing along with a higher integration of technology in students' social lives in general (Ferri & Pozzali, 2012; Jones & Healing, 2010b; Judd & Kennedy, 2010).

However, high frequencies of access and use do not apply to all technologies. Across a number of studies the use of Web 2.0 technologies such as wikis, blogs and virtual worlds was found to be quite low (Jones, Ramanau, Cross, & Healing, 2010; Oojorah & Udhin, 2012; Thinyane, 2010). Similar low levels of usage were observed in relation to the creation of audio, video and websites (Hosein, Ramanau, & Jones, 2010). These results suggest that students do not adopt new technologies unless the technology aligns with their interests and needs. Some slight drops in the use of certain technologies were observed over time. For example, a study conducted over a five-year period observed a drop in the use of email as students switched to communication options made available through social networking services (Judd & Kennedy, 2010). Despite low levels of adoption overall, further drops in the use of blogs were found across a two-year study (Ferri & Pozzali, 2012). These trends indicate a lack of stability in use of technologies. As new alternatives become available (e.g. communication tools) or technologies no longer meet the interests or needs of young people (e.g. blogs), changes in usage occur.

Several studies explored the difference in technology engagement and attitudes towards education across age groups. Young digital natives are said to possess higher skills and preferences for technology than older 'digital immigrants' (Prensky, 2001). In the studies in this review there was a disparity in findings on the relationship between age and engagement with technology. Two studies found no significant difference in usage of technologies between students of different ages (Gros, Garcia & Escofet, 2012; Guo, Dobson, & Petrina, 2008). Another found that younger students (i.e. 25 years or younger) tended to use technology more for social purposes, whereas older students focused more on using technology for administrative and study-related tasks (Hosein et al., 2010). Several other studies found that there was a self-reported higher technological proficiency and positive attitude towards technology in younger students, but not enough to claim the existence of a homogenous generation (Salajan, Schonwetter, & Cleghorn, 2010; Jelfs &

Richardson, 2013; Jones et al., 2010). No evidence was found of a discontinuity in technology engagement around the age boundary between digital natives and immigrants (Jelfs & Richardson, 2013). The findings in these studies suggest that a student's age is not a reliable defining factor of their attitude towards and proficiency with technology.

The significance of the age of a generation of digital natives relates to the idea that young people born from 1980 onwards are assumed to have grown up surrounded by technologies. It is this ongoing exposure to technologies that is said to have resulted in young people's comfort with using technology in general, and to have driven students to demand the use of more technology in education (Prensky, 2007; Tapscott, 1998). This is another claim researchers have tested. Some studies found that students had not had universal access to technologies throughout their childhoods, raising doubts about the legitimacy of this characterisation of all young people's lives. For example, in the context of South Africa a significant proportion of students had limited access to many technologies as they were growing up (Brown & Czerniewicz, 2010), including one group who had virtually no access to technology as children. While this may not be surprising in a developing country, in Western nations socioeconomic status has been identified as a more significant influencing factor than age on exposure to technology and technological proficiency (Hargittai, 2010; Morris, 2011). Even when exposed to technology as children, students' may still possess a relatively superficial understanding of technology, especially new technologies (Jones & Healing, 2010a).

There have been a variety of findings relating to students' confidence and ability with technology in both everyday life and academic contexts. In addition to studies that found high (Ghaith, 2010) and low (Ferri & Pozzali, 2012) levels of confidence with technology, others found confidence levels varied depending on the task and the technology used (Jones et al., 2010; Jones & Healing, 2010a). Corresponding to levels of adoption, students were found to be highly proficient when using mainstream technologies (e.g. email, word processing), but less so with 'Web 2.0' technologies (e.g. wikis, blogs)(Ng, 2012). There is also some question about the gap between students' perception of their own technological ability and their actual, demonstrated skill (Gros et al., 2012; Guo et al., 2008). Gros et al. (2012, p. 207) observed, "although most university students have a basic set of technological abilities, these do not necessarily translate into sophisticated skills in the use of other technologies or information literacy in general". This suggests that claims of high levels of technical literacy across multiple media commonly found in the literature on digital natives exaggerates the technology competencies of young people.

Several of the studies in this review considered the validity of claims about very specific characteristics of the digital native generation. A study of students' preferences towards multitasking found levels of multitasking were much lower that the rhetoric around digital natives implies (Judd & Kennedy, 2011). In another study of multitasking behaviour, it was found that there were a variety of levels of multitasking and that students who multitasked using social networking technologies tended to have lower academic performance (Kirschner & Karpinski, 2010). Members of the digital native generation are often said to be involved in the creation and sharing of content online, but little evidence of this was found across several studies (Ferri & Pozzali, 2012; Freeman, 2010). Young people's attitude towards gaming was also examined, but no unified preference for gaming was found (van den Beemt et al., 2011; Bekebrede et al., 2011). These studies demonstrate that while many students make use of these technologies to varying degrees for a variety of purposes, adoption is not universal.

In summary, the studies in this review show that the patterns of students' technology engagement are not consistent with those proposed by the notion of digital natives. While a high frequency of use and high levels of confidence with some mainstream technologies were observed, other technologies still showed low levels of adoption. There was little evidence to support the argument that young people's exposure to and use of technology throughout their lives places them within a homogeneous generation of highly adept technology users. Instead, the research shows variance in access, exposure, confidence and skills among young people who are studying at university.

Research question 2: How do university students select and adapt technologies to suit their learning goals and strategies?

A key characteristic of the digital native generation is said to be their unique attitude towards education (Tapscott, 1998; Prensky, 2001). Specifically, the claim has been made that young people learn in different ways as a result of their exposure to technology. The studies analysed in this review found no evidence of a radically different approach to learning among young students (Bekebrede et al., 2011; Ellis et al., 2012). Instead, it was found that students still preferred more conventional forms of learning (Margaryan et al., 2011). It was also found that, despite the flexibility offered by mobile technologies, students still tended to study in the same kinds of learning spaces that they did ten years before (Jones & Healing, 2010b). A study of student teachers' preferences for incorporating technology into the classroom found that students did not create new and

innovative ways of using technology, rather they added technology to familiar learning methods (Valtonen et al., 2011).

Differences in learning approaches between younger and older students have also been investigated. In one online course, older students were found to possess higher knowledge application skills and to be more socially reliant in learning activities (Ransdell, Kent, Gaillard-Kenney, & Long, 2011). Another study of online students found that older students tended to adopt a deeper, more strategic approach to learning (Jelfs & Richardson, 2013). In both of these studies the differences in learning approaches were attributed to differences in motivation to study. This maturity means that older students were able to bring more work and social experiences to compensate for any lack of digital skills (Ransdell et al., 2011). However, beyond the differences in motivations to study, these studies did not find evidence to support the assumption that younger university students learn in new ways related to technology exposure.

Several studies found that students' views of the role of technology in education were influenced by the discipline and the teaching approaches used in a course (Margaryan et al., 2011; Ellis et al., 2012). In the case of teacher education students, the teaching approaches of academic staff were found to have more influence on their adoption of technology in the classroom than the frequency with which they used technology in their personal lives (So et al., 2012). Whether the mode of study was face to face or online was also found to influence technology use and preference (Jones & Healing, 2010a; Jones et al., 2010; Ellis et al., 2012). These findings suggest that students' attitudes towards technology in education are not a direct result of their general technological experiences. Rather, their attitudes are influenced by various factors inherent in the educational contexts in which they study.

The choice of technology students make to support their studies was found to be heavily influenced by the requirements of their course/degree. Students were found to regularly access their university's learning management system and to use other technologies provided by the institution (e.g. email, library services) (Kennedy et al., 2008; Margaryan et al., 2011). Not only did students mainly used the technologies required by the course, they also used these technologies more than was required (Jones et al., 2010). When asked to indicate the usefulness of technologies to learning, a correlation was found between what teachers recommended students use and what students considered most useful (Gros et al., 2012). Contrary to the assumption that students' educational use of

technology is driven by their use of technology in their everyday lives, these studies found that students regularly adapt technologies suggested by their teachers to support their learning needs.

Across the studies in the review there was little evidence of students adopting the technologies they use as part of their everyday lives in their academic studies. As Kennedy et al. (2008) stated, "clearly we cannot assume that being a member of the 'Net Generation' is synonymous with knowing how to employ technology-based tools strategically to optimise learning experiences in university settings" (p.118). Several studies observed students' lack of understanding of the functionality that technology could offer to support their learning (Margaryan et al., 2011; Ng, 2012; Valtonen et al., 2011). In the context of teacher education it was found that students struggled to link their pedagogical and technological knowledge (So et al., 2012; Valtonen et al., 2011). Evidence was presented in several studies that many students prefer to keep their educational and personal technologies separate, especially in the case of social networking (Ferri & Pozzali, 2012; Gros et al., 2012; Morris, 2011). The challenge for students was balancing the desire to keep their technology-related personal and educational lives separate against the convenience and flexibility that integrating technology across contexts can offer (Waycott et al., 2010). These findings challenge the assumptions about students' abilities to intuitively transfer their technological skills across different contexts.

Another common claim about digital natives is that they are demanding more technology in the classroom (Prensky, 2001; Tapscott, 1998). While there was no evidence to support such a claim in the studies reviewed, there were studies in which some students were open to the use of more technology. Preferences for more technology in the classroom were found to vary between disciplines (Buzzard, Crittenden, Crittenden, & McCarty, 2011). For example, a study of medical students found that approximately half of students surveyed thought that the introduction of blogs, wikis and chat could be useful to their learning (Sandars & Morrison, 2007). Variations in preferences were also found in different country contexts. In a South African study, a high percentage of students thought that the use of mobile phones to support the administrative side of learning (e.g. delivering grades, accessing university services and receiving course alerts) would be useful (Thinyane, 2010). While specific examples such as these were observed, generally the studies in this review did not find the kind of demands for new technology in teaching and learning that the digital native rhetoric suggests.

Overall, the ways in which university students adapted their use of technology to support their learning were heavily influenced by the requirements of the course, teaching approaches and mode of study, rather than the students' general usage of technology. Little evidence was found for the assumption that students are demanding a greater role for technology in education, nor was there evidence of the radically different approaches to learning often cited in the literature. Instead, students were found to value technologies that enabled efficient completion of learning tasks, and most were happy to be guided by teachers' choices rather than seeking out and trialling new technologies for these purposes.

Discussion

This review of empirical research has shown that higher education students' engagement with technology does not fit neatly with the generational assumptions proposed by the literature on digital natives (Dede, 2005; Prensky, 2001; Tapscott, 1998). Instead these studies demonstrated a significant diversity in attitudes towards and use of technology, both in students' everyday lives and in their use of technology in education. Investigation of students' technology access and use has now been replicated across multiple environments, with similar patterns of diversity found. The challenge for research in this area is to explore this diversity in ways that can provide useful recommendations for educational practice.

The patterns relating to access to technology across the studies have shown that several mainstream technologies have very high levels of access (e.g. computers and mobile phones) (Jones & Healing, 2010a; Kennedy, Gray & Tse, 2008; Kennedy et al., 2008; Thompson, 2013; Waycott et al., 2010). When the claims about digital natives first emerged the functionality students could utilise depended largely on the range of technologies to which they had access (e.g. camera, GPS, PDA, games console, etc.). However, more devices now have multiple functions. This allows greater flexibility in how technologies can be used in different situations. Young people are using the same tool in different ways and particular subsets of technology for specific purposes (Corrin, Bennett, & Lockyer, 2013). This trend has implications for the future direction of research into students' technology engagement, suggesting that the emphasis needs to shift from access to technology towards understanding more about the activities that these technologies enable. A greater understanding of these activities through research that focuses on actual

use rather than self-reported data can provide important insights into how technology could be adopted and used more effectively in education.

The ways in which young people use technology as part of their lives is a result of a variety of influences. The generational arguments on which the digital native idea is founded suggest that a person's age determines their attitude towards and ability with technology. The research conducted since shows that this is an overly simplistic view of technology engagement. Instead, many of the age-related differences that have been found in technology use can be better attributed to differences in life stage, rather than age (Waycott et al., 2010). For example, older students tend to have different motivations for studying because they often have work and/or family commitments that impact their study practices and the time they have to engage with technology in comparison with their younger counterparts.

While socio-economic differences are no longer as profound in determining access to technology, research has shown they still have an effect on the ways people engage with technology and the exposure they have had to different technology-based activities over their lives (Hargittai, 2010; Morris, 2011). This new form of the 'digital divide' has significant implications on the information and technology-related skills that students bring to education (Selwyn, 2010). Differences in technology access and use between developing countries, such as South Africa, and developed countries such as Australia, the United Kingdom and the United States show the impact of economics and infrastructure on the technology choices of students (Brown & Czerniewicz, 2010; Thinyane, 2010). These factors suggest that the influences on students' technology use cannot be reduced to simple generalisations. There are important lessons that can be learned from these complexities that can inform how technology is implemented and supported in different educational environments.

The importance of context on students' use of technology is increasingly demonstrated in the research (Bennett & Maton, 2010). Early claims about digital natives assumed that students want more engagement with technology regardless of the context (Prensky, 2001; Tapscott, 1998). However, recent empirical studies have found that technology use varies considerably between contexts and that students often make conscious decisions to adjust their technology according to the contexts in which they engage (Ferri & Pozzali, 2012; Gros et al., 2012; Morris, 2011). This is most commonly observed in relation to the use of social networking and communication tools about which students expressed a

desire to keep their personal and academic communication separate (Dahlstrom, 2012). This presents a challenge to educators to balance these preferences for separation with the reach and functionality such tools may provide for educational activities.

In contrast to the high levels of diversity observed in the use of technology across students' everyday life activities, less variation has been found in the ways that students engage with technologies as part of their academic studies. Students' choices about technology have been found to be heavily influenced by the requirements of their courses and the technologies recommended by teachers (Jones et al., 2010; Kennedy et al., 2008; Margaryan et al., 2011). This suggests that students take a pragmatic approach when selecting technologies that will assist them to complete their academic tasks as required. It has been observed that students often lack the pedagogical knowledge to make innovative choices about technology to support their learning (Margaryan et al., 2011; Valtonen et al., 2011). This raises questions about whether universities should provide greater support for the development of technology-supported learning strategies in addition to discipline knowledge to aid students' choices of study methods and tools.

A common recommendation arising from many of the research studies in this review was to increase the level of support for digital literacy within the learning environment (Gros et al., 2012; Ismail, 2010; Nasah, DaCosta, Kinsell, & Seok, 2010; Ng, 2012; Thompson, 2013; Waycott et al., 2010). In some studies the need for support to use certain technologies in the context of particular learning activities was requested by the students (Buzzard et al., 2011; Toliver, 2011). Support for using emerging technologies was recommended, especially in building the kinds of technological skills that could be useful to the students' future professional careers (Kennedy, Gray & Tse, 2008). However, in order to be able to provide this support, teachers also need training and support to develop their own technological literacy (Ng, 2012). What is not clear from the research to date is the form that this support for the development of students' technological skills should take, and the best time for it to be provided. This is complicated further by the need to cater for a population of students with diverse experiences and skills and, therefore, diverse support needs.

The studies in this review provide insights into the patterns of technology use amongst students in varying levels of detail and context. They highlight the diversity of students' engagement with technology and provide suggestions for the use of technology in the classroom. However, there is still much that we do not know about this issue.

Limitations to the review

As inclusion criteria were applied to the studies of young people's technology engagement to clearly define the scope of this review, several limitations result. The review focused on young adults who were university students. As not all young adults attend university, conclusions cannot be drawn from this analysis to apply to young adults generally. The focus on university students, in particular, means that participants are more likely to be from higher socio-economic sections of society (Bradley, Noonan, Nugent, & Scales, 2008) and so not representative of the broader population.

In order to situate this analysis in the context of the discussion about digital natives, the search criteria was set as those publications which included the terms 'digital natives' or 'Net Generation'. In doing so, this excluded many studies that examined students' engagement with technology and approaches to learning that did not make specific reference to the digital natives/Net Generation discussion. This means that there may be additional research on specific characteristics of higher education students' engagement with technology which have not been captured in this review.

A focus of this literature review was on students and technology use in the context of higher education and the literature was limited to studies in this context. However, there are many other contexts in which interesting studies of technology use are occurring (e.g. school education, vocational training, professional learning, marketing, etc.) the outcomes of which could inform how technology is used in higher education. While an examination of this research was outside the scope of this review, further research could examine how the lessons learned in these other contexts could be applied in the higher education environment.

Suggestions for future research

While research on this topic to date has provided an empirical basis to dispel assumptions about a homogeneous generation of technologically adept students, there are still many aspects of young people's technology engagement that require further research. The role of context on young people's technology engagement requires further research to examine in greater detail the influence of different contexts on the way people adapt their suite of personal technologies for activities in different situations (Bennett & Maton, 2011). The development of digital literacy is also an area for further study to consider the skills young people currently have and those that they will require to facilitate lifelong learning and

effective use of technology in the workplace (Beetham, 2012). The relationship between the technologies that young people are using in the workplace and their everyday lives is also an area where there has been limited research to date.

To facilitate further exploration of the detail of young people's engagement with technology a more theoretically informed approach with greater use of qualitative or mixed methodologies is needed. In this review around 70% of the studies were based on survey research alone. While surveys are useful to observe patterns and trends in technology engagement, further exploration of the detail of the diversity of students' technology use requires methods that are able to manage the complexity of students' motivations, influences, contexts and activities (Bennett & Maton, 2010; Kirschner & Karpinski, 2010). As technology use is constantly changing, methods that allow for collection of data over time are needed to improve our understanding of the factors which influence technology engagement and their implications for education.

Conclusion

A better understanding of students' engagement with technology is essential to support the effective implementation of technology in higher education. New technology-based initiatives, such as Massive Open Online Courses (MOOCs) and students bringing their own devices to campus (BYOD), raise many questions about how well prepared students are to engage with technology to support their learning. The research analysed in this review suggests that while some students would be equipped with the requisite skills to engage with these new trends, others are likely to require significant additional support. Empirical studies of students' engagement with technology have provided evidence which questions the validity of many of the generational claims about young people's attitudes towards technology and education. However, there are still many aspects of students' technological engagement that require greater understanding. Future research is needed to understand more about the ongoing technological decisions young people make in regards to the technologies they use, to inform effective integration of technology in teaching and learning in higher education.

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CHAPTER 3

A MIXED METHODS APPROACH TO INVESTIGATING UNIVERSITY STUDENTS' TECHNOLOGY EXPERIENCES AND PRACTICES IN EVERYDAY AND ACADEMIC CONTEXTS

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Abstract

The study of young people's engagement with technology is challenging due to the diversity and fluidity of their technology-based activities. Recent studies have demonstrated diversity of technological adeptness and experience, but are limited by their reliance on participants' accurate recall of their activities and the inability to explore changes in technology use over time. This paper reports on a mixed methods approach that employs multiple methods of data collection customised to the particular technological activities of the participants. Incorporating methods originating across disciplines, the methodology is also innovative in its ability to provide multiple perspectives on a diverse and dynamic phenomenon while addressing issues associated with retrospective self-reported data and the study of ongoing practice.

Introduction

The complex and dynamic nature of young people's adoption and use of technology make it a difficult phenomenon to research. Recent studies have found diversity in attitudes towards and uses of technology by young people participating in higher education (Garcia & Qin, 2007; Kennedy et al., 2007). These findings challenge popular claims about the universal technology-savvy characteristics of the current generation of students. However, to date, many of these studies have relied almost exclusively on retrospective self-reported data. Also as data is often only collected at one point in time, changes in technology use over time are not effectively captured. These weaknesses in current research approaches have prompted calls for a higher level sophistication in the design of research into students' technology use (Bennett & Maton, 2010; Helsper & Eynon, 2009).

This paper reports on a mixed methods approach to investigating first year university students' everyday and academic engagement with technology at an Australian university. The combination of a survey, interviews, a modified experience sampling method (ESM) and observation of online activities enabled investigation of students' motivations and influences on technology engagement as well as their actual use and concurrent activity. This study demonstrates the benefits of using a mixed methods approach to research this phenomenon. In particular this approach improves the reliability of self-reported data through the triangulation of diverse data sources and provides a way to examine continuous phenomena. The approach also allows for a deeper understanding of students' perspectives on technology, providing educators with a more realistic and holistic basis upon which to base pedagogic decisions.

Researching Digital Natives

Generalisations about the advanced technological characteristics of students entering higher education have been used to promote arguments for greater adoption of technology in the classroom. These students, often referred to as 'digital natives' (Prensky, 2001) or members of the 'Net Generation' (Tapscott, 1998) were born in or after 1980. They are said to exhibit high levels of technical literacy, an innate ability to multitask, an inclination for sharing information online, a preference for constant online connectivity and a unique attitude towards education (Barnes, Marateo & Ferris, 2007; Dede, 2005; Frand, 2000; Oblinger & Oblinger, 2005; Prensky, 2004). However, the lack of empirical evidence for these purported characteristics has prompted researchers to caution against reliance on rhetoric or anecdotal evidence as a basis of educational change (Bennett, Maton & Kervin, 2008; Bullen, Morgan, Belfer & Qayyum, 2009; Helsper & Eynon, 2009).

To address this evidence gap several studies examined students' technology use via survey methods (Garcia & Qin, 2007; Kennedy et al., 2007; Kvavik, Caruso, & Morgan, 2004; Schulmeister, 2010; Shao, Jones & Richardson, 2010). Findings from this research suggested that, while technology ownership and use is increasing, the homogeneity of this generation's attitude towards technology cannot be assumed. Instead, the studies showed that the technological characteristics of this generation are highly diverse (Bullen, Morgan & Qayyum, 2011). However, while surveys were useful in exploring students' self-reported rates of technology ownership, access and common technology-based activities, they did not capture the complexity and fluidity of these activities and the motivations for adoption and adaption of technology in students' everyday and academic lives.

Questions have also been raised about the utility of surveys as the primary means to capture information about technology use due to the lack of a shared language around technology and significant changes in technology use over relatively short time periods (Corrin, Lockyer & Bennett, 2010). The recall issues inherent in retrospective self-reported data also impact data reliability with respect to scale use, social desirability and question comprehension (Schwarz, 2007). This response bias was observed in Collopy's (1996) study of computer usage which found that infrequent technology users tended to overestimate their usage, whilst high frequency users underestimated theirs. These shortcomings in the survey method suggest that a mixed approach incorporating substantive qualitative methods to broaden the type of data collected will provide the opportunity to explore student adoption and adaption of technology in greater depth.

Recently, several studies have emerged that have adopted other data collection methods to gain a more in-depth view of students' technology use. In a United Kingdom study of students' location when using networked technologies, participants were required to record their responses to questions about technology use periodically over the period of 24 hours, either by video or on paper, in combination with survey and interview techniques (Jones & Healing, 2010). In South Africa, Czerniewicz and Brown (2010) combined large surveys with interviews and focus groups to develop cases exploring the technology use of students. In an Australian study, Waycott and colleagues (2010) used student focus groups, designed to complement findings from large scale studies, to provide explanations for reported patterns in student technology use. All of these studies contribute to a deeper understanding of this phenomenon by exploring the motivations and influences behind the most common findings as established in previous survey-based studies.

The next section of the paper provides a brief overview of the research design, with subsequent descriptions of each method in detail. This is followed by a discussion of the advantages and opportunities afforded by this combination of methods and what this can offer for future studies in this area.

A Mixed Methods Approach

The use of mixed methods for investigating the concept of digital natives expands possibilities for obtaining more reliable and detailed perspectives of how and why students use technology. Mixed methods research involves the combination of qualitative and quantitative approaches in research design and analysis to provide a greater

understanding of the research focus (Creswell & Plano Clark, 2007). In particular, mixed methods research provides multiple ways of seeing, hearing and making sense of the world (Greene, 2007). Due to the complexity and fluidity of students' technology-based activities across the contexts of their lives, the ability to look at students' experiences from multiple perspectives over time is an important element of the study's research design. Other benefits of the mixed methods research approach include the ability to triangulate data to corroborate results between methods, the complementarity of data sources to enable elaboration and illustration, and the development of methods based on the findings of previous methods (Greene, Caracelli & Graham, 1989).

The purpose of the study was to examine students' technology engagement across the contexts of their everyday life and academic study. The study sought to answer the following research questions:

1. To what extent do the patterns of technology use of first year university students reflect the notion of digital natives?
2. How do first year students select and adapt technologies to suit their learning goals and strategies?
3. How does first year students' use and preference for particular technologies relate to the identities they adopt in everyday and academic life contexts?

The research was framed by theoretical constructs derived from Carroll, Howard, Vetere, Peck and Murphy's (2002) model of technology appropriation and Benson and Mekolichick's (2007) identity measures informing both the methodological design and data analysis. Theories on the appropriation of technology provided perspectives on which technologies students adopt, their processes of choice, and the adaption that takes place to mould a technology to the user's everyday and academic needs. While most studies of technology appropriation focus on the use of a single technology in a particular context, this study applied these factors of appropriation to students' use of multiple technologies across different contexts of their lives. This different perspective was also used to identify additional influencing factors not included in the model of technology appropriation. This model was combined with an examination of the identity students adopt when using certain technologies. Theories of identity provide a useful perspective through which to examine the distinction and relationship between how students adopt and use technology across the different contexts of their lives. In particular, the use of identity facilitated a more in-depth examination of the social factors that influence students' technology use.

The combination of methods was used to develop individual case studies of first year university students' engagement with technology. The case study approach enabled a comprehensive exploration of this phenomenon with each case providing a unique snapshot of the student's technological lifestyles. The use of multiple cases allowed for within-case and cross-case analysis (Creswell, 1998) so comparisons could be made between the technology-related activities of the participants. Multiple cases are considered to be most appropriate when it is predicted that results between cases may vary (Robson, 2002). The variance in ownership and use of technology apparent in previous studies of digital natives (Kennedy et al., 2007; Margaryan, Littlejohn, & Vojt, 2011; Oliver & Goerke, 2007) indicated that this method was suitable in this study.

This study's methodological design comprises the data collection, analysis and integration sequence shown in Figure 2.

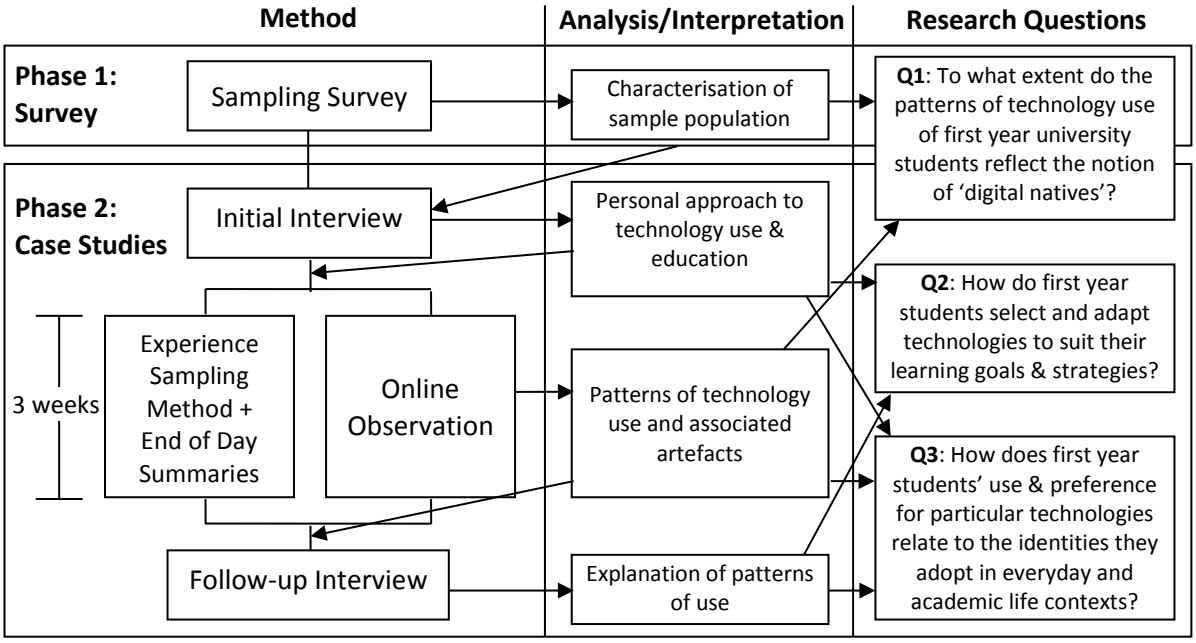

Figure 2: Methodological design

The study consisted of two phases and was conducted in the second semester of the 2008 academic year. Multiphase combination timing (Creswell & Plano Clark, 2007) was used in the research design to facilitate the order of data collected and analysed. In this approach the research study consists of multiple stages, with each stage involving sequential and/or concurrent research methods. The first phase involved the administration of a survey to gather information about the target population and to identify potential participants for the second phase. The sample was drawn from first-year students at the University of Wollongong (UOW), a regional university 80 kilometres south of Sydney. In addition to

being a convenience sample, this university was considered a good focus for this study due to the wide range of students from different academic and socio-economic backgrounds. The diverse profile of students at the university represents many different mixtures of living arrangements, employment statuses, and involvement in extra-curricular activities.

The second phase employed several methods to develop case studies of individual participants' technology experiences. In this phase a purposive sampling procedure was used to include a variety of participants reflecting the diversity of the population being investigated. Each case study began with an initial interview which served the purpose of further exploring the participants' responses from the survey and also informing the design of aspects of the later research methods.

Participants then took part in a three-week modified experience sampling method (ESM) activity during which they were prompted three times a day to report on their activities and to indicate whether, as part of their activities, they were using technology. At the end of each day participants filled in an End Of Day (EOD) summary of their technology-based activities for the day (including the number of emails/text messages sent, whether the participant had logged onto social networking sites, etc.). Concurrent to the ESM activity was the observation of participants' online activities, such as their use of social networking sites or posting of communications on discussion forums. At the end of the three-week period the participants were invited to a follow-up interview during which they were shown the data collected during the ESM/EOD and online observations, and asked to comment on any trends or anomalies.

The adoption of a mixed methods approach provides a number of advantages to the research design. The complexity of students' lives means that no one method can capture all the data required to form a useful understanding. The use of multiple methods also allows the offsetting of the weaknesses of one method with the strengths of others (Bryman, 2006). For example, the interviews were used to collect data about students' technology-based activities based on their own recall, but the ESM approach provided more representative, real-time data with greater detail of context and frequency. The combination of methods also allows for confirmation and exploration of the findings of one method with the findings of another (Teddlie & Tashakkori, 2009). For example, the survey was used to record access to technology and general technology-based activities, but interviews were required to explore the students' motivations and details of these activities. In addition, the adaptation of methodologies from other disciplines, such as the

experience sampling method from psychology, provides another lens through which to view students' technology use to advance understanding of the factors that influence technology choices.

The use of the mixed methods approach also presents some challenges to the research. The complexity of the multiphase combination timing requires strict coordination of data collection and analysis which can be an inflexible and time consuming process (Youngs & Piggot-Irvine, 2012). The use of a diverse range of data sources presents a challenge for the analysis of data since it may corroborate, complement or contradict between sources (DeCuir-Gunby, Marshall, & McCulloch, 2012).The following sections describe each of the methods in detail and discuss their use in this research design.

Phase 1: Survey

The initial phase of the research involved the administration of a survey to gather data about access to and use of technology amongst first year students across a range of disciplines. Such surveys are often used as part of a mixed method study to establish a broad picture of existing patterns and trends across a large target population. In this study the survey also facilitated the selection of participants for further investigation based on the relationship of their responses to these patterns and/or trends. The survey was developed specifically for this study with reference to previous studies of digital natives (Kennedy et al., 2007; Trinder et al., 2008). The paper-based survey was administered in lectures and tutorials of first year subjects across seven faculties including Arts, Commerce, Creative Arts, Education, Science, Informatics, and Health and Behavioural Sciences. A process of rolling recruitment in which surveying took place over a number of weeks was adopted to maximise the number of participants.

A homogeneous sampling scheme was use for the survey to represent the wider population of first year students. Full-time, domestic students were selected as participants in the sample to represent the average first year student as identified using institutional enrolment data. An age range was applied to limit participants to students born in or after 1980 so that the sample only contained those participants whose age ranges fit within those suggested in the literature on digital natives. This was to allow for the testing of assumptions of the characteristics of digital natives as implied by the literature (Tapscott, 1998; Palfrey & Gasser, 2008; Prensky, 2001). Overall the total number of responses collected was 547 of which 470 fell within the sampling criteria. These 470 students represented 16.5% of the total enrolment of first year students in the

university in 2008. At the time the survey was administered, the students were also given information sheets and consent forms which they could complete if they were willing to participate in Phase 2 of the study.

In order to profile the survey respondents, the first section of the survey collected demographic data including age, gender, living arrangements and enrolment-specific data (full/part-time, domestic/international). The main purpose of the collection of this demographic data was for it to be used in the sampling process. It also enabled the exploration of some of the claims made and/or trends observed in recent literature on digital natives. The choice of variables was guided by similar surveys in other studies of digital natives. Students were also asked to rate their level of ability with technology as either beginner, intermediate, or advanced. While there may be some inconsistency in students' self-ratings depending on their interpretation of these categories, this limitation is inherent in the nature of self-reported items. In this study the data was primarily used at a very broad level to provide a general profile of the survey population. When used for sampling for the second phase of the study it was combined with other demographic variables. For each participant in the second phase of the study, their interpretation of their self-rating was explored in the first interview and through triangulation with the data from the other methods.

The second section of the survey collected data about the access students had to particular technologies. Students were given a list of technologies and asked to indicate which level of access they had to each as follows: exclusive use/ownership, shared access, limited access, or no access at all. These distinctions allow for examination of the impact that access levels will have on degree of use. The list of technologies was derived from previous Australian and UK studies of students' technology use (Kennedy et al. 2007; Trinder et al. 2008), with updates to reflect changes in technologies that had occurred since these previous surveys were designed. The range of technologies chosen could relate to either everyday life and academic study and included desktop computers, laptops, electronic organisers, portable music players, digital cameras (still and/or video), mobile phones, memory drives, games consoles, GPS navigators and Internet access (dial-up and/or broadband).

The third and final section of the survey collected data about the frequency of use of technologies across the contexts of the students' everyday lives and academic study. This provided an opportunity to examine the similarities and differences in the frequency of

these activities across these contexts. Two lists of common technology-based activities derived from previous studies (Kennedy et al., 2007; Trinder, Guiller, Maragaryan, Littlejohn & Nicol, 2008) were presented. One list contained activities commonly associated with everyday life and the other contained activities most commonly undertaken as part of academic study. Equivalent technology-based activities were included in both context lists, where possible, to facilitate comparative analysis.

The development of the survey for this study revealed significant limitations in the use of survey methods for researching technology use. Prior to administration, researchers with expertise in quantitative research, survey design and educational technology reviewed the survey to ensure content validity (Nardi, 2006). These included three academic staff members, two with significant experience in qualitative research methods and the third with a specialisation in quantitative research. The survey was also reviewed by three research assistants who each had been involved in previous research projects incorporating survey methods. Each reviewer was asked to review and complete the survey and was then interviewed to collect their feedback. In response to the feedback changes were made to two of the 'Access to Technology' items. The example of 'MP3' was added to the 'Portable music player' item for those students who may not have owned an iPod which was previously the only example given. The other change to this section was the removal of the category of 'Wireless Internet access'. At the time of the administration of the survey this was a very new technology to which few people had access, and it was the feeling of several of the reviewers that this item may confuse students when included with the other forms of Internet access items. In the 'Use of Technology' section an example (Flickr) was added for the item 'Share photos online'. The item 'Subscribe to RSS feeds' was reworded to 'Use RSS feeds' in response to a comment from one reviewer who said "I haven't subscribed to one for months, but I read them all the time". Two of the reviewers expressed concern over student's understanding of the difference between everyday life and academic life contexts. While this didn't result in a change to the survey itself, this feedback was addressed by a fuller explanation of these contexts being added to the verbal introduction that was given to each student group prior to the survey administration.

Next the 'test re-test' method was used to determine the reliability of each survey item. The test re-test method measures the consistency of responses to a survey over time. The survey was administered twice to a group of 25 students, with one week between each administration. Reliability coefficients were then calculated on the responses from the test

re-test group. The reliability coefficients indicated a low level of reliability for items measuring the frequency of everyday (0.703, p=0.01) and academic (0.547, p=0.01) technology activities. As a result of the test re-test the 'access information online' item (reliability coefficient = 0.347, p=0.01) was removed from the everyday life activities list. Also some wording was changed to reduce the use of 'technical' terms.

One possible explanation for the low reliability coefficients is variability in students' definitions of technologies and contexts. It seems that a common technology language - which would allow for consistent responses across all students - does not exist. For example, students were asked if they wrote a blog in either their everyday or academic lives. Further exploration of this question in the subsequent interviews highlighted the confusion this item caused due to the fact that MySpace sites include a 'blog' section and participants were unsure if this would be considered a blogging activity or simply use of social networking sites. A study of undergraduate education students' personal and educational use of technology (Kumar, 2009) noted that the ways in which students define 'educational use' might also complicate analysis of how students adopt technologies in their academic context. Whilst technology prescribed as part of the students' course can be easily identified as academic use of technology, it is unclear if students considered technology used as part of self-directed study activities as academic use. The impact of self-reported data and variability in technology use over time also may have contributed to the low reliability of the survey.

Though analysis of the survey data it was observed that there was a wide variance of ownership and experiences with technology, especially between students' everyday life and academic study contexts. In relation to some technologies (e.g. electronic organisers, GPS Navigation) and some technology-based activities (e.g. writing a blog, building websites, using RSS feeds) adoption levels were very low. While general levels of technology access are increasing in comparison to other similar survey-based studies (Kennedy et al., 2007) a mismatch was found between perceived technology use reported in the original digital natives literature with the actual data (Conole, deLaat, Dillon, & Darby, 2008). Overall, this survey showed no evidence to support the claim that all students have a high level of technological ownership and use.

For the purposes of this study, the survey provided an adequate gauge of the technology ownership and usage of the sample population of first year university students. It facilitated the identification of case study participants who represented points along the

spectrum of technology access, ability and use. The findings of reliability testing suggest however that caution is required in analysing surveys of this kind to make more definitive claims about students' technology activities due to the low reliability of some items.

Phase 2: Case Studies

An initial analysis of the data was undertaken to identify potential case study participants for Phase 2 of the research. A selection matrix was used to identify participants who represented a variety of technology experience and study disciplines. The matrix included the variables of gender, degree/faculty, living arrangements, travel time, level of ability with technology, as well as averages of the technology access and activities field. The analysis of the 130 students who had volunteered to participate in the second phase of the research using the matrix identified 20 possible participants who represented a broad spectrum of access levels and use of technology, from those who used technology rarely, to those who indicated they were highly experienced technology users. To ensure sufficient numbers in case of participant attrition, 20 students were approached and 16 accepted. Due to attrition during the study, the final number of cases was 14. Each individual was considered a separate case, and so the collective case study aimed to provide depth and diversity. The design involved an initial and final interview, and a period of observation in between. The following sections describe each method in detail.

Interviews

Interviews provide an opportunity to collect in-depth responses that further investigate important concepts in the research. The interview method facilitates the collection of participants' personal accounts of a phenomenon (Hammersley & Atkinson, 1995) and can be used to explore "the meaning people attribute to their experiences and social worlds" (Miller & Glassner, 1997, p. 100). In a mixed methods study, interviews are used to corroborate findings across methods through triangulation, as well and allowing participants to elaborate on findings of other methods through the interview process (Greene, Caracelli, & Graham, 1989). Interviews also facilitate the collection of data that inform the design of other methods in the mixed methods design.

Once the case study participants had been recruited each was invited to an initial interview of approximately one hour duration. The aim of this interview was to collect more detailed data about their experiences and perspectives on technology use, adoption, and learning. The initial interview was semi-structured thereby allowing the researcher to

explore the participants' responses while making sure certain areas were covered. At the beginning of the interview the participants were asked to talk through an extended version of the activities section of the survey. This divided the study contexts down further to include everyday life, academic study and personal study. This distinction between academic and personal study was made to differentiate between formal activities undertaken as part of a course, and self-directed personal study.

Questions were then asked across four categories including technology use, learning goals and strategies, competence and confidence with technology, and adoption of technology. Participants were also asked about any social networking or online tools they used on a regular basis. This information was then used to negotiate which online activities would be observed. The initial interview concluded with a brief training session on the use of the ESM tools.

At the end of the three-week ESM/EOD and observation period, each participant was invited to a follow-up interview designed to collect reflections on their technology experiences during that time. Prior to this interview the data from the ESM, EOD and observation were analysed to determine frequency and types of technology-based activities. At the second interview students were presented with a copy of this data and given the opportunity to comment on any trends, irregularities or abnormal situations. This form of member checking or respondent validation (Creswell, 1998; Torrance, 2012) allowed the participants to verify the accuracy of data, enhancing the credibility of the study. In addition, the material provided stimulus for discussion of technology activities undertaken during the study period. Questions were also asked of the participants to get a sense of their identity across the contexts of their lives.

The interviews provided an abundance of detail into students' technology use, learning goals and strategies, competence and confidence with technology, and technology adoption. While the survey provided data on general access and average frequency of use, the interviews provided further insight into the motivations behind students' technology appropriation. The second interview extended the understanding of the data collected in the ESM period by allowing the participants to comment on their activities in light of their usual lifestyle. The use of the interview method also enabled collection of data on the students' perspectives on their identity, including consideration of the different identities they may have across the different contexts of their lives and the different technologies they use in these contexts.

Experience Sampling Method (ESM)

Originating in psychology, the experience sampling method was developed as a way to explore "*experience* in the naturally occurring contexts of everyday life" (Hektner, Schmidt & Csikszentmihalyi, 2007, p. 4). In ESM studies participants are prompted at defined intervals over a period of time to respond to a series of questions about their emotions and/or experiences at the time that the prompt is received. The ESM method minimises recall limitations by having participants report their current activities at particular times rather than recounting them later (Feldman Barrett & Barrett, 2001). An additional benefit of this method is that the minimal direct involvement of the researcher reduces influence on participant behaviour (Consolvo & Walker, 2003).

As ESM has developed over time it has been adopted across many fields of research outside psychology. In technology-related research, ESM has been used to study user experiences of new computing devices (Consolvo & Walker, 2003), students' wireless network usage (Henderson, Anthony & Kotz, 2005), and usage of new accounting information systems (Baxter & Hunton, 2011). In educational research, ESM has been used to observe levels of teacher job satisfaction (Bishay, 1996) and student engagement with game-based education in engineering (Coller & Shernoff, 2009). While early ESM studies required participants to carry pre-programmed beepers or pagers, recent developments in technology allow signals to be delivered over mobile phone networks and responses to be returned by mobile phone or entered into handheld devices (Ben Abdesslem, Parris, & Henderson, 2010; Nett, Goetz, & Hall, 2011).

ESM was adopted in this study to provide an additional lens through which students' technology use could be studied while also presenting a more richly detailed picture of day-to-day life than is possible using conventional surveys and interviews (Bishay, 1996). The use of ESM to build this comprehensive representation of students' experiences helps to guide the research towards an explanation of why students use technology to support everyday life and academic study activities. Questions in the ESM were designed to delve into the environments, motivations and activities of participants. This methods provides a more robust picture of the relationships between when students use technologies, what technologies they use, with whom they use the technologies, and for what purposes.

In this study, the duration of the ESM component was three weeks, a longer time than most ESM studies, to capture a range of academic activities including classes, assignment submissions, reading/study weeks, and examinations. A signal contingent protocol was

adopted, with students receiving three random alerts throughout each day. The alert schedule divided each day into three time periods (9am – 12pm, 12pm – 6pm, 6pm – 9pm) and alerts were randomised within these time periods leaving at least 30 minutes between alerts (see Appendix I: ESM Alert Schedule). As the initial survey indicated that all participants had access to a mobile phone, alerts were delivered by SMS.

Students were provided with an ESM booklet which included a brief introduction to the study and a questionnaire page for each of the three alerts over the 21 days of the ESM period. In order to minimise disruption to the participants' everyday activities and to maximise the rate of completion the questionnaires were brief. They incorporated only seven questions and an optional space for further comments. The questionnaires asked students to record: the time of day, their location, who they are with, their activities, and details of their technology use (see Figure 3 for an excerpt from the booklet).

Monday Morning **Date: _____**

Please fill in the following table when promoted by text msg.

What Time is it?	____:____ AM/PM		
Where are you?			
Who are you with?	☐ Friends ☐ By Myself	☐ Family ☐ Work Colleagues	☐ Partner ☐ Other_____
What are you doing?	☐ Studying ☐ Playing sport ☐ Watching TV ☐ Going online ☐ Travelling ☐ Shopping ☐ Grooming	☐ Attending Lecture ☐ Exercising ☐ Reading ☐ Preparing food ☐ Working ☐ Housework ☐ Other_____	☐ Attending Tutorial ☐ Playing games ☐ Listening to music ☐ Eating/ drinking ☐ Taking a break ☐ Sleeping
Are you using technology?	☐ Yes	☐ No	
How are you using technology?			
Comments			

Figure 3: Page for prompted time entry from the Experience Sampling Method booklet

The ESM method was pilot tested with a small group of three students prior to implementation with the case study participants. The pilot group were asked to complete

the ESM for a period of four days. At the end of this time their booklets were analysed to see what kind of responses were given and what comments were made about activities that didn't fit into the pre-defined categories. Each pilot participant was also interviewed and asked to give feedback on the process of completing the ESM booklet at the prompted times. A thematic analysis was conducted on this feedback to identify key issues and suggestions for amendments to the process.

The pilot test highlighted a number of issues that resulted in alterations to the ESM design. While the three alerts throughout the day had been implemented to ensure that the burden of participation in the study did not deter participants from continuing, it was found that this was not capturing the full range of daily technology use. When interviewed, the pilot participants said that they were using technology much more than was being reported during the three prompted time periods. In some cases the ESM did not capture any technology use in a particular day, although the participants had used technology several times.

To capture data on daily technology use an 'End Of Day' (EOD) summary page was included in the ESM booklet and participants were asked to complete this page before going to bed each night (see Figure 4). The EOD summaries provided an overview of the main technology activities of the day, as well as data on the frequencies of email and text message communication. These activities were derived from the activities that were common across the everyday life and academic study contexts in the initial survey. The activity "accessed information online" was included here to capture when students were generally browsing for information online or researching a topic as part of their study. Whilst this particular item had a low reliability score for the context of everyday life in the test-retest reliability testing in the survey, it was included in the EOD booklet to complement the academic and personal study context activity which was found to have an appropriate reliability score for the survey.

Monday EOD **Date: _____**

Please fill in this table at the end of the day.

How many text msgs did you send today?			
How many emails did you send today?			
Please indicate which activities you did today and the context of the activity:			
Activities	**Everyday Life**	**Academic Study**	**Personal Study**
Shared photos	☐	☐	☐
Read a blog	☐	☐	☐
Listened to a podcast	☐	☐	☐
Played games	☐	☐	☐
Accessed information online	☐	☐	☐
Shopped online	☐	☐	☐
Did banking &/or paid bills online	☐	☐	☐
Used a mobile to make calls	☐	☐	☐
Used a social networking site	☐	☐	☐
Used Instant Msging or Chat	☐	☐	☐
Accessed eLearning space	☐	☐	☐
Comments			

Figure 4: End Of Day (EOD) summary page from the Experience Sampling Method booklet

Two other changes were made to the ESM booklet as a result of pilot testing. Initially responses to the questions about who participants were with and what they were doing were left open-ended. It became clear that this would result in a wide variety of responses that would need to be recoded to allow for analysis. With reference to the responses collected during the pilot testing period and other ESM studies (Forgasz & Leder, 2006) categories of responses were incorporated to facilitate faster data entry for participants and assist with data analysis by providing comparable responses. Secondly, an 'Additional Comments' section was added to allow the participants to expand on their responses if they found the categories provided too restrictive. Participants were also encouraged to use this space to record any additional information that they thought might be relevant to the study.

A further change made was the development of an alternative response method to the booklet. One of the male participants in the pilot group noted that although carrying the booklet was not a problem, he often did not have access to a pen. Instead it was suggested

that a method be developed to allow participants to respond via text message. To facilitate this method a small card was developed with the details of the questions to be answered and categories of activities with corresponding codes to make entry into a text message easier and to fit within the 160 character limit (See Figure 5). Participants were able to keep this card in their wallet or purse for easy access when prompted to respond.

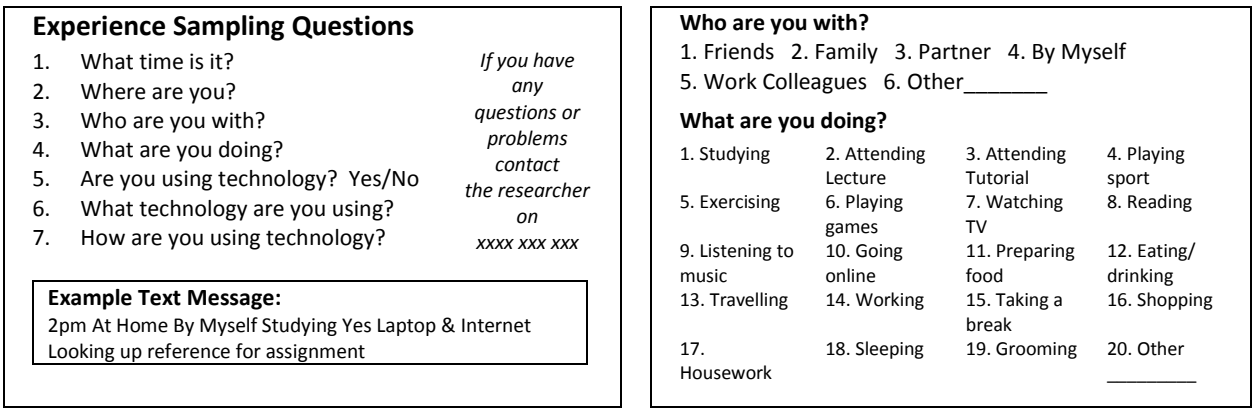

Figure 5: Experience Sampling Card

Overall, the response rate for ESM entries was high, with an average response rate of 96.5% across all participants. During the second interview participants were asked for feedback on the process of the ESM, in particular whether they found anything about the process difficult or confusing. Feedback from all participants about the practical engagement with ESM was that the task of receiving the text messages and filling in the ESM surveys was not time consuming or onerous. Each worked out ways to incorporate this process in their days. They identified some circumstances when responding immediately to the text message was made difficult (e.g. no phone reception, they were driving a car, student was at work where mobiles were not allowed), but the fact the text message was time stamped meant that students were able to calculate what they were doing at that time and fill the survey in later. Participants were also asked in the interview how immediately they completed the ESM/EOD. All participants indicated that they completed the data soon after, and no more than one day after, the text message prompt. The exact response time of the participants who responded via text message could be determined by the time-stamp of their messages.

The results of the ESM method showed a variety of technology and non-technology activities across the students' lives. In particular, the ESM method enabled participants' technology-based activities to be put in context both in terms of where the participant was when they were using technology and who they were with at the time. It was found that

not all activities fitted neatly into the expected locations or with the expected companions. For a number of the participants the frequency of use of certain technologies was found to be lower than they had self-reported. For example, several participants claimed in the survey and interview that they accessed social networking sites every day; however the EOD summary data showed that none of the participants accessed their social networks on every day of the ESM period. This finding highlights the fact that technology use is often inconsistent which makes it difficult to measure such activity through survey-based methods. The overestimation of students' own use also brings into question the reliability of surveys to accurately capture realistic statistics on technology-related activity. It is possible that such overestimation of online social networking activity could be a result of social desirability bias (Nederhof, 1985) where participants want their behaviour to fit with the stereotypes of young people's technology use prevalent in the media. The benefit of combining ESM with subsequent interviewing in this study was the possibility to explore the reasons behind the differences in these frequencies with the participants.

The ESM data also provided an insight into the types of activities that the participants were doing with particular technologies. This detail went far beyond what participants had been able to describe when asked about their range of activities in the interviews. Like the survey and interviews, the ESM data presented a complex picture of participants' technology engagement which did not neatly conform to the generalisations in the original literature about digital natives.

ESM provides a window into the real life context of the participants' technology use. By collecting data at the time of the activity recall issues were minimised, increasing the reliability of the data. This method was also useful for capturing the fluidity of technology engagement over time, demonstrating the impact that lifestyle and social influences have on technology engagement.

Online Observation

Observing the online activities of research participants provides further insights into their uses of technology across the different contexts of their lives. Conducting online observations for research purposes has been gaining popularity in the social sciences due to the new possibilities it presents for studying culture. The translation of traditional methods of participant observation to the online context presents some new challenges, but also many innovative ways of collecting, analysing and representing data (Williams, 2007). The challenges associated with this form of research include methods to capture

online activities, gaining access to closed online communities for observation, as well as ethical issues around the observation of online communities where not all people present in the community have given consent for observation of their activities.

During the initial interviews, participants were asked about their online activities to identify which online social networking and/or communication forum sites they used. Permission was then sought from the participants to observe their activities on the sites of their choice over the ESM period of three weeks. The degree to which such observation was possible depended on the type and amount of online activity that participants undertook, the activity they were willing to share, and any site-based access limitations to such material. For example, one participant was very active on a graphic design community website, but access was restricted only to account holders who also contributed their art online.

For the purpose of this study a passive observation approach was chosen, for which the researcher is present in the environment but does not directly interact with the participants in their activity (Mertens, 2005). Alder and Alder (1994) define such a role as the peripheral-member-researcher, where the researcher participates in the online environment only to the extent that allows them to gain inside identity and access. In this role the researcher aims to gain an insider's perspective through observation, but minimises impact on the natural state of the participants' daily activities by avoiding interaction. For the purposes of this observation, specific accounts were set up within the relevant social networking and communication sites. These separate accounts ensured that there was no unintended online connection between participants and to avoid connections with the researcher's personal social networking activities. During the period of observation the researcher did not engage in any form of communication or interaction with participants online beyond establishing the 'friend' connection to gain access to private social networking profiles. At the end of the observation period the connection between the participants' accounts was unlinked and the research accounts deleted.

During the observation period, online activity was checked every night between 11pm and 1am. To capture the participants' online activities screen shots were taken of the social networking and communication sites to which participants subscribed. This approach was adopted to provide a consistent method of capture across the wide variety of sites. An observation template was developed to help classify the types of activities participants engaged in online (see Appendix J: Online Observation Protocol).

Analysis of the data was undertaken using three categories of activity – communicate, create and consume. Evaluating the participants' communication was assessed if they had posted a forum entry, made a wall posting in a social networking site or commented on a friend's blog/site. Creation included the posting of photos, status updates, videos, and blog entries. The challenge in this part of the research was to determine whether students had consumed information online, as this is an activity that does not result in a digital trace. There were many days when students claimed to have been online, yet because they had not created an item or communicated, no evidence of this activity was collected. This prompted the need to cross reference the data collected in the online observation with the ESM and EOD data. By comparing ESM/EOD and observation data on specific dates it can be assumed that the online visits reported through the ESM data may have involved 'consuming' information such as reading friends' contributions or other elements of sites.

The conduct of the online observation raised an important ethical consideration. Informed consent for the online observation had been obtained from each of the participants, however as the observation took place it became apparent that a significant proportion of the content was created and contributed by the participants' 'friends'. Whilst obtaining consent from each of the participants' friends would be prohibitive in studies of this kind, sensitivity in dealing with the data created by these external participants needs to be exercised. In this study several sensitivity measures were taken to ensure the privacy and confidentiality of these external participants. Where possible, the interactions between the participants and their friends were reduced to quantitative measures that were unidentifiable, for example, the total number of friend requests that the participant accepted or the number of comments posted on a friends profile. No contributions, either textual or graphical, made by any of the external participants were included in the reporting of this research. The peripheral-member-researcher role of the researcher meant that the researcher did not contribute anything to the social network that would impact the external participants.

The ethical issues relating to the existence of the external participants in the data collection process was something that emerged throughout the research and sensitivity measures were developed as this process progressed. However, it is recommended that future studies involving the observation of online social networking and communication websites should develop such sensitivity measures prior to the data collection period. Guidelines for Internet research developed by organisations such as the Association of Internet Researchers (Markham & Buchanan, 2012) and the British Psychological Society

(2013) provide useful recommendations for the ethical conduct of online observational research.

The results of the online observation showed a variety of online behaviours and levels of interaction. These included communication through posting on discussion boards and/or commenting on friends' walls, uploading and sharing photos, publishing status updates and playing online games. The online activities of each of the participants reflected their personal interests and gave an insight into their identities in this context. Unlike popular claims that students adopt alternate identities online, the activities of the participants in this study reflected their off-line selves with very little variance.

Despite the challenges associated with this method within the study, the online observation method led to more accurate data about the students' online activities, clarifying the data that they had self-reported. It also allowed the researcher to observe unexpected activities that would not necessarily have been incorporated into research questions or raised by participants in interviews. As online observation is being used increasingly as a research method, the planning of such research needs to take into consideration issues relating to ethics, data capture, and the impact of participants' knowledge that they are being observed.

Analysis of Phase 2 Data

The analysis of the data from Phase 2 of the study was conducted using three stages inspired by qualitative data analysis processes (Miles & Huberman, 1994) and processes for mixed methods analysis (Greene, 2007; Onwuegbuzie & Teddlie, 2003). The first stage involved data transformation and display, with initial analysis of each method being conducted separately. The data from the experience sampling (ESM) and end-of-day (EOD) summary methods for each participant were each summarised in a table with frequencies of activity calculated. The online observation screenshots were analysis using the three categories of activity (communicate, create, consume) as set out in the online observation protocol and then transformed into a table for each participant (see Appendix J: Online Observation Protocol). The ESM, EOD and observation data were all analysed at the end of the ESM period so that the tables could be used in the second interviews to elicit participants' further reflections on their activities. At the end of the second phase a thematic analysis was conducted on the two sets of qualitative interview data using the analysis coding framework outlined in Appendix N.

The next stage of the analysis involved data consolidation and reduction. It was at this point that the data from across the methods were integrated in order to form individual case summaries. The summaries were organised into five main themes: (1) experiences **with** technology in everyday life, (2) learning goals and strategies, (3) experiences with technology in academic study, (4) appropriation of technology, and (5) identity. **This** was followed by the third stage where the individual case summaries were compared to identify common themes, draw conclusions and inform recommendations for educational practice.

Discussion

The evolution of the digital natives discussion has resulted in the need for more in-depth methods to explore the intricacies of students' uses of and choices about technology. In this study the use of mixed methods provided a more thorough approach to collecting data over a broad array of contexts and technologies. Each of the methods employed provided a slightly different perspective on the participants' activities, which added to the completeness of the story of each case as well as improving the reliability through cross-examination of data between methods.

This research study was designed to address three research questions. The first was to observe the extent to which patterns of technology use of first year university students reflect the notion of digital natives. The literature claims that young people, born after 1980, possess a high level of technology literacy and unique attitude towards education due to the fact they have grown up surrounded by technology. The research design addressed this question in a number of ways.

Initially the survey provided a broad view of patterns and trends in relation to 470 students' access to and use of technology across their everyday life and academic study. The results of the survey demonstrated a diversity of technology engagement. There was considerable difference between the levels and types of technology usage in everyday life and academic study contexts. There was also little evidence of the adaptation of everyday life technologies into academic technologies. For example, use of social networking was common in the everyday life context, but used considerably less in the academic context. However, the survey was designed to collect quantitative data on students' ownership and use of technology and didn't explore all aspects of the claims about digital natives, including study preferences, motivations behind adoption of technology and the relationship between lifestyle and technology. Instead the interviews were used to further

explore students' motivations and influences in relation to their technology choices, as well as their study preferences and general interests. The ESM and online observation methods also contributed real-time data which could be used to build the case studies of students who represented different technology profiles. This contributed to the understanding of the diversity observed in the survey and other studies of digital natives.

The second research question examined how first year students selected and adapted technologies to suit their learning goals and strategies. In the first interview the students were asked to describe their approach to study and how they used technology to support their study strategies. The ESM period contributed data to address this question by recording types and frequencies of use of technology for academic purposes. This real-time data were then further explored in the second interview. The results showed that all eight case participants used very traditional approaches to study. Few had adopted technologies as part of their studies outside those prescribed by the University. Contrary to claims that students want more technology in their studies, six of the eight the participants in this study indicated that they were happy with the current level of technology used in their courses. Overall, only four students showed any impetus to keep up with the latest in technology for use in any of their life contexts. Rather they would rely on the opinion of peers and the requirements of their hobbies/interests or academic courses, with a strong consideration for cost versus utility.

The third research question asked how first year students' use and have a preference for particular technologies related to the identities they adopt in everyday and academic life contexts. Explicit questions about identity were built into the second interview, however the participants had great difficulty in defining their own identity and how it may relate to technology. Instead analysis of the complete data set for each participant was used by the researcher to build a picture of the identities they adopted and the impact of these identities on their technology preferences. In analysing the data, gaps in how the data could address this question were acknowledged.

Contradictions were also observed between participants' view of their own identity and their actions. For example, one participant presented herself as quite reserved when asked about how she portrayed herself online, however the same participant's Facebook profile presented a very different image online with statements demonstrating great self-confidence such as "I am awesome. And that's all you've gotta know". Another participant claimed that they were careful to present a very professional image online at all times, yet

some status updates showed lax attitudes to study and concerned other informal aspects of their life. Conversely, other participants had very strong identities which influenced their technology behaviour across both contexts of their lives. For example, one participant strongly identified themselves as a 'gamer' and this influenced how they used virtually all their technologies (e.g. reading blogs about games, communicating on game forums, sharing reviews of games via social networks, etc.) and their preference for the use of games as part of their studies.

Limitations of the Study

Despite the use of multiple methods to strengthen the research design, several limitations to this study were identified. The generalizability of findings was limited by the fact that this study was only conducted at one institution. Data collection techniques chosen for this study necessitated significant commitment of researcher time and thus also limited the scope of the study in terms of the number of cases that could be included. There is also a challenge that mixed methods presents to a single researcher in understanding and analysing both qualitative and quantitative research, especially in reconciling the deduction focus of quantitative research with the induction focus of qualitative research (Johnson & Onwuegbuzie, 2004). In this study role of the quantitative data was primarily for the identification and description of the sample, with the emphasis of the main phase of the study being on the qualitative data and methods.

There were several challenges to the study as a result of the use of the Experience Sampling Method (ESM). In particular, the quality and reliability of the data is said to be weakened when there is a significant time lag between the signal and participant response (Scollon, Kim-Prieto & Diener, 2003). Although in this study timely completion was a limited threat to reliability, this is an issue that researchers need to address wherever possible in studies using ESM. To minimise and monitor the threat to reliability such delays may cause, it is recommended that future studies use text messages or a mobile web interface/application to collect the data which would provide time-stamped response data. The fact that students were aware they were being observed online and through the ESM process may have led to a reactivity bias resulting in a change to their 'typical' behaviour. In each of the stages of the study the lack of a shared language to describe technology presented a challenge to data collection. Where possible, opportunities were taken in the interviews to explore and clarify the definitions of technology terms, especially in preparing students for the ESM period of the study. This issue doesn't seem

to have been addressed in the literature to date, but presents a challenge that needs to be addressed in order to maintain reliability in research into technology engagement.

Another challenge was the ability for participants to be able to talk about their own identity. In the interviews participants struggled to answer direct questions about their identity. As a result, other open-ended questions about concepts such as hobbies, online self-portrayal and the commitment to being a student were used to elicit students' self-described identities. These were then interpreted by the researcher using the coding framework in Appendix N and incorporated with data from the online observation and ESM methods. Researcher interpretation of people's identities from interviews and narrative stories is an approach that has been used in a number of other studies in the field of identity (McLeod, 2000) and, in particular, studies of identity and technology (Goode, 2010; Hilsen & Helvik, 2012). While there are limitations to this approach, it avoids the weaknesses of asking participants to choose from pre-supposed identities as have been done in other studies of identity roles (for example, Mekolichick, 2002).

Contribution to Mixed Methods Research

An examination of the design of this study provides two main contributions to mixed methods research. The first is the utility of multiple data sources to reduce the well-known limitations of retrospective self-report survey data. While the use of multiple methods to strengthen self-report data is common in mixed methods research, the contribution of this study is the particular combination of methods used, including the experience sampling method (ESM). The use of the ESM/EOD provided real-time data on technology use and the context of the technology-based activities. This approach was integrated with interviews both before and after providing background to students' activities and confirmation and further explanation of these activities at the end of the ESM/EOD period. The ability to get students to comment directly on activities they undertook over the ESM/EOD period helps to link scenarios, contexts and actions, meaning that the data is more likely to measure students' strategies rather than just perceptions (Schellings & Van Hout-Wolters, 2011). The second contribution is the sequence and combination of methods enabled a more reliable picture of students' actual technology engagement to be formed through triangulation (Creswell, 1998; Stake, 2005; Yin, 1994).

Clarification of inconsistent or unusual data was made possible in this study by using data from one method to inform the design of another. For example, during the final interview, participants were provided with a summary of their own ESM, EOD and observation data.

Many were surprised at both the nature and extent of their actual activity. This prompted further explanation of the motivations and special circumstances surrounding their technology use during that period of time. Data from the ESM period was also used to identify technology activities that participants didn't mention in the initial interview. The final interview was used to explore these activities in greater depth. The online observation also provided data on how the participants' portrayed themselves online which feed into discussions of identity and technology use.

The second contribution this study makes towards mixed methods research is an approach to researching a phenomenon that changes over time. Rapid development in technologies and their related services means that technology engagement is difficult to gauge from a single point of data collection. The use of ESM and observation over the period of three weeks allowed for collection of data that covered many of the aspects of a student's life including classes, assessments and a variety of everyday life occasions. An example of change in technology use over this period was one student who cut back her social networking activities when she had assessment tasks due. While this study provided insight into the variations in technology use over a short period of time, a suggestion for further research in this area would be to extend the length of the study to examine how students change their technology ownership and use as new technologies and services become available.

Conclusion

This paper presented the design of a mixed methods study for investigating students' use of technology in academic and everyday contexts. The use of multiple data sources added a depth to the case studies not previously seen in other qualitative studies of digital natives. The study demonstrated the utility of mixed methods approaches to help minimise recall issues through a more reliable data set that allows for triangulation. The innovative use of methods from other disciplines, such as ESM, enabled the study of technology use over time, an aspect often overlooked in studies of digital natives' technology engagement. For educational research, this study provides an example of the benefits and limitations of the combination of research approaches. For education practitioners, the outcomes from studies such as this provide in-depth information from which to consider how educational programs might better cater the diversity of student engagement with technology. This includes the planning of support for the use of technologies to support teaching and learning activities, the need to make the purpose of the technology in the activity explicit

to students and enabling students, where appropriate, to discover new tools to help them complete learning and teaching activities. Understanding more about how different students adapt technologies to their needs can also help guide the development of more personalised learning options for students.

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CHAPTER 4

THE ROLE OF THEORY IN DEVELOPING A GREATER UNDERSTANDING OF UNIVERSITY STUDENTS' ENGAGEMENT WITH TECHNOLOGY

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Abstract

In challenging the validity of generational assumptions about young people's attitude towards and engagement with technology inherent in concepts such as 'digital natives' or the 'Net Generation', recent research has sought to examine this phenomenon from new perspectives. This paper explores how theory can be used to expand our knowledge of young people's engagement with technology. It examines two bodies of theory, technology appropriation and identity theory, and their application to a recent study of the technological engagement of digital natives. The utility of these complementary perspectives is considered and suggestions made for the role of theory in future studies in this area.

Introduction

It is often asserted that young people possess a high level of digital literacy due to the fact they have grown up surrounded by technology. These young people, born in or after 1980, are commonly labelled 'digital natives' (Prensky, 2001), 'millenials' (Howe & Strauss, 2000), or the 'Net Generation' (Tapscott, 1998). As a result of their exposure to technology it is claimed that this generation have developed a common set of technology-related characteristics including an aptitude for multitasking, the need to be constantly connected, a culture of sharing information, and fluency in the use of multiple media (Barnes, Marateo, & Ferris, 2007; Dede, 2005; Frand, 2000; Oblinger & Oblinger, 2005; Prensky, 2001). It is also claimed that this generation have a new and unique approach to learning, one that is no longer compatible with established teaching methods (Dede, 2005; Prensky, 2001; Tapscott, 1998).

In examining these assumptions, subsequent empirical research presented a very different view of the characteristics and technology-based experiences of young people. Several large research studies (Garcia & Qin, 2007; Kennedy et al., 2007; Salaway & Caruso, 2007) found a diversity of technology engagement, indicating that not all young people fit neatly

within these generational stereotypes. From an education perspective, there was little evidence that young people have a radically different approach to learning (Bekebrede, Warmelink, & Myer, 2011; Ellis, Bliuc, & Goodyear, 2011). Instead it was found that conventional forms of learning and learning spaces were preferred by most students (Margaryan, Littlejohn, & Vojt, 2011; Jones & Healing, 2010), and their use of technology in this contexts tended to supplement familiar learning methods, rather than creating new ones (Valtonen et al., 2011). These findings suggest that there is a complexity inherent in young people's engagement with technology that is not amenable to simple generalisations.

The importance of the role of technology in education requires us to develop a better understanding of how and why young people engage with technology. However, to study technology engagement we need to conceptualise this phenomenon to guide empirical studies and ultimately inform educators' approaches to using technology to support learning. As yet, few studies have brought theory to bear on this issue, an approach which may assist with extending our understanding of the phenomenon. When studying a phenomenon as complex and diverse as engagement with technology, theory enables the conceptualisation of practices and contexts. Theory provides a shared common language that allows outcomes to be compared and contrasted across studies (Gunn & Steel, 2012; Jones & Czerniewicz, 2011). The combination of multiple theories in a theoretical framework provides different perspectives through which to view and ultimately further illuminate and interpret aspects and complexities of the phenomenon. Using theory to facilitate a greater understanding of the influences on technology engagement provides insights which can inform educational practice.

There are many existing theories which can be mobilised to provide a useful perspective on young people's technology engagement. Some recent literature has endeavoured to apply theory to this phenomenon using theories such as Bourdieu's habitus (Bennett & Maton, 2010; Czerniewicz & Brown, 2012) and agency (Jones & Healing, 2010). The concept of habitus was used to consider students' dispositions and attitudes towards the use of technology to support education, with specific reference to access to technology and cultural capital (Czerniwicz & Brown, 2012). Agency was used to consider the structural influences from social networks and educational institutions on students' intentions to adopt and use technology (Jones & Healing, 2010). These theories examine the phenomenon from distinct perspectives, though both focus heavily on the social factors that influence technology engagement.

This paper explores how theory can be used to expand our knowledge of young people's engagement with technology. First we examine two bodies of theory that relate to the phenomenon, technology appropriation and identity theory, and consider what each offers towards the development of a greater understanding of the ways in which students engage with technology. We then discuss how these theories have been used to provide a theoretical framework for a recent study of digital natives. The utility of this approach is considered and suggestions made for future studies in this area.

Technology Appropriation

Research into how people adopt and accept technology into their lives has led to the development of a variety of theoretical models over the last 30 years in the disciplines of information systems and sociology. Early research in this area focused on the influences on user's decisions to adopt information systems in business organisations. In this context, the Technology Acceptance Model (TAM) (Davis, 1985) was developed to examine the motivation and behavioural intent to adopt new technology in terms of three factors: perceived ease of use, perceived usefulness, and attitude towards technology (Davis, 1985). The simplicity of TAM and its applicability to a variety of contexts and different technologies made this a popular model in technology adoption research (Straub, 2009).

However, over time the reliability and validity of the model began to be questioned (Bagozzi, 2007; Chutter, 2009; Lee, Kozar, & Larsen, 2003). Its origin in the information systems domain meant that TAM was developed based on scenarios involving mandatory use of technology mostly for a single task at a single time. Studies found that the reliability of the measurement of the TAM factors was considerably impacted by changes in the context and the nature of the task for which the technology is used (Gefen & Straub, 2000). In studies using TAM, measurement of usage is typically based on self-reported data with no measure of actual use (Bradley, 2009). The model also does not adequately consider social influences on the users' intention to adopt technology (Chutter, 2009; Straub, 2009). Subsequent versions of TAM, including TAM2 and the Unified Theory of Acceptance and Use of Technology (UTAUT), have attempted to incorporate additional social and organisational factors to broaden usability (Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003). Despite the expanded explanatory power of these new models, some contend that the large number of independent variables creates a complexity which reduces usefulness (Bagozzi, 2007; Bradley, 2009).

A major limitation of models such as TAM, TAM2 and UTAUT is that they are based on the assumption that technology itself is a fixed entity which does not allow for adaption, personalisation or reinvention (Carroll, 2004). These models investigate the factors that influence the user's initial decision to adopt and use technology, but do not examine ongoing use or discontinuation of use. In studying young people's engagement with multiple technologies across several contexts of their lives, these models were considered to be incapable of sufficiently handling the complexity of the phenomenon. In particular, a model was required to consider how young people adapted technologies to their needs in different contexts. The concept of technology appropriation was chosen due to the fact it addresses many of these elements by examining how people select, explore and modify technology to become a part of their lives (Carroll, 2004).

Model of Technology Appropriation (MTA)

Based on social constructionism and studies of young people's use of mobile phones, Carroll, Howard, Vetere, Peck, & Murphy (2001) developed the model of technology appropriation which examines the transformation from technology as it was designed to be used (technology-as-design) to the way it is actually adopted and integrated by the user (technology-in-use). The foundation of social constructionism provides a distinct way of viewing the social impacts of technology which go beyond the simple observation of what is happening to consider how such social realities are produced, assembled and maintained (Holstein, 2007). From a social constructionist perspective, technology can mean different things to different people as a result of the processes of social negotiation and interpretation in their specific contexts (Hine, 2000). In other words, technology can both shape and be shaped by society (Carroll et al., 2001).

In developing the MTA, Carroll, Howard, Peck, & Murphy (2003) defined the appropriation of technology as "the way that users evaluate and adopt, adapt and integrate a technology into their everyday practices" (p. 39). The model addresses the interplay between young people's wants, the capability of the technology, and the impact of society. Importantly, the MTA was designed to capture factors which influence engagement with technology both prior to adoption and post-adoption. The MTA proposes a new combination of research methods, factors and concepts that can be used in the "scattered spaces in which young people live and undertake leisure, work, education and social activities" (Carroll, Howard, Vetere, Peck, & Murphy, 2002, p. 1). The design of the model acknowledges that a deterministic path does not exist between the design of a technology and the way it is used: a technology can be used by many different people and the same technology can be

interpreted by people in many different ways (Carroll, 2004). Furthermore, a single technology can be adapted in different ways in different contexts.

The MTA consists of three levels of technology appropriation. The first level explores the user's initial encounter with the technology and the factors (attractors) which influence their decision whether or not to adopt. The second level explores the process of adaption that the user undertakes in trialling and evaluating the technology with a view to adapting it to fit their needs. The third level explores the integration of technology into the user's life on an ongoing basis. An iterative stage, the third level influencing factors (reinforcers) either stabilise use or lead to disappropriation. Figure 6 outlines the design of the model and its associated factors.

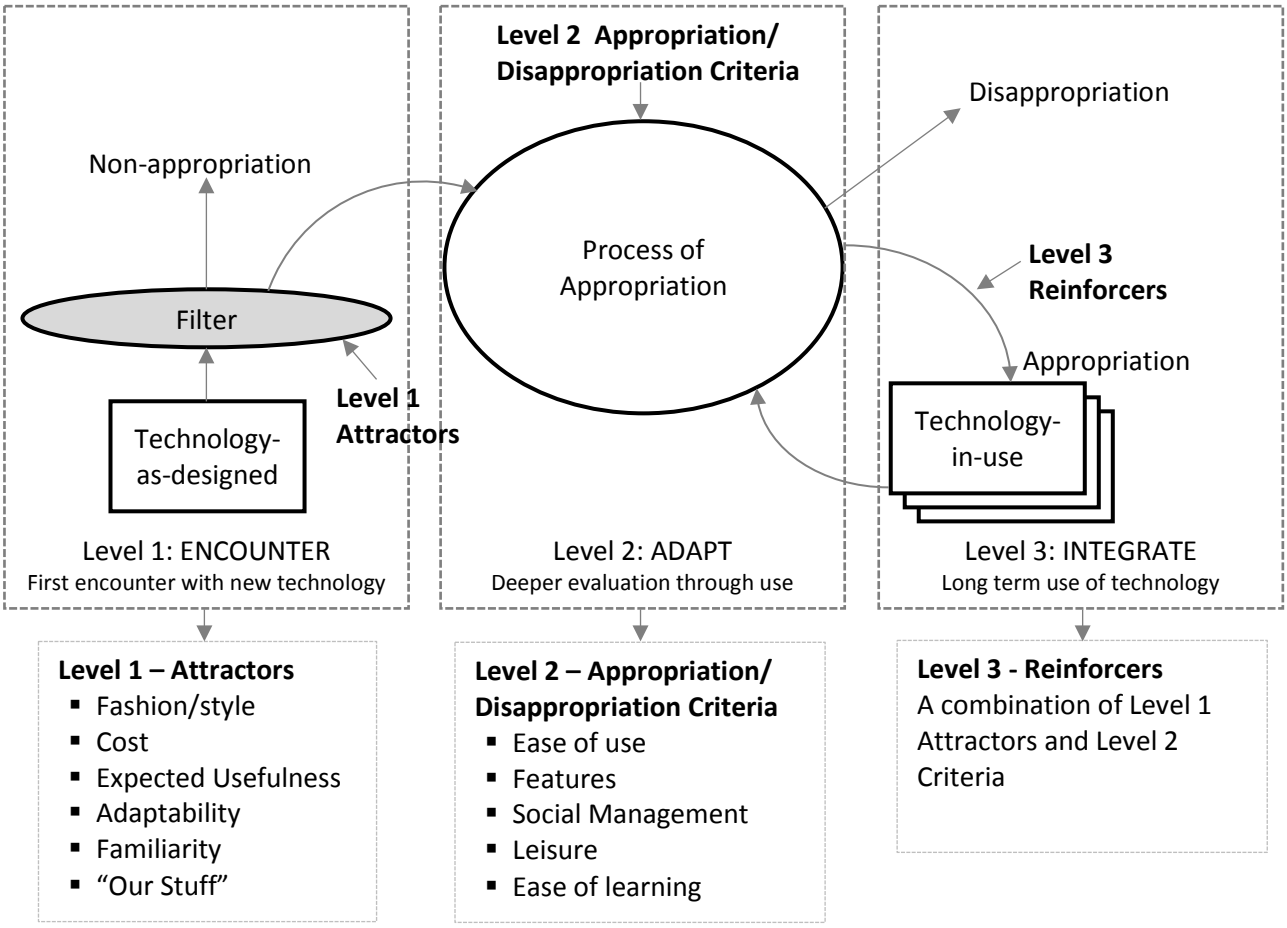

Figure 6: Adapted from Carroll et al., 2002: Model of Technology Appropriation (MTA)

In education, studies that have considered technology adoption have tended to focus on teachers' adoption of technology for use in the classroom (Teo, 2009). To date, few studies have examined what technologies students bring to the classroom from this perspective, although more research in this area is starting to emerge (Bennett, Maton & Carrington,

2011; Raman, 2011). The MTA offers a number of benefits to the study of students' technology use. It helps to conceptualise the process of adoption and adaption of technology to people's needs and wants over time. In particular, it acknowledges that the factors that influence continued use are not necessarily the same as the factors which influenced initial adoption decisions (Carroll et al., 2003). The MTA considers the interaction between technology appropriation and social influences which are important in studying technology use which may traverse multiple contexts. This can inform the examination of the adoption, adaption and transference of technology between contexts of everyday life and academic study.

However, while the MTA makes reference to some social factors, it is limited in its examination of how social roles impact technology use. The Level 1 attractors 'Our Stuff' and 'Fashion/Style' seek to address this to some extent; however how this is measured is unclear. Therefore it was necessary to complement the use of the MTA with another theory that allows for the conceptualisation of how an individual's roles in society impact their adoption and use of technology. In this study identity theory was chosen to explore these individual social concepts in greater depth.

Theories of Identity

Identity theory is concerned with "parts of the self composed of the meanings that persons attach to the multiple roles they typically play in highly differentiated contemporary societies" (Stryker & Burke, 2000, p.284). People have multiple identities and these identities are relational and collective in society (Lawler, 2008), meaning that particular identities are only active in certain contexts. Goffman (1959) defined the concept of multiple identities using the notion of people as actors who perform different roles to different audiences. Research has also found that people tend to see themselves as they think other people see them (Cassidy & Trew, 2001). This is known as reflected appraisals which was also described by Giddens (1991, p.53) as "a person's own reflexive understanding of their biography". However, Goffman (1959) suggested that sometimes people try to manage the impressions of others by modifying their behaviour to influence the way others see them.

At a broad level, identity theory, as defined by Styker (1980), was derived from the theoretical foundation of symbolic interactionism (Mead, 1934) which focuses on the interaction and interpretation of symbols in social action to develop an understanding of the self. Styker (1980) extended this idea beyond interactional interpretation to

incorporate social influence on the self, as well as how the self influences social behaviours. Simon (2004, p. 25) outlines five core aspects of identity theory in that identity is relational, socially constructed, socially structured, multiple, and have social consequences.

While the concept of identity is useful in considering the multiple roles people play across the different contexts of their lives, a significant problem with identity theory is that the term "identity" can be ascribed many definitions. It is a "slippery and ambiguous term" which is claimed to be often overused (Buckingham, 2008, p.1). Over time researchers have developed and/or chosen definitions of identity that fit best with their research aims, resulting in a broad array of assumptions about identity and its related theories. In this study identity was used to describe the social roles of the participants, but also the way which young people create identities for themselves in online social environments which may or may not correlate to their off-line identities.

Several researchers have focused on technology's role in young people's identity development. Technology has been considered as "a canvas for personal expression" where young people can develop and refine their identity (Turkle, 1984, p.138). This allows for greater individualisation which impacts how identity is defined and lived (Buckingham, 2008). However, Buckingham also observed that research in this area has tended to have a technological determinist viewpoint which claims that technology is an autonomous force which influences identity instead of a socially constructed entity. In this study we tried to view both technology's influence on identity as well as identity's influence on technology adoption and use.

Identity theory, as defined by Stryker (1968; 1980), provides a useful perspective for the consideration of how young people appropriate technology across the different contexts of their lives. As identity theory recognises that people can have multiple identities as a result of the multiple roles they play in society, it can be used to consider how technology engagement may be affected by the multiple identities that a young person may have in both online and offline environments. It helps to examine a range of technology engagement at the level of the individual and how they experience technology in their social and academic lives.

Current research into young people's engagement with technology and the notion of digital natives has addressed identity in various ways. Some studies have focused on

young people's creation of alternative identities in online environments (James et al., 2009). Others have formed new categorisations of young people on the basis of their technology-based activities (Ferri et al., 2008; Green & Hannon, 2007; Kennedy, Judd, Dalgarno, & Waycott, 2010; Morgan & Bullen, 2011; van den Beemt et al., 2010; White & Le Cornu, 2012). Identity has also been used in considering the validity of generational constructs such as 'digital natives' and the 'Net Generation' (Palfrey & Gasser, 2008). Overall identity theory is useful in explaining more about how individuals approach technology appropriation and how they are influenced by technology. This strengthens the understanding of social influences covered by the model of technology appropriation.

Theoretical Framework Developed for this Study

A theoretical framework that combined the model of technology appropriation and identity theory was developed to guide the design, data analysis and interpretation of a study of first year university students' engagement with technology in their everyday and academic lives. The study was conducted at an Australian university during the second semester of 2008.

The study employed a mixed methods approach to explore the diversity of students' technological lives. The first phase of the study involved a survey of 547 first year students across seven faculties. The survey collected data on students' access to and use of technologies across their everyday life and academic study contexts. Analysis of the data provided an overview of the patterns and trends within the sample population and was also used to identify potential participants for the study's second phase. An age restriction was applied to the sample so that it was representative of young people who fit within the definition of digital natives according to the literature (i.e. only respondents born in or after 1980). Of the eligible 470 responses, 16 students were invited to participate in the second phase of the study. These 16 students represented a diverse range of technology access, ability and use. These students were enrolled in a variety of degrees including creative arts (3), education (3), informatics (2), law (2), science (4), commerce (1), and nursing (1). In terms of self-ability with technology seven of the students rated themselves as advanced, seven as intermediate, and two as beginner. An average of access and activities frequencies was calculated for each survey respondent and ranged from 1.13 for students who had access to and engaged with technology a lot, to 3.26 who didn't have as much access and/or participated in less technology-related activities. The 16 students in the study represented various points on this average range between 1.57 and 3.02.

The second phase employed a collective case study design. Participants took part in an initial interview to explore their technology-based activities in more detail. This was followed by a three-week modified experience sampling method (ESM) activity where participants were prompted three times throughout the day and asked to record details about any technology-based activities they were undertaking at the time. Participants were also asked to complete an end-of-day (EOD) summary of their technology-based activities each day. Also during this time, participants' online social networking activities were observed. Participants were interviewed again at the end of the three-week period to further explore the technology-based activities recorded and observed.

The following sections describe how each of the theories were used in conceptualising the research problem and informing the design of the data collection and analysis.

Technology Appropriation in the Study

In examining technology appropriation, this study sought to identify the factors that influenced initial adoption and ongoing and/or discontinued use of technologies. In doing so, it made reference to two main concepts from the MTA. Firstly the Level 1 attractors on initial appropriation decisions and, secondly, appropriation/disappropriation criteria from Level 2. Investigation was also undertaken to distinguish between technology-as-design and technology-in-use.

The initial survey collected data on participants' access to technologies and a general overview of the frequency of common technology-based activities involving these technologies. Access and use were used as a fundamental measure of technology adoption. The use of survey-based methods is a common approach in many large studies of the digital natives concept (Kennedy et al., 2007; Garcia & Qin, 2007, Salaway & Caruso, 2007). Such studies have consistently found diversity in adoption and use of technologies by young people. While these studies have reported on technology adoption in terms of frequency, few have explored this adoption in terms of influencing factors.

In order to explore the motivations and influences behind these frequencies, interviews were used to gather more detail about how the participants adopted and used their technology. This data were analysed to determine the differences between the technology-as-designed and technology-in-use. The data also provided an insight into the social and institutional influences on students' decisions about which technologies to adopt and the particular uses they made of technology. It was evident that participants had personalised

their uses of technologies to best suit their interests, social priorities, and study commitments. For example, one participant used her Facebook account for the sole purpose of arranging face-to-face activities with friends. Another participant used their social network profile as a way to build their professional image related to their interest in politics. One participant used their mobile phone substantially more for playing games than communication. Another participant, who had a significant interest in playing computer games, sought ways to play games across multiple devices that he owned.

Each had determined the features and tools that best fit with their individual lifestyle and focused on these rather than using the full range of functions available through the technology. These findings correspond with a study of students' technology use across five UK institutions which used the theoretical concept of agency to examine adoption and use of technology (Jones & Healing, 2010). It was found that ownership of technology did not always mean that the student has the interest or ability to use the full range of a technology's features. In the current study some participants used technology in ways that were quite distinctive from the technology's design. For example, one participant and a group of their peers used a single email address, to which they all had the access details, as a group file sharing area. Another participant owned a games console, but only used it to watch DVDs. Similarly another participant only used their laptop to watch movies, using university desktop computers for all their other computer tasks.

In order to identify the attractors which influenced adoption decisions participants were asked what influenced their decision to purchase and/or start using a new technology in both their everyday life and academic study contexts. If participants were struggling to identify factors or information sources, they were asked to consider a specific technology (e.g. a mobile phone) and asked how they approached their decision to purchase this technology. Then they were guided to think about the other technologies they own. Participants were also asked if there were any technologies that they were currently considering purchasing and the reasons why they wanted these new technologies. These questions were asked in the initial interview and again in the interview at the end of the three-week experience sampling period.

The participants identified ease of use, relevance, necessity, appearance, cost, functionality, convenience and trend as important technology adoption influences in line with the attractors in the MTA. In addition, participants identified durability (how long the technology is likely to last before needing replacement) and compatibility (how well it

works with other technology they already own) as other factors which influenced adoption decisions. Another strong motivator for adopting new technology was necessity. Necessity was not considered in the study by Carroll et al. (2002) as the participants were all given a particular technology to use whether they needed it or not. It could be said to be related to the MTA attractor 'expected usefulness/convenience'. However, in the context of this study, it was defined as the technology being needed in order to the user to perform a task associated with their work/study/interests.

The MTA acknowledges the social constructionist view that technology shapes and is shaped by society. The consideration of social influences in the MTA at Level 1 is through the factors of 'fashion/style' and 'Our Stuff'. 'Our Stuff' is considered by Carroll et al. (2003) to be a composite concept that relates to factors that fit with a user's generational style and environment. Its vague definition does not easily suggest reliable methods for measurement. In the current study this gap was addressed through the use of identity theory to examine participants' relationship with social roles and influences. Some investigation of social influence on adoption decisions was undertaken by asking participants how they gathered information about new technologies that they were considering adopting. This gave an insight into the different sources of social influences on adoption decisions. Some participants reported the strong influence of family and friends and their experiences and choices. For example, several participants said they would buy a particular mobile phone because their friends had one and it seems to meet their friends' needs well. Other participants relied on the advice of shop assistants and websites to inform them of the benefits and problems with the technologies. One participant commented that they didn't ask their friends they just "went to the sales person and got all the information from him… and pamphlets".

As this study asked participants about their appropriation of technology subsequent to their adoption decisions, it was sometimes difficult to distinguish between factors that both influenced their initial adoption decisions at Level 1 of the MTA and those that continue to be appropriation/disappropriation criteria at Level 2. For example, perceptions of the ease of use of technology could only be considered by the participants after some time of use - their initial recall of the ease of use of the technology was clouded by subsequent use. Participants were prompted to consider appropriation influences for online sites and services in addition to physical technologies. When it came to social networking technologies, the actions and choices of their friends were found to have a major impact. This connects to the social management criteria within the MTA which

identified any time/any place, asynchronous and low-cost issues as important to continued appropriation along with a critical mass among the participants' social group. At the time of the current study, many participants were making the transition from MySpace to Facebook. Several participants said that they made the change only because a large number of their friends had, so in order to keep in contact with them online they had to change as well. This was also the case for some participants who were members of interest-based online communities such as gaming forums or art-sharing sites.

In the case of some technologies, participants' adoption decisions were directly influenced by institutional requirements. An example of this is the university's learning management system which was a required tool in all the participants' courses. This relates to the factor of necessity as university-required technologies and online services are not essentially things students would adopt by choice. It was evident in the study that in terms of appropriation of technology across contexts, very few participants had adapted their personal technologies to support their academic study. This is consistent with the findings of several other large studies of high educational students' technology use (Kennedy et al., 2007; Margaryan, Littlejohn, & Vojt, 2011, Thompson, 2013). To further explore this concept participants were asked if there were any technologies that they used in their everyday life that they thought could be useful in their studies. The majority of participants struggled to identify any instances where their everyday technologies could support their studies. Some suggested that they would like to see more YouTube videos included in classes or to be directed by lecturers to videos that could be useful to their personal study. Two participants suggested that recordings of lectures that they could view on their laptop or listen to on their mp3 players for revision would be helpful.

The MTA refers to ease of learning as an appropriation/disappropriation criterion. In this study participants were asked about the methods they used to learn new technologies and how easy they found it to 'pick up' new technologies. Responses to this question found that trial and error, asking peers for help, and reading the manual were methods participants used to learn a new technology. This finding challenges the assumption that all students take a trial and error approach to learning new technologies which features in some literature relating to digital natives (Dede, 2005).

In order to identify factors that had influenced disappropriation of technology the participants were asked if there were any technologies that they had purchased but then not used, either at all, or in a very limited way. Examples of disappropriated technology

included games consoles and instant messaging services. In relation to social networking, many participants had recently stopped using one social network (MySpace) and had adopted a new service (Facebook). At the end of the three-week experience sampling period the participants were asked if there were any technologies that they had stopped using during those three weeks and what influenced their decision to stop using the technology. This was used to gain a recent perspective on technology disappropriation in an attempt to minimise recall issues.

Participants were also asked if there had been any changes in how they used their current technologies. The MTA recognises that there is a continuous cycle of reinforcement and that disappropriation could result from any changes in a user's evaluation of technology. There were few examples of changes in technology use in the limited period of the experience sampling. Some students had begun to access their social networking sites less frequently, however this was found to be in response to greater study time pressures and not seemingly because they were considering disappropriating the technology.

Overall the MTA provided a useful perspective through which to view students' technology adoption and use. The strength of this approach is that it considers both pre and post adoption of technology across multiple contexts. It also acknowledges the overlap between factors which attract a user to a technology and the criteria for appropriation/disappropriation over time. Its weaknesses include limited consideration of social influences on the levels of appropriation. Also, the factors that act as reinforcers (or factors that lead to disappropriation) in Level 3 of the model need development so as to provide more guidance on how these factors can be researched. Another weakness of the model is that it was originally designed with a focus on the adoption of a single technology rather than examining general adoption behaviour. While it was used in this study to explore the suite of technologies used by participants, some amendments may be needed to make it more suitable to multiple technologies across multiple contexts. Such amendment should include the addition of attractors and/or appropriation criteria to address factors such as durability, compatibility and necessity. Further guidance is also required on methods that are suitable to measure the social factors of the model and how these methods can be conducted to study technology appropriation and disappropriation over time. Further research into the utility of the model is required to examine how it can be applied to changes people make between the same technology when they update to a new version or brand of a technology or online service.

Identity Theory in the Study

In this study the concept of identity was approached from a number of perspectives. Participants' various identities, including their academic identity, were examined and compared to their technology ownership and use. The design of the aspects of the study related to identity was influenced by a study of the use of technology in the academic context by Benson and Mekolichick (2007) who used identity theory to explore whether students' conceptions of self influenced their use of technology as part of learning. The study used five measures to study the relationship between identity and technology:

1. Use of digital technologies
2. Level of comfort in using digital technologies
3. Cognitive commitment to academic identity
4. Desire to use digital technologies
5. Computer Self-efficacy

The study found that "Those with stronger commitment to the academic role (student or faculty member) are more likely to use and be comfortable with digital technology" (Benson & Mekolichick, 2007, p. 508). In this study, data was collected throughout the various methods to address each of the five measures. In the initial interview we explored the students' learning goals and strategies to build a profile of their commitment to their academic role. Students were asked why they decided to come to university and what they wanted to get from their degree. We then explored their study approaches in more detail including how they studied during session and in preparations for assessments/exams, and whether they preferred to study on their own or in a group. We also asked how confident the students felt in participating in classroom and online discussions as part of their courses. Desire to use and level of comfort in using technology were explored in the initial interview and combined with data from the survey and ESM on use of technology.

Most of the participants in the study enrolled in university with a clear career path in mind. Those few participants who did not have a defined career path chose degrees in disciplines related to their interests and which they thought may lead to good job prospects in the future. There was little variation in general approaches to study with most students adopting very traditional study methods. These methods included reading textbooks, revising lecture notes, rewriting class notes, completing exercises and listening to lecture recordings. Some difference could be observed in the effort and timing of preparation for exams. However, this did not always correlate to the participant's identity

as a student. For example, one participant claimed to rarely study for exams, but his engagement with his area of study was strong throughout his subjects and he often went beyond the requirements of the course to make sure his knowledge of the discipline was substantial. For example, he would spend time online researching the types of theatre and techniques they were studying in class and share his findings with his classmates. Few participants showed a preference for their other life activities over their study commitments. Two exceptions to this were participants who were involved in a number of community activities which they considered important to their personal development as a professional in their fields. Therefore the majority of participants in the study demonstrated a considerable commitment to their academic identity.

In addition to academic identity, the participants' other identities were explored using data from across the various datasets. In particular, the experience sampling method and end-of-day summaries provided an overview of participants' daily activities and were used to prompt discussion of identity in the second interview. The observation of participants' online activities also feed into this discussion. This gave an insight into the identities participants assume across the various contexts and activities in their lives (i.e. work, social, family). It was clear that participants' identities were strongly linked with their hobbies and interests. Some participants allowed their identities to cross contexts, especially through the use of social networking platforms, where others preferred to keep the different parts of their lives separate. Several participants harnessed the power of social networking and communication tools to maintain and enhance contact with people in similar social groups/roles.

A significant challenge in this study was to get participants to consider and comment on their own identities. In many cases the participants were unable to clearly articulate their perspective on their social roles and groups. There was also some inconsistency between how participants interpreted their own identity with what they actually did. For example, the traits that some participants promoted in their online profile were different to the traits they described and demonstrated in the interview. The multiplicity of individuals' identities and the fact that the interview itself could be seen as "a forum for the production and re-presentation of identity" (McLeod, 2000, p49) further complicates these interpretations. Participants also found it difficult to associate their identity with their use of technology. While the social and reflexive nature of identity theory would suggest that individuals are aware of the meanings attached to their version of the self, this study

corresponded with the view that the self is made up of both conscious and unconscious motivations (McLeod, 2000).

While identity theory can be used to address the multiple social influences on young people and their technology use, the complexity of the theory and its measures makes it difficult to extrapolate useful recommendations. As participants were not able to discuss their own identities to the extent required by this research, examination of the data collected through the experience sampling method and online observation was undertaken to identify relevant issues. This was successful in forming a broader picture of participants' identities especially in relation to social contexts, but it lacked the detail of personal perspectives and motivations. Links between identity and technology use were also observed, but again could not be explored in detail. This complexity therefore reduced the usefulness of this theory in studying this particular phenomenon.

Discussion

The use of theory to inform research into students' use of technology in their everyday lives and academic study allows the conceptualisation of uses and contexts in a way that enables broader understanding and sharing. This study used a theoretical framework based on theories of technology appropriation and identity to examine this phenomenon. The model of technology appropriation allowed for the examination of the factors that influenced the initial adoption and ongoing adaption/disappropriation of technology across the contexts of participants' lives. To strengthen the focus on social contexts and influences, identity theory was used to examine the relationship between participants' roles and groups in society with their technology use. The combination of these theoretical perspectives gave a distinct view of students' technology adoption and use that provided useful understandings as well as challenges.

The understanding of the influences on technology engagement enabled through the use of these theories provides several useful insights to inform educational practice. Despite the fact that the participants of the study demonstrated a strong commitment to their student identity, their use of technology in the academic context was limited primarily to those technologies required by their course. There was little evidence of students intuitively adapting their everyday technologies to support their studies, which is consistent with findings from other studies in this field (Kennedy et al., 2007; Margaryan, Littlejohn & Vojt, 2011; Thompson, 2013). Educators should therefore not assume that students have the skills and knowledge to use a wide range of technology in the academic context. Suitable

support is required to help students to adapt technology for the purpose required by the learning activity (Buzzard, Crittenden, Crittenden, & McCarty, 2001; Gros, Garcia, & Escofet, 2001; Kennedy, Gray & Tse, 2008; Ng, 2012).

A greater understanding of the factors that influence students' decisions to adopt and adapt technologies can inform how technology-based activities can been designed and articulated to students. Students demonstrated an approach to technology that was discerning and purposeful, personalising their technology in very practical ways to meet their personal and social needs (Corrin, Bennett & Lockyer, 2013). In designing technology-based activities educators need to consider the purpose of the technology in the context of the activity and make this clear to students (Kennedy et al., 2009; So, Choi, Lim, & Xiong, 2012). If a particular technology provides value to the activity this should be explained to students (Ng, 2012). Alternatively, if an activity doesn't require a specific tool or technology flexibility could be given to students to allow them to discover a technology that they feel meets the need of the task. The factors that led students to disappropriate technologies should also be considered in order to minimise these influences throughout learning activities.

The broad scope of examining students' engagement with multiple technologies across multiple contexts presents a significant challenge to research in this area. Understanding the various practices associated with technology engagement in everyday and academic contexts was complicated due to the diversity of motivations and influences. This challenge has been identified in other studies of students' technology engagement. For example, a mixed methods study conducted across two universities in the UK found that technology adoption across contexts of students' lives is "influenced by complex interdependencies" (Margaryan et al., 2011, p.438). Selecting theories to address this broad scope was difficult. By combining two theories into a framework more territory could be explored, yet there were still several aspects of the study that fell outside this framework.

The specific examination of the link between technology use and learning was one aspect that was wasn't adequately addressed by the study's framework. The study collected data about the technologies that students used to support their studies, but the impact of that use on the students' processes of learning was beyond the scope of the theories used. There is also a need to consider the further difference between learning that happens in formal and informal contexts and the role technology plays in supporting this learning.

These contexts may also impact students' agency to make their own choices about the technologies they adopt and use (Jones & Healing, 2010). In a study of Finnish students it was found that students didn't necessarily see technology as a tool to support learning (Valtonen et al., 2011). Understanding the link between technology use and learning is vital to using findings to inform educational approaches.

The decision-making process relating to the adoption of a new technology is influenced by many factors, some of which were beyond the scope of the model of technology appropriation. In particular the model needed to be clearer on how social impacts on appropriation decisions were to be measured. The inclusion of identity theory in the framework for the study was to help strengthen the social focus. However, the difficulty of the research participants in articulating factors related to identity reduced its usefulness in providing a deeper understanding of social influences. Further development of the model of technology appropriation is required to clarify the role of social influences, or alternatively the framework requires the addition of another theory that can provide such perspectives.

Another challenge to the research is that it is limited to only a small time period of students' academic studies. The study examined first year students who had recently made the transition from school to university. This factor has implications from both the technology appropriation and identity perspectives. In their first year, students are still developing ideas of their self as a student. They are getting used to institutional culture and education systems and may not have had the opportunity or need to investigate additional technologies. From an identity perspective, as students progress through their studies their student identities move towards more professional identities as they prepare to enter the workforce. This vocational focus will be more evident in some disciplines more than others. There may also be transitions and changes in students' personal lives which will impact their technology adoption and use. A longitudinal approach is needed to form a better understanding of how students' interaction with technology changes over time (Mendoza, Carroll, & Stern, 2008; Ramanau, Hosein, & Jones, 2010).

Related to this concept is the need for a greater understanding of the transition between technologies over time. Adoption studies often look at how people adopt technologies that are new to them. However, as technologies constantly evolve the idea of upgrading technologies or transferring between similar technologies (e.g. moving from a laptop to a tablet) needs more investigation. This can add to the understandings around technology

appropriation and how previous experiences with technologies influence new adoption decisions.

A result of the lack of theoretically informed research in educational technology is limited understanding of how theories can be applied to such phenomenon (Bennett & Maton, 2010; Bennett & Oliver, 2011; Jones & Czerniewicz, 2011; Phillips, Kennedy & McNaught, 2012). The ability that theory affords to consider and present findings in a meaningful and comparable way is restricted by a lack of development in methods and analyses in the area. This is not to suggest that brand new theories are needed. Rather, more work is needed on how existing theories can be applied as part of theoretical frameworks to address the complexity of the field (Bennett & Maton, 2010). In this study a limitation of both theories was the development of associated research measures to adequately explore the phenomenon from those perspectives. In particular, the uncertainty around how to explore participants' identity and its relation to technology engagement limited the usefulness of this theory. A greater sophistication in research approaches can provide more useful understandings to inform education practices.

It is now time to turn our attention to theories that can help to further our understanding of technology engagement across the contexts of students' lives. In a society where technological options are expanding and decisions about adoption and adaption are ongoing, theories that can help to understand technology appropriation behaviour at a more general level are needed. To date, the majority of technology adoption and appropriate models have focused on specific technologies or systems primarily in organisational settings. Theories are needed which can cater for the range of social and personal influences on adoption decisions.

Conclusion

The complexity of how people choose and use technology challenges the ability of a single theory to encompass all the factors that may influence people's technology choices. As a result, research has continued to push the boundaries of theoretical models to seek more comprehensive ways of studying this phenomenon. This paper outlined how a theoretical framework, using the module of technology appropriation and identity theory, was used to investigate students' use of technology in their everyday and academic lives. While this approach provided new perspectives on this phenomenon through a detailed study of social and appropriation factors that influence technology use over time and across different contexts, there are still a number of elements that fell outside the scope of the

theories used. We suggest that future research needs to incorporate theory so that the understanding of the diversity in students' technology engagement can be better understood.

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CHAPTER 5

TECHNOLOGICAL DIVERSITY: AN INVESTIGATION OF STUDENTS' TECHNOLOGY USE IN EVERYDAY LIFE AND ACADEMIC STUDY

Corrin, L., Lockyer, L., & Bennett, S. (2010). Technological diversity: An investigation of students' technology use in everyday life and academic study. *Learning, Media and Technology, 35*(4), 387-401.

Abstract

Generational generalisations regarding how students interact with technology have been used in recent times to prompt calls for radical changes to the delivery of teaching in higher education. This article reports on a study aimed to investigate first-year students' technology access and usage in two contexts of use: everyday life and academic study. A survey was delivered to first-year students across seven faculties of an Australian university during the second semester of the 2008 academic year. A total of 470 respondents met the criteria for this study. The findings suggest a wide diversity of usage of technologies with the usage rates of technology in academic study being generally lower than those in everyday life. These findings indicated that generational generalisations are not useful in informing the design of learning and teaching in higher education. However, there are questions regarding reliability of current survey-based methods to examine students' technology use and the level of diversity discovered across both contexts of use. This suggests that further in-depth research into how students shape technology to suit their lives is required to gain a greater understanding of how technology can effectively support teaching and learning.

Introduction

Recent calls for changes to teaching and learning strategies in higher education as a result of increasing access to and usage of technology have been significantly driven by generational generalisations. The 'Digital Natives' or 'Net Generation' construct is based on the idea that the majority of students who are currently taking part in our higher education system were born into a generation that has grown up surrounded by technologies and have therefore developed an inherent ability and reliance on technology across all contexts of their lives. The attributes of members of this generational group are often defined as an advanced ability to multitask, a dependence on technology to maintain

social contact, a willingness to share content and the ability to adopt and adapt new technologies to their personal needs (Dede, 2005; Oblinger & Oblinger, 2005; Prensky, 2001). However, recent studies have challenged this idea of a technological homogeneous generation and shown instead a diversity of technological experiences and aptitude – especially in relation to how students use technology as part of their academic studies (Kennedy et al., 2008; van den Beemt, Akkerman, & Simons, 2010). The extent of this diversity is still largely unexplored in the current research and questions over the reliability of the current survey-based methods of collecting information about students' adoption and usage of technology suggest that more in-depth research is needed in this area. This article presents the findings from a study examining first-year students' access to and use of technology across the contexts of everyday life and academic study. For the purposes of this study age has been used as the defining criteria of the digital natives group, including those students born in or after 1980.

Literature review

The concept of Digital Natives (Prensky, 2001) or the Net Generation (Tapscott, 1998) has developed over the past decade based on assumptions of technological propensity of students born after 1980 (Oblinger & Oblinger, 2005). These students, who are now entering, studying and graduating through higher education systems, are said to exhibit a number of new and common characteristics including a high level of digital aptitude, the ability to multitask, literacy in multiple media, constant connectivity, the need for speed in delivery of information, a culture of sharing information and a unique attitude towards education as a result of their significant level of exposure to technology over the course of their lives (Barnes, Marateo, & Ferris, 2007; Dede, 2005; Frand, 2000; Oblinger & Oblinger, 2005; Prensky, 2004). The identification of this 'radical' shift in student aptitude and behaviour has prompted many to suggest that teaching approaches in higher education need to be changed to accommodate the new learning needs of this generation and to address the divide between the technological abilities of 'Digital Native' students and their 'Digital Immigrant' teachers (Oblinger & Oblinger, 2005; Prensky, 2001).

Other researchers have cautioned that such changes to higher education need to be based, not on the rhetoric and anecdotal evidence upon which much of this digital natives discussion has been founded, but on empirical evidence derived from comprehensive research into students' interaction with and use of technology (Bennett, Maton, & Kervin, 2008; Helsper & Eynon, 2009; Kennedy et al., 2006). As a result, a number of survey-based

studies have emerged examining students' ownership and levels of common uses of technology (Garcia and Qin, 2007; Kennedy et al., 2007). These surveys have found a general increase in ownership of technologies and the rate of participation in a range of online activities, but also show that there is still a wide variance in technological aptitude and online activities of digital native students. These findings have challenged the notion of the age-based homogenous group of technological expertise and have prompted some researchers to shift to the use of levels of usage and experience as a more appropriate basis for defining who is a 'digital native' (Bullen et al., 2009; Dede, 2005). However, the diversity and complexity of the ways that students use technology make such distinctions hard to support and are therefore often ignored in discussions of generational generalisations (Helsper & Eynon, 2009).

Recent research has moved beyond studies of general uses of technology to examine the way students adapt technologies to support their learning. Kennedy et al. (2007) suggest that any discussion of changes to teaching in universities needs to be informed by an understanding of how technologies can be translated from personal technologies into 'learning technologies'. Several studies to date have observed some transference of everyday life technologies into the academic context, but to a far less extent than had been expected (Kumar, 2009; Selwyn, 2008).

It is apparent from these studies that methods of research into the factors around students' use of technology to support their learning need to delve further than the current survey-based methods have allowed. There is also a question of the reliability of these forms of surveys in terms of a shared understanding of technological terms and contexts of use that has not been addressed adequately in the current Digital Natives' literature. Whilst the findings from such survey-based research have made a significant contribution to the development of the discussion around digital natives and university teaching strategies to date, future studies need to employ more extensive research methods to explore in more detail the factors that influence students' technology adoption for learning support.

Methodology

This article is based on data collected as part of the first phase of a doctoral study examining the way first-year students use technology as part of their everyday life and academic study. An anonymous paper-based survey was delivered to 547 first-year students across seven faculties of an Australian university during the second semester of

the 2008 academic year. The survey collected demographic data including age, gender, degree and enrolment-specific data (full/part-time, domestic/international). These data were collected to determine if respondents met the criteria of the participant group.

Inclusion criteria for the participant group were set in order to generate a probability sample reflective of the typical first-year student in the university in which the study was conducted. The university's enrolment data indicated that the majority of first-year students were full-time, domestic students. An age limit for participants was set at those students born in 1980 or after to correspond with the most popular generalisations of the digital native/net generation literature (Palfrey & Gasser, 2008; Tapscott, 1998). Students were then asked to self-rate their ability in relation to using technology as either beginner, intermediate or advanced.

The next section of the survey asked students to indicate the technologies to which they had access. Students were asked to indicate their level of access to a range of common technologies as either exclusive use/ownership, shared access, limited access or no access at all. The list of technologies presented to respondents included technologies that could relate to either the contexts of everyday life or academic study or both including desktop computers, laptop computers, electronic organisers, portable music players, digital cameras (still and/or video), mobile phones, memory drives, games consoles, GPS navigators and internet access (dial-up and/or broadband).

The next two sections of the survey examined usage of technologies across the contexts of everyday life and academic study. Reference to previous Australian and UK-based studies (Kennedy et al., 2007; Trinder et al., 2008) contributed to the design of two lists of common technology-based activities, one of activities most commonly undertaken as part of everyday life and the second of activities most commonly associated with academic study. To ensure that the survey was an appropriately short length, it was necessary to be selective taking into consideration technology available in the institution. Whilst some items were specific to a particular context, where possible equivalent items were included in both lists to allow for comparative analysis between contexts. To get a sense of how regularly students use technology they were asked to indicate the frequency which they undertook the activities on a four-point scale from daily, weekly, occasionally or never.

Prior to administration of the survey instrument, content validity (Nardi, 2006) was determined through a review by several research colleagues with knowledge across the

areas of survey design, quantitative research and educational technology. Additionally, the reliability of the survey instrument was evaluated using a test re-test reliability test conducted by using a separate cohort of 25 students. The test re-test reliability coefficients showed that the access section of the survey had a coefficient of 0.852 ($p = 0.01$) which indicates a good and acceptable level of reliability (Groth-Marnat, 2009). However, the technology activities sections showed lower levels of reliability with the coefficient of everyday life activities being 0.703 and academic studies being 0.547. One possible explanation for the low reliability coefficients is variability in students' definitions of technologies and contexts. A shared language of technology does not appear to exist which would allow for consistent responses across all students. These coefficients reflect the limitations of this kind of survey research in reliably measuring students' use of technology and these limitations will be discussed in more detail in the results section of this article.

In conducting the analysis for this article the frequency of use was recoded from the four to three categories of usage: 'high' usage incorporated both 'daily' and 'weekly' responses whilst 'occasionally' become 'low' and 'never' became 'non'. Frequencies of everyday life and academic study activities were examined and when diversity in usage levels was found cross-tabulation of demographic and usage variables was undertaken using Chi-square tests to explore relationships.

Results

Data for this study were collected during the first three weeks of the second semester of the 2008 academic year. The study took place in the second semester of the students' first year so that students had already had some experience of technologies incorporated in university-style learning and teaching and the opportunity to adopt personal technologies that they considered useful to their study. The survey was administered in lectures and tutorials in nine subjects across seven faculties of the university.

Of the 547 responses collected, 470 met the participant criteria, a representation of 16.5% of the total 2008 enrolment of students in this criteria group. In terms of demographics, the age distribution showed that the majority of respondents were born between 1988 and 1990 (85.3%). These students represented those who had recently completed high school or were entering university after a gap year. The distribution of gender was skewed slightly towards females with 64% females and 35.7% males, which was slightly higher than the university's ratio of 52% female to 48% male. A large proportion of respondents

belonged to the Education faculty which can explain in part the slightly higher ratio of females than males. In terms of disciplines, the faculties were recoded into two main groups, Humanities and Social Science (Arts, Commerce, Creative Arts, Education and Law) which made up 44% of the respondents, whilst the other 56% were from science-based disciplines (Science, Informatics, and Health and Behavioural Science).

Contrary to the assertions of several authors (Oblinger & Oblinger, 2005; Prensky, 2001) regarding the high level of digital literacy of digital native students, responses varied when respondents were asked to self-rate their general level of ability with technology. Only 23.2% of students classified their ability with technology as advanced, with the majority (67%) rating themselves as intermediate and 8.5% rating themselves as beginners. In terms of gender almost double the proportion of male respondents (34.4%) viewed themselves as advanced technology users than females (17.4%). This finding contradicts recent studies including Gunn et al.'s (2003) UK longitudinal study which found that over time (10 years) the gap in ability and confidence between males and females narrowed. However, Hargittai and Shafer (2006) found that whilst males and females had similar abilities in relation to their use of online technologies, females self-assessed themselves as having lower online skills than males.

Access

The level of access to technologies was generally high across the most common technologies with students either owning or having substantial access to desktop computers (92.4%), laptop computers (84.3%), mobile phones (100%), USB drives (96.6%), digital cameras (88.9%) and portable music players (88.6%). Computer ownership showed that students were more likely to own a laptop (73.4%) than a desktop (61.5%); however, 44.4% indicated that they owned both. These findings show that the access to computers is almost ubiquitous with only 0.4% (or two students) indicating that they have limited or restricted access to either a desktop or laptop computer.

The most popular technology in terms of access was found to be the mobile phone with 469 out of 470 students owning a mobile and the remaining one student having shared access. Interestingly 42.8% of students indicated that their phone was 3G which is substantially higher than the findings of 25% 3G phone ownership reported in an Australia-wide survey of mobile phone usage conducted around the same time by the Australian Interactive Media Industry Association (AIMIA Mobile Industry Group, 2008).

Access levels were also high (96.6%) in relation to access to broadband Internet, with only a small proportion still accessing the Internet though dial-up facilities (27.4%).

Full access levels were found to be significantly lower for other technologies including electronic organisers (5.5%) and GPS navigation (15.7%). As students, these technologies may not be seen to be relevant to their lives or, in the case of GPS, be viewed more as a luxury item rather than an everyday technology. In terms of PDAs, they have been traditionally seen primarily as a business tool which may impact their adoption rates. However, the lower adoption rates could also be attributed to the fact that many mobile phones are now offering PDA-style functionality making the purchase of a PDA unnecessary.

Everyday life activities

A large variation was observed in relation to the responses to the use of technology in everyday life (see Table 1).

Table 1

Use of technology in everyday life

Activities	n	High	Low	Non
Use a computer to create or edit audio and/or video	469	74 (15.8%)	212 (45.2%)	183 (39%)
Share photos online with friends and family	470	235 (50%)	207 (44%)	28 (6%)
Write a blog	469	34 (7.2%)	127 (27.1%)	308 (65.5%)
Build or maintain a website	465	78 (16.8%)	60 (12.9%)	327 (70.3%)
Download and listen to podcasts	467	117 (25.1%)	158 (33.8%)	192 (41.1%)
Read other people's blogs	468	128 (27.4%)	187 (40%)	153 (32.6%)
Use RSS feeds	454	28 (6.2%)	57 (12.6%)	369 (81.3%)
Use a computer/game console to play games	469	157 (33.5%)	205 (43.7%)	107 (22.8%)
Use a computer/mobile phone/PDA as a personal organiser	468	279 (59.6%)	94 (20.1%)	95 (20.3%)
Buy or sell items online	470	42 (8.9%)	238 (50.6%)	190 (40.4%)
Do your banking and pay bills online	469	192 (40.9%)	121 (25.8%)	156 (33.2%)
Send and/or receive emails	468	434 (92.7%)	29 (6.2%	5 (1.1%)
Use a mobile phone to make calls	470	451 (96%)	16 (3.4%)	3 (0.6%)
Use a mobile phone to send text (SMS) messages	470	463 (98.5%)	4 (0.9%)	3 (0.6%)
Use social networking websites (ie. MySpace, Facebook)	470	382 (81.3%)	40 (8.5%)	48 (10.2%)
Use instant messaging or chat (ie. MSN, Yahoo Messenger)	470	293 (62.3%)	118 (25.1%)	59 (12.6%)

Communication-based activities showed the highest frequency of use, especially using a mobile phone to send a text message (98.5%) and to make calls (96%). Overall mobile communications displayed the highest frequency of use and the lowest percentage of non-use. Only slightly less in term of frequency of activity was the more traditional method of online communication via email (92.7% high usage). Interestingly 1.1% of respondents reported that they did not use email communication at all which is surprising given that the university makes use of email as a channel for the distribution of important information and that all students are given an email address upon enrolment. Communication via instant messaging tools also showed a high level of adoption (87.4%) although usage was less frequent than mobile phone and email communication.

Using social networking sites returned the third highest figure in terms of high frequency of use with 81.3% of students using social networking on a daily or weekly basis. Whilst the Digital Natives literature has reported that the need for constant connectivity is a major characteristic of the Digital Natives generation (Frand, 2000; Philip, 2007; Prensky, 2001), 10% of students reported that they had never used social networking websites. Other online socialisation activities such as sharing photos with friends and family also showed high levels of adoption (96%).

Using technology to play games was undertaken by a majority of students surveyed (77.2%) although mostly on an infrequent basis (43.7%) rather than daily or weekly (33.5%). A higher proportion of male students (90.4%) played games compared to their female peers (69.7%) in the participant group ($p < 0.001$, Chi-square = 71.5, df = 2); however, the strength of this relationship was relatively weak (Cramer's V = 0.391).

Whilst communication and social networking activities displayed high levels of adoption, activities involving the creation of content showed much lower adoption rates. Only 7.2% of students wrote a blog on a daily or weekly basis and 65.5% of students had never undertaken this activity. Similar low rates of usage were found in relation to creation and maintenance of websites with 70.3% of students not engaging with this activity at all. These findings correlate with those of a recent study of students in the Netherlands which observed production of interactive media was very low despite high levels of engagement in other technological activities (Van den Beemt, Akkerman, & Simons, 2010).

Academic study activities

In comparison to the average frequencies found for the use of technology in everyday life, frequencies of use for academic study were much lower (see Table 2).

Table 2

Use of technology in academic study

Activities	n	High	Low	Non
Use a computer to create or edit audio and/or video	469	30 (6.4%)	131 (27.9%)	308 (65.7%)
Share photos online	468	36 (7.7%)	105 (22.4%)	327 (69.9%)
Write a blog	469	11 (2.3%)	53 (11.3%)	405 (86.4%)
Build or maintain a website	464	12 (2.6%)	35 (7.5%)	417 (89.9%)
Use a computer to create presentations (ie. PowerPoint)	465	102 (21.9%)	315 (67.7%)	48 (10.3%)
Access information online	465	433 (93.1%)	29 (6.2%)	3 (0.6%)
Download and listen to podcasts	465	58 (12.5%)	129 (27.7%)	278 (59.8%)
Read other people's blogs	465	30 (6.5%)	86 (18.5%)	349 (75.1%)
Use RSS feeds	455	11 (2.4%)	31 (6.8%)	413 (90.8%)
Use a computer/game console to play games	463	21 (4.5%)	32 (6.9%)	411 (88.6%)
Use a computer/mobile phone/PDA as a personal organiser	463	215 (46.4%)	83 (17.9%)	165 (35.6%)
Access eLearning space (the University's online learning website)	465	457 (98.3%)	6 (1.3%)	2 (0.4%)
Send and/or receive emails	466	394 (84.5%)	66 (14.2%)	6 (1.3%)
Use a mobile phone to make calls	465	281 (60.4%)	111 (23.9%)	73 (15.7%)
Use a mobile phone to send text (SMS) messages	464	303 (65.3%)	103 (22.2%)	58 (12.5%)
Use social networking websites (ie. MySpace, Facebook)	465	151 (32.5%)	131 (28/.2%)	183 (39.4%)
Use instant messaging or chat (ie. MSN, Yahoo Messenger)	465	121 (26%)	118 (25.4%)	226 (48.6%)

The activity with the highest frequency of adoption in the academic study context was access to the university's online learning system (eLearning Space) with 98.3% of students accessing this site on a daily or weekly basis. Jones and Healing (2010) observed in their UK study of location habituations that institutional requirements have significant impacts on the motivation of students to use certain technologies. A possible interpretation of this finding is that whilst institutional requirements had a positive effect on students' use of the university's elearning system in this study, it is possible that institutional teaching methods had the opposite effect on the engagement with other technological activities such as writing blogs or creating websites. A possible lack of learning activities explicitly

designed to use technologies within the course could explain the low adoption rates to a certain extent. However, these figures also suggest that students may not be adopting these technologies through personal choice to support their studies as suggested in the literature (Conole et al., 2008).

Accessing information online (99.4%) also showed a high frequency of adoption by students followed by emailing (98.7%) and using a computer to create presentations (89.7%). In general communication tools, which are more likely to be adopted by students for individual needs than because of the formal requirements of academic study, showed relatively high levels of adoption with 84.3% of students communicating by voice and 87.5% by text on mobile phones in relation to academic studies. Just over half (51.4%) of students used instant messaging as a method of communication for academic purposes whilst 60.7% communicated via social networking sites. With regards to social networking a statistically significant higher proportion of students from the Humanities and Social Studies Faculties (70.5%) engaged in social networking activities than those from Science Faculties (52.7%) ($p < 0.001$, Chi-square =17.2, df = 2). Similar relationships were found in relation to blogging (Humanities = 20.3%, Science = 8.4%, $p = 0.001$, Chi-square = 13.9, df = 2) and sharing photos (Humanities = 38.8%, Science = 23.3%, $p = 0.001$, Chi-square = 15.03, df = 2).

Comparison of everyday life and academic study activities

An underlying assumption of the Digital Natives discussion has been a willingness and ability of students to translate their use of technologies from their everyday life to their academic study (Oblinger & Oblinger, 2005; Prensky, 2001). However, this study has found a considerable difference in the levels of adoption between comparable activities across the two contexts.

Similar patterns of frequency of use were observed in a number of activities including the creation of audio/video, writing a blog, building websites, listening to podcasts, using RSS feeds (see Figure 7), using technology as a personal organiser, and communication via email. However, in each of these activities the frequency was higher in everyday life than in academic study.

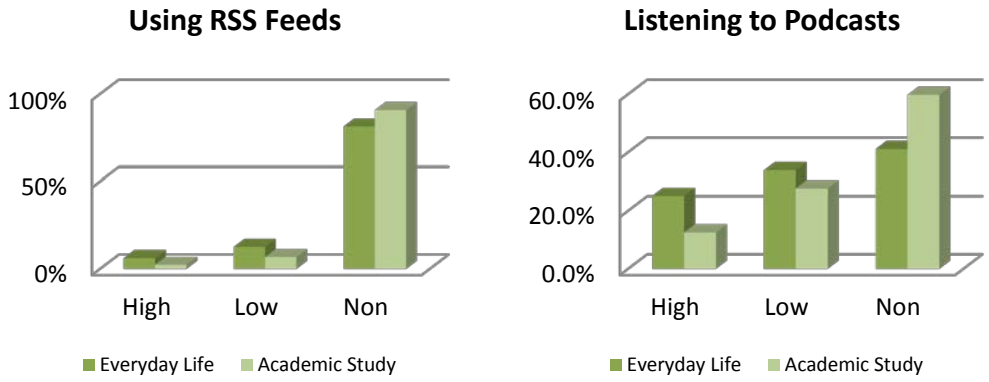

Figure 7: Everyday life and academic study frequencies of activity

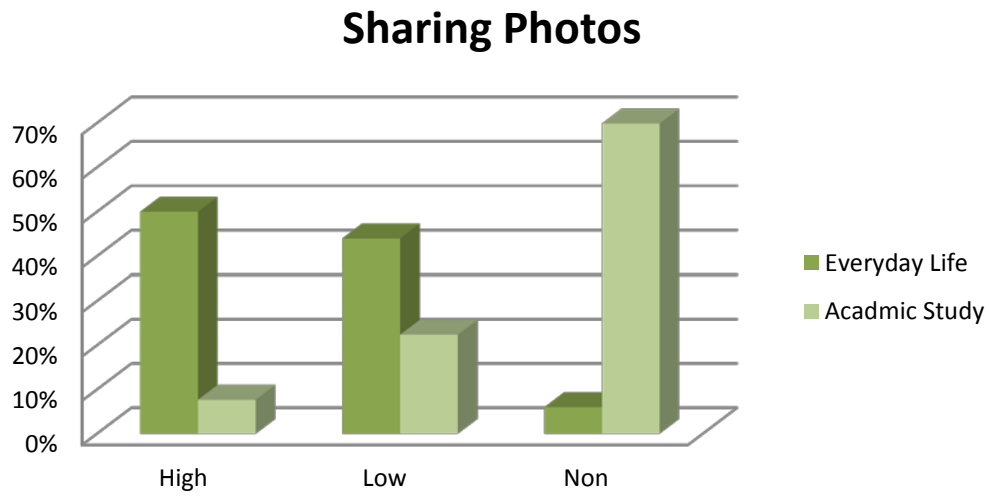

Figure 8: Inverse relationship between everyday life and academic study

In relation to reading other people's blogs, playing games and communication via mobile phone, the patterns of frequency were found to be inconsistent. Alternatively, inverse relationship between everyday life and academic use were found for the activities of sharing photos online (see Figure 7), using social networking sites, and the use of instant messaging.

Discussion

The notion of Digital Natives has been used as a powerful generalisation in calls for changes to educational strategies in higher education. However, this study has demonstrated that there is enough diversity in ability, access and use of technology by first year university students to suggest that a technological homogenous group of students cannot be assumed. Whilst respondents indicated a high frequency of engagement with

some technological activities, they indicated that others including those most commonly associated with the Digital Native generation (e.g. writing a blog), showed low frequencies. This warns of the disparity between actual level of technological ability and use, and the assumptions of educational institutions in setting curriculum and teaching approaches (Conole et al., 2008).

Overall levels of technology access and use found in this study indicate a slight increase over those found in previous similar studies (Kennedy et al., 2007). However, it is important to note that whilst respondents indicated high levels of engagement with some activities, they noted little engagement at all with others. Closer inspection of demographic variables such as gender and faculty offered little explanation for this variance in findings. In the context of everyday life, a statistically significant relationship was found between gender and game playing ($p < 0.001$, Chi-square = 71.5, df = 2), but not between gender and other activities in everyday life or academic study. From a faculty perspective, relationships were observed between students of the Humanities and Social Science Faculty and writing blogs ($p = 0.001$, Chi-square = 13.9, df = 2), website creation ($p = 0.005$, Chi-square = 10.6, df = 2) and social networking ($p < 0.001$, Chi-square = 17.2, df = 2), but not in relation to any activities in everyday life. These intricacies of engagement with technology and online activities provide valuable insights into students' worlds and should not be overlooked when designing learning activities (Guo, Dobson & Petrina, 2008).

The analysis of the relationship between the frequency of use of technology between students' everyday life and academic study found a lower level of use of technology in the context of academic study. This finding varies from those of other studies that claim that students are actively adopting and personalising technologies to support their learning (Conole et al., 2008). In contrast, in this study several inverse relationships were observed between usage in everyday life and academic study including sharing photos, using social networking sites and instant messaging. This disparity between usage rates of technologies in everyday life and academic study indicates that whilst students have the aptitude for using certain technologies this does not automatically translate into a want and/or ability to transfer these skills to the academic context. However, the higher adoption rates of some technologies in the academic context could be seen to indicate that technologies have an increasing role to play in higher education (Kennedy et al., 2008).

An important consideration in the analysis of the findings of this and similar studies is the reliability of the survey instrument. The test re-test reliability test for the survey used in this study indicated that the activities sections of the survey had a low reliability coefficient, especially the section on usage of technology in academic study. Definitions of technologies and contexts also pose difficulties for the reliability of the survey's findings. In the study conducted by Kumar (2009) it was noted that analysis of how students adopt technologies in their academic context is complicated by how students define 'educational use' when responding to the survey. Whilst students seem to identify use of technology prescribed as part of their course as educational use, it is less clear if students also identify self-directed use of technology as part of study activities as educational use.

These reliability issues prompt the question of whether these types of surveys are providing the information needed to inform the Digital Natives discussion. There are now a number of survey-based studies that have emerged and have gone some way to dispelling the idea of a homogenous group of highly technologically literate students, but the stories behind the statistics could allow a greater understanding of influences on students' selection, adoption and adaption of technologies across both everyday and academic contexts of their lives. Only recently have studies started to emerge that go beyond surveys of ownership and activity and provide more in-depth views of students' technology use (Czerniewicz & Brown, 2010; Jones & Healing, 2010); however, the full results of such studies are (at the time of writing) yet to be published. Further research into the area is necessary to gain perspectives on how and why students use technology in the way they do (Hargittai, 2007; Lei, 2010).

The research reported in this article outlines the first part of a study aimed to gain a more detailed perspective of students' technology use across their everyday life and academic study. The subsequent phase of this study uses a case study approach to investigate students' adoption and adaption of technology to support their learning needs. A purpose sample of students was identified from the survey respondents and these students were firstly interviewed to collect more detailed information about their technology ownership and choices. The participants then took part in a three-week experience sampling method study coinciding with observation of online social networking activities. At the end of this period the students were interviewed again and given a chance to comment on their technology usage. Analysis of this data is still taking place, and it is anticipated that the findings will provide a better understanding of students' perspectives and use of

technology to support learning so that policy-makers and academics can be better placed to make more effective decisions about the use of technology in higher education.

Conclusion

The diversity of students' use of technology in both their everyday life and as part of their academic study found in this research indicates that generalisations based on Digital Native generational concepts are not useful to discussions about changes to learning and teaching strategies in higher education. It was also apparent from the findings that adoption and use of technology to support learning in the academic context was generally lower than usage levels in everyday life which challenges the assumption that students are adopting and personalising technologies to support their learning. However, questions over the reliability of the survey-based design of the current and recent studies combined with the level of diversity discovered across everyday and academic contexts of use suggests that further in-depth research into how students shape technology to suit their lives is required to gain a greater understanding of how technology can effectively support teaching and learning in higher education.

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CHAPTER 6

COMPARING THE NUANCES OF TWO FIRST YEAR UNIVERSITY STUDENTS' USE OF TECHNOLOGY

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Abstract

Research on young people's engagement with technology has shown that, contrary to popular claims that all young people are 'digital natives' or members of a 'Net Generation', a diversity of technology adoption and use exists. Few studies to date have explored higher education students' technology engagement in an in-depth manner, going beyond questions of access and how often they use technology, to explore the factors which influence how and why technologies are used. The study presented in this paper used a mixed methods approach to investigate students' technological lifestyles. This paper profiles two students, selected from the larger study, who have widely divergent engagement with technology. It explores how and why they use technology in their everyday and academic lives. These cases demonstrate the diversity of adoption and use of technologies found across all contexts of the students' lives influenced by factors of lifestyle, personal interests, social priorities, career aspirations and personal values. A greater understanding of these nuances relating to technology engagement can inform approaches to engaging young people with technology in education to develop more efficient teaching and learning strategies.

Introduction

There has been considerable focus in recent literature on how young people use technology. Much of this has been stimulated by claims that *all* young people are highly proficient with technology by virtue of their exposure since birth (see Prensky, 2001; Tapscott, 1998 for original propositions). Subsequent empirical research has consistently identified significant diversity in technology use among young people, simultaneously discrediting the original assertions and revealing important considerations for educators and researchers interested in effective technology integration (Garcia & Qin, 2007; Jones & Ramanau, 2009; Kennedy et al., 2007).

With the proliferation of new technologies and their increasing prevalence in all realms of society, it is more important than ever to understand the technology practices students bring to education. Recent surveys provide insights into which technologies are adopted and the extent of their use by higher education students (Kennedy et al., 2007; Margaryan, Littlejohn, & Vojt, 2011). Several studies have moved beyond simple access and activity data to explore how young people are using particular technologies, such as social networking (Boyd, 2008) and the Internet (Hargittai, 2010). However, few studies have explored in detail how the many technologies that students use across the contexts of their lives are used and why. In-depth studies of individuals' lives across the various contexts in which they socialise, study and work are needed to develop a sophisticated understanding of technology use. This could then inform our thinking about how we can engage young people with technologies in education in ways that are sensitive to their values and practices and therefore more likely to be successful.

This paper presents findings from a mixed methods study that investigated university students' technological engagement. The study consisted of fourteen student case studies of technology adoption and use across everyday and academic life contexts. Specifically in this paper, we discuss two students who are widely divergent in the technologies they use and how they use them, but are driven by a similar desire to adopt and adapt technologies that suit their needs. By focusing on only two cases we are able to present greater detail of technology engagement which would not be possible if all cases were to be presented. These two particular cases were chosen for their ability to demonstrate the differences and similarities in students' approaches to technology which were evident across the whole study. The findings are significant for what they reveal about the nuances in students' technology adoption and use and the influence of lifestyle, personal interests, social priorities, career aspirations and personal values on their engagement with technology. The purpose of this paper is to reveal the lessons for higher education that the exploration of these students' approaches to learning and technology provide.

Methodology

The study was designed to explore first year university students' engagement with technology across the contexts of their everyday life and academic study. The research was guided by the following questions:

1. To what extent do the patterns of technology use of first year university students reflect the notion of 'digital natives'?

2. How do first year students select and adapt technologies to suit their learning goals and strategies?
3. How does first year students' use and preference for particular technologies relate to the identities they adopt in everyday and academic life contexts?

The two-phase design comprised (1) a sampling survey, the results of which informed the sample for (2) a collective case study involving sequential and concurrent data collection methods. The mixed methods approach provided multiple perspectives on students' engagement with technology across a broad array of contexts and technologies. The collection of multiple sources of data and analysis of data across and within phases allowed for detailed investigation and triangulation of data to improve the reliability and coverage of the findings.

From a theoretical perspective, the research design was informed by models of technology appropriation (Carroll, Howard, Vetere, Peck & Murphy, 2002) and theories of identity (Benson & Mekolichick, 2007). Use of the model of technology appropriation facilitated exploration of the influences and process of technology adoption and subsequent adaption of the technology to the students' personal and learning needs. This was combined with consideration of the identities students adopt when using technology to provide a perspective on technology engagement across the different contexts of their lives.

The purpose of the first phase of the study was to investigate the context of academic and everyday life technology use amongst first year university students. It was also used as a recruitment and selection mechanism for the second phase of the study. Phase 1 involved administration of a paper-based survey to students in first year courses across seven faculties at an Australian university in 2008. The choice of first year courses provided access to a large number of students across disciplines and majors (i.e. despite the students' subsequent choice of major they are all required to take core first year subjects). The study was undertaken in the second semester of the academic year so that first year students had some experience of higher education and technology use on which to comment.

The survey included questions about the students' access to technology, self-rated ability with technology, technology-supported activities spanning everyday and academic contexts, and demographic information. A total of 547 responses were collected which represented 16.5% of the first year cohort of the University. The dataset was reduced to

only those respondents born in or after 1980 (i.e. those students who fit within the 'digital native' age definition). The remaining 470 responses were analysed using descriptive statistics to characterise the sample (Corrin, Lockyer, & Bennett, 2010) and to identify potential participants for the cases in Phase 2.

Phase 2 used a collective case study design to investigate the similarities and differences in the phenomenon of young people's engagement with technology (Stake, 2005). Each case profiled a student's unique technological lifestyle. This approach enabled within-case and cross-case analysis (Creswell, 1998) to explore commonalities and variances in participants' behaviour and activities. The collective case study approach also allowed the multiple cases to be compared to the typical profile of a 'digital native'.

From the potential participants identified in Phase 1, a selection matrix was developed based on a purposive sampling approach (Creswell, 1998; Walter, 2006). The aim was to include a variety of cases to reflect the technological experience and study discipline diversity, of the population being investigated. The selection matrix was comprised of the gender, degree/faculty, living arrangements, travel time, level of ability, and averages of the technology access and activities fields. The values for each of the 130 students who indicated they were interested in participating in Phase 2 of the study were entered and compared. Analysis of the data led to the selection of twenty participants who represented different points along the spectrum of the selection matrix criteria. Of the 20 students who were invited to participate, 16 agreed to take part in Phase 2 – each serving as an individual, holistic case. Attrition during the data collection period reduced the total number of cases to 14.

Participants in the second phase of the study were invited to an initial interview designed to gain a detailed understanding of their technology-based activities and approaches to study. The participants' results from the initial survey were used to guide discussion. The interview was followed by a three-week technology activity record during the academic semester comprised of:

- A modified experience sampling method (ESM) activity in which case participants were asked to record daily technology-based activities in a structured diary format. Participants were prompted, via text message, to record technology-based activities at three random times throughout the day as well as to complete an End-Of-Day (EOD) summary.

- Researcher-recorded observations of participants' online activities which were identified in the initial interview. This occurred concurrently with the ESM/EOD activity and involved the participants providing access to the social networking, blogging, and discussion forum sites that they used. The researcher accessed participants' online activity nightly and recorded this in an observation template which classified activity into one of three categories: communicate, create and consume.

Participants were interviewed again at the end of the three-week period where they were provided with a summary of the activities recorded and observed and given an opportunity to expand on their description of their technology use in light of these findings. In this second interview further exploration was also undertaken of the relationship between participants'' technology use and identity in everyday and academic contexts.

Analysis of the data took place throughout the study as data from one method often informed the design of the data collection in another method. At the end of the study all data sources were integrated and analysed. Individual case summaries were then developed for each participant using an analytic framework encompassing: experiences with technology in everyday life, learning goals and strategies, experiences with technology as part of academic study, and adoption and adaption of technology. This analytic framework allowed for cross-case analysis to be conducted, examining similarities and differences in students' engagement with technology. The next section of this paper presents two of the case summaries profiling participants with diverse approaches to technology adoption and use.

Results

Lucy

Lucy was a 20-year-old Bachelor of Biomedical Science student. She chose her course as a stepping stone to a postgraduate degree in either medicine or forensic anthropology. Prior to starting university, Lucy spent one year travelling and living overseas. Originally from a small town several hours away from the university, Lucy lived in a campus residence during semester.

Lucy reported that she had limited exposure to technology as she was growing up. Her family purchased a computer only a few years before she started university. At high school she resisted using technology to support her study until her final two years. Now at university, she said that she felt she used the Internet more than some of her peers, but everything else "much, much less". The ESM/EOD and observational data showed that she made limited or no use of some technologies. Lucy did not own a USB drive, a PDA or a portable music player. She rated herself as an intermediate user of technology. When discussing technology in the interview there were several technologies with which Lucy was not familiar at all including podcasts, blogs and RSS feeds.

Experiences with Technology in Everyday Life

Lucy's use of technology in her everyday life was limited due to her lack of interest and access to a range of technologies. Although Lucy owned a laptop, she mainly used university computers in the labs on campus and in her residence for her everyday and academic online activities. She claimed that her laptop was "really, really old so I only ever use it if I want to watch a movie". During semester, Lucy had access to the Internet via the university's network; however this was metered so she was very conscious to regulate her everyday usage to avoid additional charges. When at home she made use of her family's desktop computers and had broadband Internet access.

Lucy owned a digital camera which she used to take photos that she shared online with friends via Facebook. She did not trust the university's network for uploading photos so waited until she was home to put them online. Similar security concerns stopped Lucy from conducting her banking, paying bills or shopping online: "I'm a bit paranoid about, you know, how people can get card numbers and stuff". However, she was happy to use the Internet for other activities such as playing games, accessing Facebook, participating in online forums and visiting her favourite websites.

Lucy had originally set up her Facebook profile to keep in contact with friends and family at home while she was travelling overseas. However, by the time she got back she was "hooked on it" and continued to use it as a way to keep up to date with her friends' activities. Lucy reported that she did not typically log into Facebook on a daily basis, instead her access was more sporadic and she could go for weeks without logging in at all. During the data collection period Lucy accessed Facebook on eight of the 21 days (38.1%) - she accepted friend requests, played games, updated her status, changed her profile picture, joined groups, wrote on group walls, and added new applications.

Lucy enjoyed using technology to play games. She played simulation and strategy games on the Internet, via Facebook, on her brothers' and friends' games consoles, and on her phone. She indicated that she would have played online games more often at university if her Internet quota was not restricted.

Lucy's concerns about the university's Internet quota restrictions impacted her use of technology for communication. Before coming to university, Lucy had regularly used MSN to instant message her friends. However now at university she was concerned about how much quota this activity would use. Instead she made use of email to keep in contact with family and friends and due to the fact she did not own a USB drive, she also used email to transfer files between computers. Despite her preference for emails, Lucy only sent 17 emails during the data collection period.

Lucy owned a mobile phone which she used occasionally to make calls and play games. The cost of phone credit meant that Lucy kept her mobile usage to a minimum. As she didn't use her mobile regularly, Lucy reported that she would often leave it in her room. During the first interview when asked if she had her phone with her, Lucy replied: "The only reason I have it is because I broke my watch and until it gets repaired I need my mobile to tell the time". Lucy had only ever sent one text message, explaining it took her "half an hour to write a sentence", after which she decided it was too time consuming to do on a regular basis.

Learning Goals and Strategies

Lucy was very committed to her studies. She always attended classes, actively studied and prepared well in advance for assessments. In her personal study time Lucy would read textbooks, complete practice exercises and read over the notes she had taken in class. She indicated a strong preference for individual study over group study.

Experiences with Technology in Academic Study

The structure and requirements of her course meant Lucy regularly used email and the University's learning management system (LMS). Lucy accessed the LMS to print lecture notes, participate in online discussions, and to complete online quizzes. She used email regularly to check university notifications and messages from group members about assessments. Her assignment groups conducted most of their communication via email as their conflicting study timetables made it difficult for them to find a common time to meet. Just prior to the ESM period one of Lucy's assignment groups set up a Facebook account

for communication. Lucy used the Internet to conduct further research on topics that interested her in class or course content that required further clarification.

Adoption and Adaption of Technology

When Lucy used technology she did so for a particular purpose and only knew enough about the functionality she needed. She was not interested in exploring new technologies; instead her choices were influenced heavily by university requirements or peers to maintain social connections (e.g. Facebook). When she adopted a technology that was prescribed as part of her degree she would first learn the functions that she was required to use, "then I start finding things I like about it". She said she was a bit scared of new technology and her motivation to learn something new was driven by how interesting she found the technology: "It depends how much I want to use it, if it was, say a new game, I'd probably figure it out, but if it was like some assignment I'd probably procrastinate and not learn it very well".

When purchasing a new technology, Lucy asked friends for their opinions to inform her purchase and was not interested in technologies with many new features. Instead she said "the cost, how it could be used and whether it looks nice or not" were her main considerations.

In summary, Lucy was a purposeful user of technology and used it primarily to facilitate her social life, play games, and support her studies as necessary. Her use of technology was more sporadic than regular and influenced by concerns for costs and security.

Trent

Trent was a 22-year-old Bachelor of Health and Physical Education student. Prior to starting this degree, Trent worked and commenced, then discontinued a degree at another university. He decided to study education as he felt that it would equip him with transferable skills for his prospective career as a politician: "I'm here for my career before my career". Trent considered teaching as a good career for establishing himself as "a valuable member of society" which complemented his significant involvement in community and political organisations in his home town. During the data collection period Trent was heavily involved in a local government political campaign. Trent lived between two houses, both approximately one hour from the university, and commuted daily to attend classes.

Trent considered himself an advanced user of technology and said he felt comfortable using technology as he uses it all the time:

> I use technology for most things. I tend to integrate it into everything. I don't use technology explicitly, I don't use pen and paper explicitly, I work across both fairly easily. If I'm sitting at my computer I'll nearly always have textbooks laid out next to me as well.

Trent was not exposed much to technology as he was growing up: "I never had the Internet at a house that I lived at until I paid for it myself two years ago… and we never had telephones in our house either".

Experiences with Technology in Everyday Life

Trent owned a desktop computer and laptop. He made limited use of his desktop computer because it was not connected to the Internet. Trent used his laptop for word processing and online access. However, he said his laptop was unreliable and often froze when doing complex tasks. When he wanted to work on graphics, music or video projects for his community groups and personal interests he transferred relevant files from his laptop to use on his desktop computer via USB drive.

Trent used the Internet to stay up to date with the latest news and political developments. He also used the Internet to research the best prices for items he wanted to buy, but he did not make purchases online because he did not have a credit card. Trent was wary of Internet security issues so did not like to transfer money or do banking online.

One of the most common activities for which Trent used technology was communication. During the data collection period Trent made extensive use of his mobile phone, sending 337 text messages and making calls every day. This confirmed his claim that he was rarely without his phone: "it doesn't leave my side and I use it all day". He indicated that he would like to use his phone to access the Internet, but the cost was prohibitive. Trent also used instant messaging for communication. He logged in to MSN at night to talk to friends as an inexpensive alternative to calling or texting. He also accessed his email every time he was online.

Trent used a range of social networking sites. For his individual profile, Trent recently moved to Facebook having previously used MySpace and Bebo. At first he approached Facebook as a fun, social network, however over time he changed to using his profile to

promote his professional image. For example, he removed some photos of him at parties and changed his profile photo to one of him giving a speech at parliament house: "suited up, notes in hand, at the lectern, mid-sentence, and I've got the Australian and Aboriginal flags behind me… because that's the look that I need". Trent saw his status updates on Facebook as way to let people know what he was working on. He wanted to capitalise on the networking opportunity that broadcasting his activities could create with acquaintances he had met through his various community and political projects. As his Facebook friends included several high-profile politicians, he made sure anything he posted showed him in a good light, as "someone you would vote for". Trent also used Facebook to stay up-to-date with the activities and projects in which his politician and community group acquaintances were involved. For several of his community groups, Trent was responsible for updating MySpace pages with the group's latest news and activities.

Trent enjoyed playing games using technology. However, time, limited Internet access, and the processing power of his laptop prevented him from doing so very often. He indicated that his preference for games had changed from console-based individual games (he owned a Playstation 2) to online games where he was able to play against other people (e.g. Scrabble, Word Twist, Nations). During the ESM period he played games on ten of the 21 days.

Learning Goals and Strategies

Trent's social style was evident in his approaches to academic study. Trent read through study materials on his own and then discussed the concepts with peers to reinforce them. This was through informal conversations had outside the classroom, rather than a formal study group. He said he was always an active participant in class discussions and also posted to discussion boards on the University's learning management system. However, he did not like the format of the online discussion boards which he claimed made the conversations very difficult to follow. He expressed disappointment at the lack of engagement by other students with online discussions.

When preparing for exams, Trent created question and answer-style study notes from the notes he took in class, lecture notes and prescribed textbooks. He then asked someone to test him using these questions and answers. For one particular exam he made an audio recording of the important concepts and played it on his iPod in the car on the way to the exam.

Experiences with Technology in Academic Study

Trent regularly logged in to the university's learning management system to download lecture notes and participate in online discussions. He enjoyed using technology as part of assessment tasks, which recently included a video production, creation of PowerPoint presentations, and the evaluation of online educational games. In particular, Trent enjoyed learning activities in which technology was used to develop creative work. For a recent group assignment, Trent's group set up an email address to which all the group members had the access details. When a group member came across articles or resources that were relevant to their assignment they would email it to this address so everyone was able to view them.

Trent was satisfied with the extent of technology used in his course, but would also like it to be used to give students more flexibility. The university has a campus near where Trent lived and he suggested that more lectures should be video conferenced to this location to reduce the travel burdens on students in the area. He also wanted lectures to be recorded so he could review them if it was too difficult for him to get to campus. Trent admitted that he attempted to fit his university studies around his other priorities, but in some cases his other commitments took first preference.

Adoption and Adaption of Technology

Over the past few years Trent adopted a wide range of technologies which he used to support his social, community, political and study commitments. While he was interested in adopting newer versions of the technology he owned, his purchases were ruled by cost considerations. For him, each purchase had to be justified as a definite need. When Trent used something new, he trialled each of the technology's functions to determine which were most useful to him. He preferred to learn by trial and error rather than consulting instruction manuals or getting guidance from others. He liked to continually develop his technical skills especially in the areas of video editing and website development, and used resources from the Internet to teach himself.

In summary, Trent was an active user of a range of technologies that supported his diverse interests and commitments, although this use was limited by cost considerations. Trent enjoyed learning about new technologies and was particularly interested in how technologies could support and facilitate his future career.

Discussion

The predominant definition of digital natives assumes that all young people are highly digitally literate with a common set of characteristics regarding their approaches to technology, communication and learning. While previous research has shown that not all young people equally demonstrate digital native characteristics (Kennedy et al., 2007; Margaryan, Littlejohn & Vojt, 2011), the current study sought to investigate the extent to which university students' technology engagement and approaches to learning reflected the notion of digital natives. The cases of Trent and Lucy provide the opportunity to explore in greater detail some of the more common assumptions inherent in this stereotype.

It is often claimed that young people are constantly using a range of technology to support their lifestyle (Philip, 2007; Prensky, 2001). It was apparent from the case data that neither Lucy nor Trent used technology on a constant basis, yet Trent used technology more often and for more purposes than Lucy. The data from Trent and Lucy's ESM observations showed that there were several days within the three-week data collection period when they interacted with technology very little, if at all. The exception to this was Trent's use of his mobile phone which he used throughout the day for calls and messages. Whilst both students used a variety of online and social networking services, they did not access these services on a daily basis. For example, Trent only accessed Facebook on nine of the 21 days observed (42.9%) and Lucy on eight of the 21 days (38.1%).

Lucy and Trent had access to several technologies each, but not a vast range as the stereotype suggests. Both had access to laptop and desktop computers, mobile phones, Internet and digital cameras. Trent also had access to an mp3 player, USB drive and games console. However, closer examination of how they used these technologies found unexpected and/or limited use. For example, whilst Lucy owned a laptop, her only use of this technology was to watch movies. Similarly, she only made use of her mobile phone for calls and games, but not messages or other functions. These examples show that caution should be exercised when making assumptions about technology use based on ownership statistics alone. Just because a person owns a technology they may not have the ability or interest to use the full range of features of that technology (Jones & Healing, 2010).

Costs, lifestyle, interests and social involvement influenced Lucy and Trent's use and ownership of technology. They both identified cost as a limiting factor to their ownership of additional or more advanced technology. As they both had limited incomes, their

technology purchases were driven by absolute need rather than interest. Financial considerations also impacted Lucy and Trent's access to a range of supporting services for their technology use (e.g. data plans for their phones, credit cards for online purchases).

Lucy and Trent had very different lifestyles, but had both personalised the technologies they had adopted to best suit their interests, social priorities, study commitments and community involvement. Lucy was very focused on her studies and much of her technology adoption was driven by university requirements. Trent customised his technology use to suit the aspects of his busy lifestyle, for example, using audio recordings of study notes so that he could fit study into his commuting time. In particular, he used technology to facilitate his community and political activities to build a public profile which would strengthen his chances for a future political career. His community activities also provided him an opportunity to develop audio, photography and video projects which were personal interests of his.

Contrary to what is often the central claim of the digital native stereotype, neither Lucy nor Trent showed a high level of technology literacy. Trent took some interest in new technology and had a good working knowledge of the technologies he used most frequently, but he identified that there were several areas in which he lacked skills (e.g. video editing and website development). Lucy acknowledged in her interview that she knew the main functions of the technology to which she had access but "not much more". When interviewed Lucy indicated that she was unaware of several common technologies including blogs, podcasts and RSS feeds.

Another factor that may have influenced their technology literacy was the length of time they had been exposed to technology. Fundamental to the digital natives stereotype is the assumption that all young people are digital natives because they grew up surrounded by technology (Prensky, 2001; Tapscott, 1998). However, both Lucy and Trent indicated that they had limited exposure to technology as they were growing up. Lucy had only started to use computers and the Internet in her final two years at high school. Trent's family didn't have a telephone throughout his childhood, and it was only when he was fourteen that his family purchased a computer. It was not until after Trent had completed his secondary school education that he gained access to the Internet at home. This finding is consistent with a large study of primary and secondary school children in the UK between 2001 and 2003, around the time Trent and Lucy were finishing primary school, which found that in low socio-economic areas only 81% of students had access to a computer and 65% to the

Internet at home (Kent & Facer, 2004). Selwyn (2004) makes the related point that a digital divide still exists that isn't just tied to socio economic status, but can be influenced by a number of complex social factors.

In their technology use, Lucy and Trent showed few innovative uses of technologies. It is often supposed that digital natives are constantly pushing the boundaries of technology's capabilities, demanding more from technology and keeping up with the latest trends (Tapscott, 1998). Trent showed some interest in keeping up with new developments in technology, but had not adopted many of these in his own practice. Lucy was not interested in keeping up with new technologies and allowed her technology adoption decisions to be determined by institutional requirements and the social tools of choice of her friends.

Another area where Lucy and Trent's behaviour varied from the stereotype was in relation to expectations of technology use in education. Both Lucy and Trent made use of the technology prescribed by the university as part of their degrees. This included accessing learning materials and participating in online discussions on the university's learning management system, and use of email to communicate with other students and academic staff. There was only limited evidence in either case to show any transfer of personal technologies to the academic context. This corresponds with the findings of several other studies of higher education students which found that students do not necessarily have the skills or knowledge to translate the functions of their everyday technology into support tools for their academic study (Kennedy et al., 2007; Kumar, 2009). Where they did use their personal technologies to support their studies they took a very purposeful approach customising how they fit this technology use in with their own personal learning goals and strategies.

There was also no indication that these students had a new or different approach to learning that would lead to an expectation of more technology in the classroom. Both students employed fairly traditional study techniques and technology played a limited role in their study approaches. This is consistent with the findings of Margaryan, Littlejohn & Vojt (2011, p.438) who found no evidence of radically different learning styles amongst students; rather they observed a "deficit of learning literacies".

Neither Lucy nor Trent used technology for their studies in an experimental or innovative way. Despite the existence of new technology and tools that could support their studies,

they rarely adopted anything outside technologies prescribed by the university. Contrary to claims that students are demanding more technology to facilitate their learning (Prensky, 2001; Tapscott, 1998), Lucy indicated she was happy with the level of technology used. Trent indicated that he was open to new creative technology experiences, but his main request was one of convenience (e.g. video conferencing of lectures) rather than of learning.

Implications for education

The comparison of Lucy and Trent's cases has shown many similarities and differences in their adoption and use of technology in their lives. However, both cases demonstrated the purposeful way students approach their use of technology. These students are driven by goals in their personal and academic lives and choose and adapt their technologies specifically to meet those goals. This finding provides an insight that is significant to higher education in that the use of technology in the classroom should be linked to the goal or outcome of the learning. Technology that is peripheral to the learning activity may not be adopted/adapted by students if it does not directly facilitate the attainment of their learning goals. This finding also suggests that continued use of a technological tool will only occur if the students can find a benefit in using the technology which can be transferred to their other learning goals and/or general interests.

The variety of technologies to which Lucy and Trent had access and their differing levels of interest in new technologies raises a number of important considerations for the implementation of technology-based activities in education. Support for how a technology is to be used in the academic context should be provided for students who have not previously had access to the technology, as well as for those students who have used the technology before but in a different context. It should not be assumed that students will have knowledge of all of the functions of the technologies that they own and/or the ability to adapt the technology to their studies. Support may be required that relates the technology's functions to the task's requirements. The diversity of students' technological experiences suggests that flexibility in support for technology-based activities is needed to cater for the differing levels of technical literacy and learning approaches.

Contrary to popular claims about digital natives, neither of the students in these cases showed a strong desire for more technology to be integrated into the classroom or any particularly innovative ways they had adapted technologies to support their learning goals and strategies. Lucy's lack of interest in keeping up with new technologies and Trent's

busy lifestyle are factors which may have limited their ability to devise ways that technology could make their approach to study more effect and efficient. They both had adapted existing technologies to cover their study needs, but may have developed alternative solutions had they had greater knowledge of technology options/services available. There appeared to be little or no support from the university to expose students to ideas about how technology could support their studies generally, outside support for course-specific learning tasks. As previous studies have found that students rarely instinctively translate everyday technologies into academic technologies (Kennedy et al., 2007; Kumar, 2009), there exists an opportunity for higher education institutions to educate students on technology opportunities that could support their studies. Whether integrated directly into the students' academic programs or as an additional resource for students, such support could demonstrate to students the usefulness of technology in meeting their needs and supporting their academic interests.

Conclusion

Consistent with the findings of several recent research studies, Lucy and Trent's cases demonstrate diversity in adoption, adaption and use of technology across all the contexts of their lives. Similar diversity was a feature of all the cases which formed part of this research (see Corrin, Bennett, & Lockyer, 2013, for more student case summaries). The data showed that diversity in technology engagement was influenced by factors of lifestyle, personal interests, social priorities, career aspirations and personal values.

However, it is important to note that even when technology use appeared to be consistent with a common digital natives' characteristic, further in-depth exploration often showed practices that were inconsistent with the generalisation of the characteristic. On the surface students' technology use may appear to be similar or not from the stereotype, but when we look closer, nuances can be found. The complexity and fluidity of students' technology engagement indicates that it would be inadvisable to base decisions about design, support and assessment on digital native-style generalisations of students' technology aptitude. Instead, a greater understanding of such nuances can provide useful insights into factors that may impact students' adoption and use of technology in education. In turn these factors can influence details of how technology-based learning activities can be designed, implemented and supported in more effective ways.

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CHAPTER 7

DIGITAL NATIVES: EXPLORING THE DIVERSITY OF YOUNG PEOPLE'S EXPERIENCE WITH TECHNOLOGY

This chapter presents eight of the participant case studies. The selection of the eight case studies was undertaken in the initial analysis of the data after the second interviews had been conducted. Due to the structure of the thesis being that of a series of publications it was recognised that only a limited number of cases could be presented across the publication. This decision was made to allow for the level of detail to be given which was necessary to demonstrate the diversity of students' experience with technology. It was felt that eight would be a suitable number to fit into a book chapter which allowed a slightly longer format than a standard journal article. From an initial analysis of the 14 cases it was clear that, while there was diversity across every case, focus on a smaller subset would be suitably representative for the key aspects of this study. The eight case studies were selected to include a range of technology access, ability with technology, gender, age, and discipline. Therefore only these eight cases were developed into full case summaries.

Corrin, L., Bennett, S. & Lockyer, L. (2013). Digital Natives: Exploring the diversity of young people's experience with technology, In Huang, R., Kinshuk, & Spector, J. M. (Eds.) *Reshaping Learning - The Frontiers of Learning Technologies in Global Context* (pp.113-138), New York: Springer-Verlag.

Introduction

As Turkle (2011, p.19) observed "Technologies, in every generation, present opportunities to reflect on our values and direction". Based on the assumption that the current generation of young people who have grown up surrounded by technology have an innate ability with and preference for technology in all aspects of their lives, the concept of 'Digital Natives' (Prensky, 2001) or the 'Net Generation' (Tapscott, 1998) has prompted much discussion and debate about the role of technology in higher education. Whilst several research studies have since shown that these labels cannot be universally applied to the current generation of higher education students (Jones et al., 2010; Kennedy et al., 2006; Margaryan et al., 2011), the process of challenging the digital natives claims has identified the need for a more in-depth understanding of the motivations, attitudes and practices of young people in relation to technology.

This chapter presents the results of a study designed to provide a greater insight into young people's adoption and use of technologies across everyday life and academic contexts of their lives. Multiple methods of data collection were used to compile in-depth cases studies examining first-year higher education students' learning preferences and access, frequency of use, preferences, adoption, and adaption of technology. The unique profiles which resulted highlight the diversity of technology experience of young people and in some cases provide what may seem like counter-intuitive insights (Bennett & Maton, 2011) into the motivations and attitudes towards technology. Such insights help to provide a better understanding of the nature of the diversity in students' technology engagement so that educators can make informed choices about when and how to integrate technology most effectively in the classroom.

What Do We Know About Digital Natives?

When the concepts of 'digital natives' and the 'net generation' emerged ten or so years ago this prompted calls for radical changes to higher education in order to cope with this new generation of learners (Oblinger & Oblinger, 2005; Prensky, 2001). Initial claims focused on the identification of characteristics common to all students in this generation. These were said to include a high digital aptitude, a preference for multitasking, literacy across multiple media, a culture for sharing information, a need for speed of information delivery, and a desire to be constantly connected (Barnes et al., 2007; Dede, 2005; Oblinger & Oblinger, 2005; Prensky, 2004). Further claims suggested that young people's constant use of technology had altered their learning preferences. Prensky (2001, p. 1) claimed that ''today's students think and process information fundamentally differently from their predecessors''.

For some time a 'certainty-complacency spiral' existed (Bennett & Maton, 2011). Many in higher education, including educational administrators, accepted the digital natives notion, regardless of the lack of empirical evidence, due to the common sense nature of the generational claims. As empirical research emerged it was found that the alleged generational characteristics were not common to all young people. Instead significant diversity was discovered in relation to young people's access to, use and adoption of technology (Kennedy et al., 2006; Jones et al., 2010; Margaryan et al., 2011). Other studies searched for the existence of a digital generation of learners with radically different learning preferences but found no evidence to suggest that today's students' learning

approaches are incompatible with traditional learning and teaching methods (Garcia & Qin, 2007; Sanchez et al., 2011).

Although the diversity of students' engagement with technology had been established by several quantitative, survey-based studies, there is still a lack of qualitative research that provides an in-depth look at the motivations, attitudes and experiences behind technology adoption, adaption and use (Helsper & Eynon, 2009; Kennedy et al., 2007). Recently a number of studies have emerged which employ multiple methods of data collection to explore this area in greater depth (Czerniewicz & Brown, 2010; Jones & Healing, 2010). However, these studies still use methods which rely primarily on self-reported data from participants in the form of surveys and interviews. In order to provide more in-depth and reliable accounts of students' technology engagement wider methods of data collection need to be employed.

The concept of digital natives, whilst having provided the impetus for much of the recent research into students' engagement with technology, is very technologically determinist in nature (Bayne & Ross, 2007; Helsper & Eynon, 2009). Suggestions for the future direction of this research area call for a move away from a focus on generational labels towards questions around the development of knowledge and experiences (Bennett & Maton, 2011). This involves looking beyond the technology itself to other social and historical factors that may influence young people's technology use. To date, few studies have examined technology adoption and adaption within the various contexts of young people's lives. A greater understanding of the relationship between technology use across the contexts of everyday life and academic study has the potential to aid educators in making more informed decisions about the development and implementation of technology in learning and teaching (Bennett & Maton, 2011; Kennedy et al., 2007).

Looking Closely at Digital Natives

The purpose of this study was to investigate young people's experiences with technology across the different contexts of their lives. The research was guided by the following questions:

1. To what extent do the patterns of technology use of first year university students reflect the notion of digital natives?
2. How do first year students select and adapt technologies to suit their learning goals and strategies?

3. How do first year students use and preference for particular technologies relates to the identities they adopt in everyday and academic life contexts?

The theoretical framework for the study was informed by models of technology appropriation (Carroll et al., 2002) and theories of identity (Benson & Mekolichick, 2007). Specifically, we took the view that people adopt and adapt technologies according to their perceptions and needs in ways that are not necessarily consistent with the original designers' intentions. Furthermore, these individualised patterns of technology use can relate to expressions of identity. This perspective views technology use as a broad array of social practices shaped by personal contexts and preferences, in tandem with technological change. The study used a two phase mixed method design comprising: (1) a survey of first-year university students across a range of disciplines; and (2) case studies of individual students purposively sampled from survey respondents. The paper-based survey was administered during class time in first year courses across nine faculties at the University of Wollongong. Data was collected on access to technology, self-rated ability with technology, technology-supported activities spanning everyday and academic contexts, and demographic information. A total of 547 responses were received. Respondents born prior to 1980 were removed from the sample to focus only on individuals who fit the 'digital native' profile, leaving 470 responses for analysis. Descriptive statistics were used to characterise the sample and the key findings were compared with similar large scale surveys (Corrin et al., 2010).

Case study participants were selected from survey respondents to ensure a cross-section of individuals based on their technology adoption, ability and experience, ranging from those who rarely used technology to those who were heavily engaged. The 14 chosen participants were first interviewed to gain a detailed understanding of their technology-based activities. They were then tracked over a three-week period during academic session using a modified experience sampling method (ESM) which prompted them to complete diary entries about their daily technology-based activities. Participants were sent three text messages each day asking them to provide a series of brief responses and reminding them to complete an end-of-day summary.

During this period, the researchers also conducted observations of online activities to which participants provided access as part of the study. These included activities such as social networking, blogging, and discussion forum posts. Participants were interviewed again at the end of the three-week period and asked further questions about the activities

recorded and observed. These data sources were analysed qualitatively to develop case study accounts for each of the participants. This then allowed for a cross case analysis to be conducted and connections with the theoretical framing to be made.

The REAL Lives of Digital Natives

This paper presents the learning and technology profiles of eight of the case study participants in the study. Each case explores the participants' experiences with technology in everyday life, learning goals and strategies, experiences with technology as part of academic study, and adoption and adaption of technology.

The participants ranged in age from 19 to 21 and were enrolled in a range of programs from Arts, Creative Arts, Education, Information Technology, Law, and Science.

Jessica

Jessica was an 18-year-old Bachelor of Primary Education student who lived at home with her family. She had a daily one hour commute each way to university by train. Jessica felt that a degree in education would equip her with both the theoretical and practical knowledge to become a proficient teacher.

Everyday Life

A self-professed gamer and ''photoshop-aholic'', Jessica rated herself as an advanced user of technology. She owned (or had access to) a laptop and desktop computer, iPod, digital camera (still), mobile phone (not 3G-enabled), USB memory drive, games console and had broadband Internet at home. Jessica was an avid photographer who shared photos that she took at social events with her friends online. Before uploading the photos to Facebook (her preferred method of sharing), Jessica used Photoshop to edit the photos and add effects.

Jessica played games on 19 of the 21 days surveyed on her laptop or Nintendo DS console. She said she enjoyed games of skill and strategy over ''button-mashing'' games. The portability of Jessica's Nintendo DS meant she was able to play games in various locations, in particular, on the train during her commute to university when she connected wirelessly with her friends' consoles so they could play games together.

Jessica used her mobile phone primarily to send text messages. Over the three-week ESM period she sent 328 messages (average 15.6 messages per day) which she claimed

represented her typical text message use. Jessica only used her phone for voice calls if she was trying to locate someone or needed an immediate answer to a question. Whilst Jessica owned a mobile phone with multimedia capabilities, she didn't use these features very often instead using it mainly as a communication device:

> my mobile phone has Internet and photographs and video recording, but I never actually use any of that because the quality is pretty shoddy, so when I have, you know, my actual camera, that I love, I use that instead. So usually it's just to communicate.

Jessica used her iPod to listen to music and podcasts on the train during her commute to university. She listened to radio show podcasts that she wasn't able to listen to live. She also used her iPod to watch television shows both on the train and in bed before going to sleep at night.

Jessica's main online activity was Facebook. She said her friends convinced her to set up an account which she said she checked only ''every now and then''. This was consistent with the data collected during the ESM period in which she logged onto Facebook on nine of the 21 days. Jessica noted that she generally only visited Facebook when prompted by an email alert. When assessments were approaching, Jessica said her Facebook use would drop substantially.

Jessica used the Internet to research the answers to specific questions she had, but didn't generally browse. She used instant messaging occasionally, however she reported that her use was substantially less than before going to university. Jessica did not make use of the Internet to conduct banking or to pay bills. Security concerns and a lack of a credit card deterred her from buying and selling things online.

Academic Study

Jessica said she regularly attended classes and took an active role in classroom activities. She liked to be organised in advance for assignments and examinations. She studied by making handwritten notes from lecture slides and audio recordings of key terms and concepts for revision. Jessica felt that the process of writing out notes from the teaching materials helped her to remember the content.

Jessica made regular use of the university's learning management system to access course materials and communicate with other students via the discussion boards. She used

lecture recordings to catch up on material she had missed or to revise certain content. When searching for resources to support her studies, Jessica first went to the library catalogues as she found this produced more relevant and scholarly sources than a general Internet search.

Jessica communicated with lecturers and tutors via email to ask questions about subject content and assessments. However, when communicating with peers she used text messages and instant messaging, unless files needed to be exchange in which case she used email. Jessica said she made extensive use of the online discussion boards for her subjects to seek help from or assist other students.

Jessica was satisfied with the current level of technology used in her subjects. However, she also appreciated opportunities to learn about new technologies that she may be able to use in her future teaching career.

Adoption and Adaption of Technology

Jessica demonstrated willingness to try and adopt new technologies. She attempted to understand how new technologies worked on her own, before seeking help from friends or a manual. Jessica explored the functionality of the technology before deciding which features she would use. She identified ease of use, relevance, appearance, price and durability as the factors that influence her decision to adopt new technologies. Jessica often consulted friends to see what they used before making her decision. She also referred to manufacturers' websites to check features. However, Jessica only investigated new technologies when she had identified a need, she did not upgrade just because a new technology was available.

Trent

Trent was a 22-year-old Bachelor of Health and Physical Education student. He lived between two houses, both approximately one hour from campus. Trent aspired to a political career but felt he first needed to establish himself as ''a valuable member of society''. He chose education as he felt this was a career that would set him up with many transferable skills. Trent participated in several community organisations and during the ESM period was heavily involved in a political campaign.

Everyday Life

Trent identified his mobile phone and laptop computer as the technologies he used most frequently. He reported that he used his laptop mainly for word processing and accessing the Internet. Trent only had access to the Internet at one of the houses in which he lived and so had to work offline on his laptop when at the house without Internet. Trent also owned a desktop computer; however this was housed at the house without Internet so he primarily used this machine for working on video, music and photos which he transferred between laptop and desktop by USB drive. He was very keen to improve his video editing and website development skills which he was teaching himself using resources from the Internet. During the ESM period Trent also began to learn a language using online tools and free downloadable software.

Trent said that he was rarely without his mobile phone: ''it doesn't leave my side and I use it all day''. He used the phone to make calls, send messages, as a camera and an alarm clock. Trent wanted to use the Internet on his phone, but found it too expensive. During the ESM period he sent 337 text messages, an average of 16 messages a day, and made calls every day. Trent also occasionally used instant messaging to talk to his girlfriend.

Trent frequently used the Internet in order to keep up with the latest news and political developments. When he was at the home without Internet he accessed news via a Pay-TV service. He sometimes used the Internet to check prices on items he wanted to purchase, however he was wary of transferring money online and didn't have a credit card.

Trent used MySpace and Bebo accounts previously, but recently moved to Facebook for social networking. Trent commented that, whilst he had originally approached Facebook as a fun social network, he then changed his profile to make his online presence more business-like including a profile photo of him giving a speech at parliament house:

> suited up, notes in hand, at the lectern, mid sentence, and I've got the Australian and Aboriginal flags behind me… I specifically put that there because that's the look that I need.

Trent considered his use of status updates on Facebook as an alternative to a personal blog. He saw broadcasting his activities and following other people's status updates as a valuable networking opportunity, especially with acquaintances made through his community or political projects. Trent also maintained MySpace pages for two community groups.

Trent claimed that time pressures and the limitations of his laptop stopped him from playing games as much as he would like. When he did play games they tended to be online word games through Facebook which he played against friends (e.g. Scrabble, Word Twist) and strategy games like Nations. He owned a Playstation 2 but hadn't played it in a long time. Likewise, Trent owned an iPod but used it very rarely.

Academic Study

Trent's main study technique was to read. He also liked to reinforce concepts by talking about them with others in an informal way rather than a formal study group. He said he was active in classroom discussions and occasionally used the online discussion board. He thought the format of the online forums was difficult to follow a conversation and thus reduced student engagement. In preparing for exams, Trent made study notes in a question and answer format from textbooks, lecture notes and notes he took in class. He then got someone to ask him the questions to test his knowledge. For one anatomy exam he made a recording of important concepts and played it on his iPod as he drove to the exam.

Trent made use of numerous technologies as part of his studies. He regularly accessed the University's learning management system to download lecture notes and access discussion boards. A number of his recent assessments had involved using technology including the creation of a video, PowerPoint presentations, and the evaluation of online educational games. To support a group assignment Trent's group established an email address to which group members emailed relevant articles so everyone could access them.

Trent said that he would like to see more technology used to expand services to students who can't always get to the University campus. In particular, Trent wanted more lectures to be delivered via video conferencing to the University campus near his homes rather than having to drive to the main campus. He also expressed a preference for more learning activities that allowed him to use technology to be creative.

Adoption and Adaption of Technology

Trent was enthusiastic about adopting new technologies and tools that he could use to support his busy lifestyle. However, his adoption of technology was ruled by cost considerations causing him to justify each purchase in terms of a definite need. When using a new technology, Trent explored and learnt the tool's functions by orderly trialing each function rather than consulting other people or manuals.

Lucy

Lucy was a 20-year-old Bachelor of Biomedical Science student who travelled overseas for a year before starting university. Lucy's home was several hours away from the University in a small town so she lived in university residences during semester. Lucy was enrolled in an undergraduate degree in biomedical science as a stepping stone to a postgraduate medicine or forensic anthropology degree.

Everyday Life

In her everyday life, Lucy used a limited number of technologies in ways tailored to her needs. Lucy rated herself as intermediate in terms of her level of ability with technology. Lucy noted that there hadn't been a lot of technology around the house when she was growing up. She said she had only had exposure to more technologies in the last few years.

She owned a very old laptop which she claimed was only good enough to use to watch movies. For other computer functions she used computers in labs at university or her parents and brothers' desktop computers when she was back at home. She had broadband Internet access at her parents' house; her access to the Internet during the semester at university was metered so she was careful not to use it too much.

Lucy took photos on her digital camera which she often shared with her friends online via Facebook. However, Lucy didn't trust the university computers for doing this activity so waited until she was at her parents' house to upload photos.

When at home, Lucy played role play games such as Diablo on her brothers' games console. She claimed to play games at home ''all the time'' as there wasn't much to do in a small town. When at university Lucy played a number of online games such as Nation States (a simulation game) and various Facebook games.

Lucy owned a mobile phone which she used to make calls although she didn't always keep her phone with her. Lucy reported that she had only ever sent one text message claiming that it took too long to type text messages. Generally Lucy kept her mobile usage to a minimum due to the cost of having to buy more credit. Instead she used email as that was a ''free'' alternative.

Lucy did not own a portable music player, a PDA or USB drive. When she needed to transfer files between computers Lucy emailed them to herself. Lucy was not familiar with

technologies such as podcasts or RSS feeds She commented that she knew what she needed to know about technology to do the things she needed to do, but not much else.

The technology that Lucy claimed to use most frequently was the Internet. She used the Internet to play games, use Facebook, and visit online forums and favourite sites including Uncyclopedia. However, Lucy did not shop online or do banking or pay bills due to security concerns. Lucy originally set up her Facebook account to keep in contact with friends while she was overseas and then ''was hooked on it'' by the time she got back. She found it a very useful tool to keep up to date with what her friends were doing. Her profile displayed information about herself including a short bio, favourite music/movies/TV shows/quotes, and her contact details. During the experience sampling method period Lucy accessed Facebook on eight of the 21 days. She reported that her Facebook usage could be sporadic and sometimes she would go for weeks without logging in.

For communication, Lucy also used email and phone to keep in contact with friends and family. During the three-week ESM period Lucy sent 17 emails. She said she also used instant messaging via MSN, however not as much during semester due to the quota restrictions on her Internet use.

Academic Study

Lucy said she was committed to her studies and regularly attended classes, claiming that she ''hadn't missed a lecture yet''. Her study methods included reading textbooks, doing practice exercises/questions and reading over notes taken in lectures and tutorials. She preferred to study alone and prepared well in advance for assessments and examinations.

Lucy used the Internet to support her studies by looking up topics of interest or clarifying content. She regularly logged into the university's learning management system to access lecture notes and complete the online quizzes required for her course. Lucy also used PowerPoint for some assessments, however not as much at university as she had at high school. Lucy accessed her email on a regular basis as it was the University's method of sending announcements. She also used email to communicate with other students for group assignments as she had found it difficult to arrange face-to-face groups meetings due to her group members' different study timetables. A day prior to the first interview one of Lucy's assignment groups had decided to set up a Facebook group to facilitate discussion.

Adoption and Adaption of Technology

Lucy said she adopted a technology primarily when prescribed as part of her degree. She initially learnt to use functions needed for her study and then played around to see if there were any additional functions she liked. Lucy identified utility, price and appearance as factors that influenced her adoption of new technologies. She said she looked to see that a technology had the basic functions that allowed her to do what she needed and didn't seek out models with extra features.

When researching technology purchases Lucy's only method was to ask friends for their opinion and experience with the technology. Once she had purchased a technology she consulted the manual to work out how to use the main features she needed, then over time she explored additional capabilities of the technology sometimes adopting features if they served a useful purpose.

Michael

Michael was a 20-year-old Bachelor of Information Technology student. During semester Michael lived in university residences as his hometown was three hours from campus. Although initially wanting to work in the field of sports management, Michael chose a degree in information technology as he felt the job prospects were better.

Everyday Life

Michael considered himself an advanced user of technology. The technologies he said that he used most were his laptop and mobile phone. He primarily used his laptop to access the Internet to keep up with news and sports, watch videos on YouTube and use social networking. Michael accessed certain news sites on a regular basis and also read blogs on soccer.

Michael used Facebook to keep in contact with friends. During the ESM period he accessed Facebook on 13 of the 21 days. He occasionally shared photos via Facebook—during the ESM period posted an album of 45 photos of a social event. Michael provided many personal details in his profile including his date of birth, email addresses and former schools. When asked about how he liked to portray himself online, Michael said he presented himself as he is, although he did say he was selective in the information he made available. In describing himself in the interview he identified primarily as a university student with an interest in sport.

His love of sport was obvious in his Facebook profile:

Interests	sport!!! Football, rugby league, rugby union, cricket everything! also love my music and computers… occasional drinker
Favorite Books	sport section in the newspaper…

For communication, Michael used his mobile to contact friends and family via calls and text messages. During the ESM period Michael sent 25 text messages and made calls on nine of the 21 days. Michael also used his phone's calendar and calculator features. Email was Michael's other main form of communication—he sent 19 emails during the ESM period. Michael said that he previously used instant messaging but ''grew out of it'' when he came to university. However, he indicated that he made use of instant messaging on three of the ESM days via the chat tool in Facebook rather than a stand-alone instant message tool (e.g. MSN Messenger).

During semester Michael enjoyed playing games on his computer (e.g. Minesweeper and Solitaire). When working on assignments Michael said that he procrastinated by playing these and other games such as Call of Duty (a first-person and third-person shooter game). When at home during holiday breaks Michael played soccer on his games console. Michael did not own a portable music player or listen to podcasts, he didn't maintain a blog or website, and didn't use tools such as RSS feeds. He used the Internet to do his banking and pay bills, but did very little shopping online.

Academic Study

Michael's main study technique was to read through his lecture notes and textbooks and take notes. Michael expressed a strong preference for practical activities as part of his studies. At exam time, Michael reviewed his notes and revisited diagrams and tables which provided summaries of important concepts. Whenever possible, Michael liked to study in a group with friends who worked on questions together.

Michael used his laptop for programming and other university work as part of his studies. He regularly accessed the university's learning management system to download lecture notes and read, but rarely contribute to, the discussion board. He made limited use of presentation software as his degree required very few presentations. Michael used email to communicate with peers for his studies and also used text messaging for some group

assignments. Michael thought that the level of technology incorporated in his degree was appropriate. He had not considered making use of any of his everyday technologies as part of his studies, however indicated that he thought Facebook might be useful for group work.

Adoption and Adaption of Technology

Michael reported that his main motivation for adopting new technologies was to gain functionality. When choosing a new technology, Michael considered functionality, performance (e.g. speed, capacity), price and durability. He acknowledged that with the frequency of the emergence of new technologies he was interested in purchasing technology that would ''do for a little while that is affordable'' knowing it wouldn't be too long before he would replace the technology for greater functionality. When purchasing a new technology Michael sought advice from store salespeople, rather than consulting with friends or doing prior research online.

Toby

Toby was a 20-year-old Bachelor of Creative Arts (Performance) student. He lived in a share house 15 minutes away from the campus. Toby planned to enter the entertainment industry and wanted a degree in creative arts to prove he had studied professional acting techniques with recognised people in the field.

Everyday Life

Toby rated himself as an intermediate user of technology. He identified the Internet, mobile phone and MP3 player as his most frequently used technologies. He said he spent a lot of time on the Internet checking emails, chatting to people, reading fan fiction and web comics, and randomly surfing. He used his mobile phone for communication, but also as a camera and an alarm clock. He listened to his MP3 player when in transit: ''If I'm going somewhere and don't have anyone to speak to it is in my ears''.

Toby occasionally shared photos online via email or Facebook, but as he didn't take many photos himself, he was more likely to be the recipient of photos from friends. He didn't keep a blog but intended to start one when he spent time overseas as an exchange student. He didn't read blogs by others or subscribe to RSS feeds.

Toby liked to play role-play and strategy games on his computer. He also used online emulators of old games systems to play old games. Whilst he owned a game console, he

used it only for playing DVDs as it was missing a memory card. He also owned a Nintendo DS but hadn't used it for a long time—he said he went through times when he used it a lot and then he would put it aside for several months. Toby conducted his banking, paid bills and bought items on eBay online.

Toby preferred to make calls on his mobile rather than send texts as he saw this as the quicker and cheaper option. He checked email frequently but did not send many emails as he saw his network of friends on a regular basis at university. Whenever he was on his computer, Toby logged into his MSN instant messaging tool, although he didn't use it much as he saw his friends every day.

Toby also used Facebook but again, as he saw his friends so often, his level of Facebook usage was quite low. During the ESM period he only accessed Facebook on six of the 21 days. He indicated that he only checked Facebook when he received an email notification to say there was something new online for him to check.

Academic Study

Toby had a preference for practical learning activities which matched well with his chosen degree. He claimed that he didn't 'study' as such, instead he said he 'absorbed' information through classes, reading and discussing concepts with classmates which he was able to 'regurgitate' during assessments and exams with little review. Toby said he was a very active participant in class discussions, usually being the first to express an opinion. He particularly liked classes when he could do something practical and receive immediate feedback (e.g. singing classes).

Toby used the Internet to access readings, explore topics and find journal articles to support assignments. He accessed the university's learning management system occasionally to get details of the readings for his course. Toby was encouraged by his lecturer to use the Sephonics learning tool to learn about the phonetic alphabet which he found very useful. He rarely made use of online communication tools as in his small faculty the teachers and students see each other every day. Occasionally he used email to distribute a script or notes from a class to his classmates. He also accessed videos on YouTube as reference material in order to prepare impersonations for dramaturgy classes. Toby indicated that he would like to see the use of more podcasts in his course, not recordings of the classes but external resources covering the theory of what they were learning in the classroom.

Adoption and Adaption of Technology

Toby liked to adopt technology that provided some 'quantum leap' from what was previously available. If a new technology was just an incremental upgrade on something already in existence then Toby delayed adopting it until the price had dropped to an affordable range. When adopting new technology his primary considerations were price and functionality, something that would make his life easier. He indicated that he wanted a number of new technologies including a laptop to replace his dying desktop computer, and a new MP3 player with a bigger capacity and ease of use. When purchasing a new technology he did not research it in advance beyond looking at advertising material, instead relying on the experience of the shop assistants to guide his purchases. He found learning to use a new technology simple and approached it by trial and error, eventually consulting the manual if he was unable to work something out.

Bree

Bree was a 19-year-old Bachelor of Information Systems student. She lived at home with her family 20 minutes away from the university. Bree wasn't sure of her career direction at the end of high school so decided to pick something that interested her at university. She chose Information Systems as she wanted to gain a better understanding of technology and how it can be used in business.

Everyday Life

Despite being enrolled in an IT-based course, Bree only considered herself an intermediate user of technology. She identified her computer and mobile phone as the technologies that she used most often. She was involved in church and community groups for which she produced audio and video presentations and shared photos online using Photobucket with her church friends. She surfed the Internet frequently for items relating to her interest groups, to keep up with the news, to pay bills and do banking, to buy clothes and to sell textbooks online.

Bree downloaded and listened to podcasts of local and national radio stations. She occasionally played computer games primarily using the games website www.hallpass.com. She also owned a Nintendo Gameboy which she had received as a gift, but commented that ''I would rather read books than sit down and play my Gameboy for hours on end''. During the ESM period Bree only played games on three of the 21 days.

Bree used Facebook almost daily to keep in contact with friends. During the ESM period Bree expanded her Facebook network by accepting 17 friend requests. She said she wasn't interested in using Facebook applications, but did join several groups. Bree made an effort when she logged into check the pages of friends who she hadn't been in contact with for a while.

For communications, Bree used her mobile phone to keep in contact with friends. Her phone was a very basic model which only allowed her to make calls and send text messages. She sent 99 text messages over the ESM period and made calls on 11 of the 21 days. Bree also communicated via instant messaging most nights, primarily with friends who she didn't see on a regular basis or who lived overseas.

Academic Study

Bree's main study technique consisted of making notes from lectures and textbooks and writing or typing them over and over. She left copies of her notes all over the house and would even write key points to memorise on windows using a special marker. In class and online Bree was keen to get involved in class discussions, but only when she was confident that she knew what she was talking about. Bree expressed a strong dislike of group work and also preferred to study alone. In preparation for exams, Bree listened to audio recordings of notes from her course that had been made by her friends.

Bree regularly used technology in her studies. She accessed the university's learning management system to download lecture notes, complete online quizzes, access assessment information and read the discussion forums. In some of her subjects the discussion forums were used extensively by students, but not always for study related matters, instead as a social network for sharing links and discussing favourite movies and TV shows. Bree used instant messaging and email to communicate with group members for assignments. Bree said she would like to see the introduction of audio recordings of lectures for review and the incorporation of more multimedia such as YouTube videos. Bree was enthusiastic about new technologies, but recognised that the time that it sometimes took to learn all the elements of a new technology made it difficult for them to be incorporated in subjects only taught over 13 weeks. She had been required to use a blog as part of one of her subjects which she had found frustrating and redundant. However, she commented that, if used well, a blog could be an interesting learning tool.

Adoption and Adaption of Technology

Bree extensively researched technologies before adopting anything new. She considered cost, purpose, features, capacity and performance when making decisions to purchase new technology. She found picking up new technologies easy and would try a few functions before reading the instruction booklet to learn the full range of features. Bree also subscribed to email newsletters and regularly browsed the Internet to learn about new technologies and keep up with the latest IT trends. She expressed a desire to purchase an iPhone which had just been released to the Australian market at the time of this study.

Bridget

Bridget was a 19-year-old Bachelor of Law and Bachelor of Arts (Communications) student. She lived in a share house approximately 25 minutes from the university campus. Bridget had always planned to come to university as all the careers she had considered required a university education. Whilst she had originally thought that she would use her law degree to practice law, she changed her mind in her first year to aim towards a career in journalism. Despite this, she still saw her law degree as important to this new career direction as it provided knowledge in another field to add credibility to her writing.

Everyday Life

Bridget considered herself to be an intermediate user of technology. She said she used her mobile phone the most, especially as she did not have access to a home phone in her shared accommodation. In addition to communication, Bridget also set reminders for events in her phone and saved important information she needed to regularly reference in text messages. She also made use of her laptop, which was handed down to her by her father, for accessing the Internet.

Bridget shared photos with friends and family via email and on Facebook. She kept a 'blog' on MySpace when she was at high school but no longer updated it. She occasionally read her friends' MySpace 'blogs', in particular two of her friends who had been using MySpace to blog about their upcoming weddings. Outside MySpace Bridget didn't regularly follow any blogs or RSS feeds.

Bridget primarily used her phone to keep in contact with friends and family by text messages. In the first interview Bridget estimated that she sent around 25 text messages a day. During the ESM period she sent 201 text messages, an average of 9.6 text messages a day, and no more than 20 messages in any one day. Bridget was not as enthusiastic about

email and said that she tended only to reply when the reply could be short. For anything that required a long response she preferred to ring or visit. At high school Bridget used instant messaging a great deal, but by the time she reached university she only used it to communicate with her grandmother.

Her communication preference was firmly face-to-face communication. This preference was also observed in her use of social networking tools. She had recently moved from MySpace to Facebook. She claimed that the majority of her communication on Facebook was with people she saw on a regular basis, and primarily for the purpose of arranging face-to-face activities. She commented:

> Well the people I talk to are the people I'm catching up with if I go out. So I might as well just go and see them. It's so much more fun than just like typing away. It's not a means of catching up, it's just a means of organising your timetable.

Bridget accessed Facebook on eight of the 21 days in the ESM period. During this time she received many wall posts from friends, however her only activity was to upload an album of photos from a camping trip, change her profile picture (to one of the new photos), to accept five friend requests and write on one friend's wall. Bridget regularly used the Internet to buy items that either she had trouble finding locally (e.g. camping equipment) and/or wanted to get at a lower cost (e.g. books). She also did all of her banking and paid her bills online. Bridget listened to music on her iPod as she walked to and from university, but didn't listen to podcasts for pleasure.

Academic Study

Bridget's main study technique was to read her notes and materials over and over. She highlighted and made notes of important concepts and reviewed these prior to exams. When working on assignments she liked to prepare them well in advance and hated group work for the fact that others in the group were generally happy to leave things to the last minute. When working on assignments and studying for exams Bridget spent time in the library as she found this environment to have fewer distractions. She liked to participate in class discussions when she had done her readings in advance. Online she participated in discussions as her participation was assessed. She said that had participation not been assessable she may have read the discussion board postings but would have been unlikely to respond.

Bridget made some use of technology as part of her study. She accessed the University's learning management system for lecture notes if the lecture was cancelled (she would normally just take notes in class), to check announcements, to access assessment questions and to participate in compulsory online discussion activities. She used her laptop at home to work on assignments and study, but used the university computers when on campus. She researched assignments online using the law resources available through the library website as well as other blogs and/or related articles online. When asked if she would like to see more technology used as part of her studies she replied:

> I'm quite content to just stick to pens and paper. I had a typewriter in high school because my grandfather gave it to me. Cause I loved the idea of having a typewriter. I was in year 10 before we got our [family] computer.

As part of one of her law classes Bridget was required to listen to an ABC radio podcast and she indicated that she enjoyed that sort of activity. Bridget was also involved in the shooting of a video for a university student association.

Adoption and Adaption of Technology

Bridget felt that a number of technologies seemed forced upon her in both her everyday life and academic study due to the convenience they afford (e.g. microwaves, computers, printers, etc.). When adopting a new technology Bridget considered factors of convenience, aesthetics, functions, compatibility, durability, price and necessity. She was not interested in doubling up on technologies, for example, she already owned a digital camera so when shopping for a new mobile she was not interested in getting one with a good camera. She used a technology until it stopped working and then sought out a replacement that was advanced enough that it would last for a reasonable time. Bridget also indicated she was influenced by what type of technologies her friends owned. She didn't necessarily research her purchases in advance, instead relying on the expertise of shop assistants. When learning to use a new technology she preferred a demonstration by another person before she would try it on her own.

Jack

Jack was a 21-year-old Bachelor of Biological Science student. Initially, he didn't get the prerequisite marks to enter university directly from high school so waited until he could enter a degree as a mature age student. Jack was very career driven towards his goal of becoming a microbiologist. He was also interested in the technical aspects of audio-visual

equipment and had completed a technical college course in this area prior to starting university.

Everyday Life

Jack identified himself as an advanced user of technology with a preference for online gaming. He used his desktop computer, mobile phone and video games console most frequently. He used his computer for playing games and accessing the Internet. He used his mobile phone for calls and messages as well as accessing the Internet, checking news, and as a personal organiser.

Jack had a very strong interest in gaming, especially World of Warcraft (WoW) and first person shooter and strategy games on various game consoles (e.g. xBox360, Playstation 3 and Nintendo Wii). During the ESM period he played games on 18 of the 21 days. His love of games formed the basis of many of this other online activities. He made blog postings on MySpace about game censorship. He regularly listened to podcasts about xBox360 releases and WoW updates. He had RSS feeds set up to deliver game-related news and would use eBay to buy and sell games (as well as movies and clothes). He previously managed a games forum online but found he didn't have the time to keep it maintained. Instead he now spent his time on game console forum sites (e.g. xBox360 Live Forum) where he reported his gaming achievements as well as contributing to discussions and reviewing games.

For social networking, Jack used MySpace which he accessed seven of the 21 days of the ESM period. His MySpace profile strongly represented his interests in gaming, horror films and heavy metal music. He said that he shared photos and checked MySpace for messages and comments that he received regularly, but didn't update his profile or use it to communicate.

Whenever Jack was online he had his instant messaging client open (Windows Messenger). During the ESM period he used instant messaging on 20 of the 21 days. He also sent 107 text messages and 14 emails.

Academic Study

At the end of each day at university, Jack went home and reviewed the day's lecture notes, looking up online anything that was unclear. Only if he was unable to find helpful information on the Internet would he then refer to the textbook. Jack was part of a study group which met weekly and he said that the act of describing concepts to others helped

him to concrete them in his own mind. Whilst Jack's preference was to work alone on assignments and study, he recognised the importance of having friends in his class and in the years above with whom he could discuss concepts in his course that were challenging him. In preparation for exams Jack reviewed the lecture notes and repeatedly completed practice quizzes until he had memorised the answers, albeit this was usually done at the last minute.

Jack used a number of technologies as part of his studies. He used his mobile phone to store copies of the lecture notes and to keep track of assignment due dates or if class times changed. He logged into the University's learning management system almost daily to download lecture notes, access practice quizzes and check assignment information. Jack suggested that students should be given more guidance towards useful online sites/resources to support their studies. He spent a lot of time looking for resources online which could clarify the concepts he was being taught in the classroom. He also expressed a wish to use games, even WoW, in his studies. At his own initiative he found some small science-based games online which he used, including a chemistry program which allowed students to put together molecules and see what they looked like in a 3D space.

Adoption and Adaption of Technology

When adopting new technologies Jack considered the price, function and longevity (how long he could use it before it would seem out-of-date). Before purchasing a new technology Jack researched it thoroughly online using technology review websites and user forums to see what other people thought of the technology. He indicated that he was considering purchasing a laptop for its portability as he was finding his phone screen too small to read lecture notes and the keyboard on his phone was not suitable for fast note taking. Jack said he found it easy to pick up new technologies and would do so by playing around and exploring the functions. During the ESM period he had adopted GPS navigation through his phone which he found very useful when riding on his motorbike.

Exploring Young Peoples' Technology Diversity

The main premise of the digital natives claim is that young students currently entering higher education have a universally high level of digital literacy and technology use. Contrary to these claims the cases in this study demonstrated diversity in students' technology access, usage, confidence and adoption. Each student presented a unique approach towards adoption and use of technology which they had customised over time to support their interests, social communication, employment, study and free-time. Whilst

some students made extensive use of technology across all the contexts of their life, others made limited use of technology for very specific purposes. This is consistent with the findings of several other large scale studies (Kennedy et al., 2006; Jones et al., 2010; Margaryan et al., 2011) which also found significant diversity in technology use.

Overall technology access levels across the cases showed unanimous adoption of technologies such as computers, mobile phones and digital cameras as well as high levels of adoption of MP3 players, USB drives and game consoles. However, diversity was found in all other categories of ownership and usage. In some cases the diversity was quite distinct from high levels of use in some cases to no use at all. Consistent with the findings of Judd and Kennedy (2010), social networking and communication tools showed generally high levels of engagement by the students, yet adoption of other ''Web 2.0'' tools (blogs, RSS feeds, photo sharing, etc.) was much less. Yet, what this study has allowed is to move beyond examination of diversity through frequencies of access and broad categories of technology-based activities alone to explore the students' motivations, interests and attitudes to technology in more detail.

Primarily, the cases demonstrated that uses of technology in everyday life were firmly driven by the students' personal interests and social priorities. For example, Jack used technology predominantly to play games (computer, games consoles), talk about games (online forums), research new games (RSS feeds, Internet) or buy and sell games (eBay). Trent used technology to support and promote his political and community activities and to create a strong image for himself as part of his strategy towards a career in politics. Bridget was interested in maintaining an active social life and used technology as a tool to organise social activities rather than as a forum for the social activities themselves.

Beyond specific interests, other lifestyle factors influenced students' use of technology. It is common in Australia for students to travel significant distances to get to university each day. In this study, students with travel times of 20 minutes or more indicated that they used technology to fill in this time. Jessica played games with friends using her portable games console on the train. Toby, Bridget and Bree listened to their MP3 players as they walked to university. Trent took advantage of his hour-long car journey to listen to news on the radio or listen to recordings of study notes when exams were approaching.

The influence of peers was strong in relation to the choice and use of some technologies. Some students reported that the consulted their peers when making decisions about

adopting new technologies. For all students in the study the use of social networking sites was influenced by their peers' activities and engagement, in particular the transition several of the students had made from MySpace to Facebook. A decrease in the use of instant messaging since leaving high school was observed which participants attributed to shifts in their friends' activities.

The students' attitudes towards adopting new technology also showed diversity, contrary to the digital natives' assumption that all young people are willing to take on new technologies. Jack, Trent and Bree actively followed the latest trends in technology and updated their technologies as quickly as their student budgets would allow. Toby's futurist view led him to virtually ignore incremental upgrades and wait until he saw a technology that offered something completely new. Jessica and Michael only sought out new technologies when they had a definite need and took advice from friends and salespeople to choose a new technology without any further research. Bridget said that she felt that many technologies were forced upon her by society's focus on convenience and only replaced technology that no longer worked. Lucy didn't actively seek out new technologies at all, instead she only adopted a technology when it became a requirement of something in which she was involved (e.g. university). Cost was the common consideration which influenced all the students' adoption habits especially as only some students had part-time incomes. This also led them to focus on the durability of the technology, as students didn't want new purchases to break down or be out of date too quickly. The ECAR study in the US found that students were most likely to adopt new technologies when the benefits and cost align (Salaway & Caruso, 2008).

It has been suggested that the study of students' technology use needs to be move beyond a focus on the technology towards the contexts within which the technology is used (Bennett & Maton, 2010). This study examined students' use of technology across the contexts of their everyday and academic lives and found little support for the claim that students actively seek to use everyday life technologies as part of their studies. The cases demonstrated that whilst students would identify and personalise technologies to support their everyday life activities, when it came to academic study students tended not to stray outside the technology requirements established by their teachers and their university's infrastructure offerings. Use of the University's learning management system was consistently high across the cases, with some students logging in almost daily to check for new materials and discussion postings. A generally high level of satisfaction with

University learning management systems has also been observed in several previous studies (Salaway & Caruso, 2008; Jones et al., 2010).

Throughout the research it became clear that most students had difficulty articulating their different technology use across contexts. This was even more pronounced when students were asked to identify how they used technology for academic study (technology used driven by institutional requirements) as opposed to technology use for personal study (technologies chosen by the students to support their individual study methods).

Technology Use in Academic Study

The cases demonstrated a limited transfer of everyday life technologies into academic study technologies. When students were asked if they would like to see any of their everyday life technologies incorporated into their academic context, few were able to offer any suggestions. An example of one suggestion came from Jack who wanted the use of games as part of the teaching in his course. At the other extreme, some students were very keen for their everyday technologies to remain everyday and not become study tools (e.g., social networking tools).

The digital native concept has prompted calls for changes to the way students are taught in higher education to accommodate this generation's technology preferences and literacy. Prensky (2001) claimed that today's students are radically different in their use of technology and have a different view of learning from that of their teachers. Yet, the cases in this study provided little support for these assertions. Students' motivations for studying, study methods and assessment approaches did not indicate a perspective different to those compatible with the traditional teaching and learning practices they were experiencing in the higher education classroom. Nor did the students claim that the teaching they were receiving wasn't meeting their learning needs. This is consistent with the research of Garcia and Qin (2007) who found that digitally literate students were still comfortable with traditional learning and teaching methods.

Traditional methods of study including making notes and reviewing textbooks were common to all students' study preferences. Some students used technology to support study methods, for example making audio recordings of study notes or typing notes repeatedly instead of writing them. However this technology was a support to traditional study methods rather than a radical new form of studying.

Additionally, the majority of students indicated that they were happy with the level of technology currently available in their university courses. Suggestions that students made for more technologies in their studies focused on alternative access to existing teaching methods such as audio recording of lectures (for review purposes) or video conferencing of lectures to reduce travel burdens. None of the students in these cases suggested the use of more technology as a replacement for classroom teaching activities; rather they suggested technology as a supplement to current methods. This was consistent with McWilliams (2002, p. 295) observation that ''there is no clear evidence to date that any group of students, apart from those studying in distance mode, want to replace on-campus teaching and learning with web-based pedagogy''.

The diversity of students' technology experiences also raises important consideration for support resources in the implementation of technology-based activities. The digital natives claims assume that students' informal use of technology has equipped students with the digital literacy and skills necessary to tackle any technology offered in the classroom. In reality, a wide variance in technology confidence and ability has been found in this study as well as others (Caruso & Kvavik, 2005; Kirkwood & Price, 2005; Kennedy et al., 2007; Margaryan et al., 2011). As Ryberg et al. (2010) suggest, pedagogic support for the development of digital literacy skills needs to be made available to students to ensure all students are adequately prepared to use technologies for academic purposes. Whilst students may have experience using technology as part of their everyday life, the use of the same technology in an academic context may require a different approach to use which needs to be adequately supported.

The amount of time available for students to learn a new technology poses another challenge to using technology in the classroom (e.g. Bree's blog activity). Allowing students to develop better understandings of what certain technologies can do, as well as the other non-technical skills related to their use (e.g. the art of reflection for composing blog entries), may allow more engaging uses of the technology to occur. A solution to this problem would be the coordination of development activities across subjects within a course that incrementally built on students' technology skills.

Suggestions for Educators

The case studies in this research demonstrated that these young people are diverse in their motivations, attitudes and practices in using technology, providing a further challenge to generational assumptions. For educators and administrators in higher

education, this means that it is necessary to look past the assumptions about what young people expect of the technology used in their academic environment. The diversity of technological experience and literacy of the students in this study indicates to teachers that methods in the classroom should not be designed for a single generation with mutual characteristics, but must cater for a variety of different learners. Students are different, with different learning styles and approaches to study. Technology diversity just adds another dimension to this consideration for curriculum design.

From an educational perspective these young people were generally satisfied with how technology was incorporated into their programs. Exploration of the adoption of technology across the cases found that these students were not necessarily interested in the 'bells and whistles' of technology. Rather they are discerning and purposeful in their technology practices and therefore may be skeptical of technology that was used for education without clear purpose. Limited transfer was found between the technologies students used in their everyday life and those they used for their academic study. It is therefore important that educators build in adequate support for different uses of technology in an academic context as students' informal use of technology may not adequately prepare them for such activities.

Overall, this study demonstrates the complexity inherent in understanding the technology practices of young people. Whilst the diversity of motivations, attitudes and experiences appears to complicate the patterns of technology use observed in large survey-based studies, the wealth of detail is crucial to developing a broad appreciation of the contexts, social factors, identities and influences on how technology is adopted and adapted by young people. As Bennett and Maton (2011) suggest, it is time now to move away from labels such as 'digital natives' and move towards a wider understanding of the factors influencing young people's use of technology so we can determine when and how to implement technology in the classroom in the most effective way possible.

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CHAPTER 8

CONCLUSION

Introduction

This chapter presents a summary of the outcomes of this research study which focused on how first year university students engage with technology in their everyday and academic lives with a view to informing learning and teaching practices in higher education. The chapter responds to the research questions for the study and considers the implications of these outcomes for education theory, research and practice. This is followed by a discussion of the limitations of the study. The chapter concludes with suggestions for future research.

Research Questions

1. To what extent do the patterns of technology use of first year university students reflect the notion of digital natives?

The notion of a generation of 'digital natives' as proposed by Prensky (2001) and Tapscott (1998) relies heavily on the similarity of young people's attitudes towards and use of technology. However, consistent with the findings of many large studies in the area (Kennedy et al., 2007; Jelfs & Richardson, 2013; Jones et al., 2010, Margaryan, Littlejohn & Vojt, 2011; Salaway & Caruso, 2008), this study found that participants' engagement with technology is very diverse in nature. This diversity is a result of the many different motivations, influences and contexts in which participants interact with technology. Through examination of participants' technology engagement it was evident that each had a unique approach which they have customised to support their interests, needs and goals.

The survey of students' access to and use of technology as part of their everyday life and academic study showed that the frequencies of technology access and use were slightly higher than have been reported in previous similar studies (e.g. Kennedy et al., 2007). This study found students had a high level of access to technologies such as computers and mobile phones, and frequently took part in technology-based activities such as social networking. Over the two years between the Kennedy et al. (2007) study and the collection of data in this study the availability of computer and mobile devices had increased, while the costs for these devices had decreased, which could explain the rise in

access and activity. Also during this time, the emergence of Facebook prompted a rapid increase in the use of social networking worldwide.

However, there were also a number of technologies and activities that showed low levels of adoption, especially those technologies that fall into the category of "Web 2.0" (e.g. blogs, wikis, RSS feeds). A reason for the limited adoption of these technologies could be attributed to the lack of utility of these technologies to students' personal lives. It is also possible that some of the functions of these tools were duplicated in social networking sites, for example, the existence of a blog tool in MySpace, which meant students didn't need a separate tool for this function. The highest frequency of technology use was to support communication-based activities. These results suggest that not all young people are using a wide range of technologies as suggested by some of the literature on digital natives (Prensky, 2001; Tapscott, 1998).

In this study, the frequency of participants' use of technologies to support academic study was considerably lower than in their everyday life. Participants were also found to use a smaller range of technologies to support their academic study. These usage patterns are consistent with those observed in several large studies of students' use of technology in their studies (Garcia & Qin, 2007; Kennedy et al., 2007; Salaway & Caruso, 2007). Course requirements were identified as a major influence on participants' study-related technology choices, again consistent with the findings of other similar research (Gros et al., 2012; Jones & Healing, 2010).

This study examined students' technological engagement in greater detail than previous studies offering important insights into the adoption and use of technology in their lives. More detailed exploration of students' technology-based activities through interviews, the experience sampling method and direct observation revealed many nuances in how students engage with technologies. The participants personalised their technology use to fit with their personal interests, social priorities, study commitments and community involvement. Each participant tailored their use of technology for these purposes in different ways depending on their access to technology, level of technical ability, and interest. Participants' choices of technologies for social networking, communication and gaming were often influenced by peers. These findings are consistent with a study of young people's appropriation of mobile phones which observed that "young people are adopting a lifestyle rather than a technological perspective: they want technology to add value to their lifestyle, satisfy their social and leisure needs and reinforce group identity"

(Carroll et al. 2002, p.8). Such variety in needs and motivations towards the integration of technology in young people's lives challenges the assumption of the homogenous nature of a generation of digital natives.

Several other assumptions underlying the digital natives notion were also not supported by the findings in this study. Firstly, the literature on digital natives attributes the high technical literacy of young people to their continual exposure to technology since birth (Prensky, 2001; Tapscott, 1998). However, the case studies showed that many participants recalled very little exposure to technology at home as children. The level of access of young people to technology as they are growing up has been shown in other research studies to be influenced by socio-economic status (Hargittai, 2010; Morris, 2011) and country context (Brown & Czerniewicz, 2010; Thinyane, 2010). Secondly, it is assumed that young people like to keep up with the latest technology trends. However, in the interviews it was found that students who strove to keep up with technological developments were in the minority, as most students had limited access to the finances to purchase new technologies. Instead they only explored the availability and new capacities of technologies when they had a specific need. Similar studies have found that students mostly use established technologies and have limited knowledge of newer Web 2.0 technologies (Margaryan et al. 2011; Oojorah, 2012).

It is also claimed that digital natives are commonly involved in the creation of new content which they share online (Lorenzo et al., 2007). In the cases in this study there was evidence of photo sharing by several participants. However, there were few examples of other forms of content creation such as authoring blogs or making and sharing videos. This finding is consistent with other studies of university students' online activities which found limited evidence of the creation and sharing of content (Ferri & Pozzali, 2012; Freeman, 2010; Williams, Crittenden, Keo & McCarty, 2012). With some exceptions, a large amount of the content created by young people online, primarily in the form of social networking communication, is said to be "thoroughly unspectacular" (Palfrey & Gasser, 2008, p.112). Data collected in this study through online observation consisted mainly of content that was very specific to conversations and events with friends and not the sort of content that could be shared with larger audiences.

All of these findings demonstrate that, while some students exhibit many of the characteristics said to be common to members of the so-called digital native generation, this is not the case for all. A more detailed examination of their technology-based

activities showed nuances that demonstrate the existence of diversity. Due to this diversity there are few general patterns of technology use that can be identified from students in the age group attributed to digital natives. However, patterns of access to computer and mobile technologies and social networking services have been increasing over time as observed in the annual study of undergraduate students' use of technology in the United States (Kvavik, Caruso & Morgan, 2004; Dahlstrom, 2012).

As it has become clearer that not all young people fit into a single generational stereotype, some researchers have tried to formulate alternate classifications of young peoples' technology habits (Ferri et al., 2008; Green & Hannon, 2007; Kennedy et al, 2010; Morgan & Bullen, 2011; van den Beemt et al., 2010; White & Le Cornu, 2012). However, the complexity of young people's technology use makes defining alternate categories problematic. In this study it was found that young people made use of technologies in many different ways, often in ways that were outside the intended uses for which the technology was designed. This was a result of multiple factors including context, task, motivation and skill. For example, the data from the survey showed that all the case study participants used email for basic communication, but in the interview it was discovered that some also used it for file sharing or transferring files between devices. In the interviews some students indicated that they used social networking tools to keep up with and communicate with friends, while others used it almost exclusively as a scheduling tool for face-to-face social events with friends. The many and varied ways in which young people can interact with technology when combined with different contexts and motivational factors creates a complexity that makes the identification of consistent groups based on technological characteristics problematic. This indicates that approaching the research in this manner is not particularly useful for building a greater understanding of implications of young people's technology use on teaching and learning practices.

In sum, this research question sought to determine the extent to which the technology engagement of first year university students fit with the assumptions of a digital natives generation. An examination of the technology adoption and use of students across the contexts of their everyday life and academic study showed significant variation in technology engagement between students. These findings suggest that reliance on such generational generalisations is unwise. A greater understanding of the diversity of technology engagement is therefore needed to provide educators with more useful perspectives to inform the use of technology in education.

2. How do first year students select and adapt technologies to suit their learning goals and strategies?

The study investigated how students incorporate technology into their study practices. The digital natives notion makes many assumptions about young people's attitudes towards education and the role of technology in learning. For example, it has been suggested that traditional teaching methods are no longer capable of engaging students whose attitude towards education is fundamentally different (Prensky, 2001; Tapscott, 1998). Changes in students' attitudes, behaviours and preferences resulting from their exposure to technology throughout their lives has been said to have created a discontinuity where students "think and process information fundamentally differently" (Prensky, 2001, p.1). Students were said to be frequently adapting their personal technologies to the academic context and demanding the use of more technology in the classroom (Prensky, 2004). Subsequent calls for radical change in education advocated a greater role for technology in the classroom to match levels of technology use in young people's everyday lives (Dede, 2005; Gibbons, 2007; Prensky, 2001).

In this study, the case study participants' approaches towards academic study were found to be relatively traditional in terms of their general study techniques, as well as preparation for assessments and exams. In the interviews, participants reported activities such as reading textbooks, revising lecture notes, rewriting class notes, completing online quizzes, and listening to lecture recordings as constituting the majority of their study time. They made use of technology to produce documents and presentations, to communication with teachers and peers, and to access learning resources and online information. Throughout the study there were few examples found of students using technology in new or innovative ways to support their academic activities. Instead students reported using technology to support common study methods (e.g. typing rather than handwriting notes). In general, students' approaches to study did not indicate a perspective that was incompatible with traditional teaching and learning practices. Similar studies observed that even students with high levels of technical literacy were still comfortable with current teaching and learning methods (Garcia & Qin, 2007). The majority of students in this study indicated that they were satisfied with the teaching methods used in their course, but were also open to new kinds of activities and experiences. This challenges claims that young people are demanding a more significant role for technology in their education (Prensky, 2001; Tapscott, 1998).

Discipline differences also influenced the types of teaching and learning activities that students valued. For example, students in science disciplines liked the availability of online quizzes that helped them to revise subject content, whereas creative arts students said they liked the ability to find their own learning resources in the form of YouTube videos demonstrating performance techniques. Differences in discipline preferences have also been found in studies of learning and teaching environments (Kember, Leung & McNaught, 2008) and academic Internet use (Benfield, Ramanau & Sharpe, 2009; Selwyn, 2008).

In this study one of the most common technologies used by students to support their study was the university's learning management system (LMS). Of the survey respondents, 98.3% reported that they accessed the LMS on a daily or weekly basis. The frequency of LMS access was also found to be high among students participating in the main section of the study. A high level of LMS use is consistent with other research that found students' use of technology in their studies is heavily influenced by the requirements of their course and/or degree (Ellis et al., 2011; Jones & Healing, 2010; Margaryan et al., 2011). Despite the availability of many technological tools and resources that could be useful to students' learning, students have been found to rely heavily on the technologies recommended by teachers and common technologies such as word processing and email tools. This has been attributed both to a lack of awareness of the range of tools available, but also a lack of pedagogic knowledge that would assist students to see the educational value of such tools (Margaryan et al., 2011; Valtonen et al., 2011).

These findings suggest that students' interest in and aptitude for certain technologies in their everyday life does not readily translate into a desire or the ability to adapt their skills/technologies to the academic context (Kennedy et al., 2008). For example, several of the participants indicated that they did not consider social networking tools, such as Facebook, useful to their studies. Others expressed an interest in using technologies such as games in their study, but games relevant to the course were not provided by the lecturer. One student, who despite being an advanced user of technology, indicated that she found it difficult to create and maintain a blog as part of a learning activity. By the time she had become more confident with the technology, the learning activity was over and she felt she had not had sufficient opportunity to fully engage with the task. These examples indicate that there are a variety of reasons why students do not always transfer technologies and/or technological skills from their everyday life to academic contexts. They also suggest that students may need support when they are asked to use technology

as part of their learning (Buzzard et al., 2011; Gros et al., 2012; Kennedy, Gray & Tse, 2008; Ng, 2012; Thompson, 2013).

In summary, this study showed that when selecting and adapting technology to support their learning goals and strategies students were strongly influenced by the requirements of their course and the technologies suggested by their teachers. Students made frequent use of the technologies provided by the university, including the learning management system and email, ahead of technologies that they used in their everyday lives. There was little evidence found of new or innovative ways that students used technology to support their studies. Throughout the research there was no evidence found of a desire for a radically different approach to education that is said to be common amongst members of the digital native generation in the literature (Palfrey & Gasser, 2008; Prensky, 2001; Tapscott, 1998).

3. How does first year students' use and preference for particular technologies relate to the identities they adopt in everyday life and academic study?

This study considered the identities that students adopt in their everyday lives and academic study and the impact that these identities have on students' use and preferences for technologies. Identity theory proposes that people have multiple identities that are defined by the different roles that they play in society (Stryker & Burke, 2000). Previous research has explored the role that technology can play in young people's identity development (Buckingham, 2008; Turkle, 1984). However, in this study identity theory was used to consider how young people's identities influenced their technology use across the contexts of their lives, in both offline and online environments. Identity theory is also useful in understanding the social factors which influence people's choices about technologies.

The majority of participants in this study demonstrated a strong connection to their identity as a student. This was evident by their strategic and considered approaches to study and the strong commitment each had to completing their degree. The majority of participants had a specific vocational goal which motivated their study commitments. The others were not yet sure of their exact career path, but were still motivated to achieve an educational qualification that would give them good future employment prospects. Each of the participants had developed their own approaches to study to assist them with assessment tasks and preparation for exams. While some students relied heavily on

materials provided by their teachers for study, others used technology to access additional materials. For example, Jack played chemistry games online, Bridget read blogs about legal topics, and Toby viewed YouTube videos to prepare for dramaturgy. On social networking sites, most participants' identity as a student was clear from the status updates they posted about life at university and the groups to which they belonged.

In incorporating identity theory, the design of this study was informed by the approach undertaken by Benson & Mekolichick (2007), who found that students with a strong commitment to their student identity were more likely to use and feel comfortable with technology. However, in this study it was found that participants' use and attitude towards technology varied considerably, despite their strong student identities. These findings correspond with a study of UK students' experience of elearning which found that technology was only a minor factor in how students thought of themselves as effective learners (Creanor, Trinder, Gowan & Howells, 2006). Three of the participants who showed the strongest commitment to being a student had limited use of technology. These students did not use a wide range of technologies, but were quite strategic in the ways that they did use technology, especially to support their studies. In particular, they made use of the LMS and other technologies recommended by their teachers. The difference between the Benson & Mekolichick's (2007) study and this study was that Benson & Mekolichick collected data directly from students' self-report of identity and technology use, whereas this study combined students' perceptions with observations of students' activities and online presence in social networking settings. This richer picture of students' technological engagement and portrayal of identity highlighted greater diversity than found in Benson and Mekolichick's study.

Participants in this study displayed identities across the other contexts of their lives such as in their work, social, and family lives. In particular, they developed strong identities through their hobbies and interests. For example, Michael linked his identity to his strong interest in sports and used technology regularly to keep up-to-date with the latest information about his favourite sporting teams. For some participants these identities carried over into different contexts of their lives. For example, Jack's interest in games and Trent's political interests influenced the technologies they used to directly support their activities related to these interests. However, these identities also influenced the way they portrayed themselves in other contexts and via online social networks.

In this study, identity theory provided a useful perspective for examining how students adopt technology across the different contexts of their lives. However, it was also very complex to measure due to the fact that the term "identity" can be defined in many different ways (Buckingham, 2008). This creates a challenge for the researcher in determining effective measurement methods, as well as ensuring that participants understand what identity means in the context of the study. When asked directly about their identities, participants had difficulty articulating how they perceive their social roles and groups, and the part that technology plays in relation to these roles. To elicit more information about these roles, students were asked to describe their hobbies, interests and employment in the initial interview. Together with data collected through the experience sampling method and online observation, this interview data was used to build a picture of participants' identities. In talking about their technology use in interviews some insight into the relationship between participants' identities and technology could be interpreted. This data helped to form a broader picture of participants' academic and social identities.

In sum, this study explored the relationship between the technologies students use and prefer and the identities that students adopt in their every lives and academic. The findings showed that participants used certain technologies in the different contexts of their lives. Their academic identity did not appear to have an impact on the frequency or range of their technology use, however those with a strong academic identity primarily made use of university-provided technologies. While the use of identity theory facilitated the examination of technology use across the contexts of students' lives, a number of limitations around its use in this study meant that relationship between identity and technology engagement could not fully be explored.

Contribution to Research and Theory

The results of this study advance our understanding of young people's use of technology by giving a more in depth view of the diversity of technological engagement across their everyday and academic lives. Previous research demonstrated that young people's engagement with technology is more complex than is suggested by the digital natives/net generation notions (Kennedy et al. 2006; Kvavik et al., 2005; Oliver & Goerke, 2007). This study explored this complexity through the lens of technology appropriation and identity theories to examine young people's motivations and attitudes towards technology. The findings help to re-conceptualise our understanding of technology engagement in

educational environments, providing educators with evidence that can be used to inform decisions about the integration of technology into teaching and learning practices. The findings show that students had different patterns of technology engagement in different contexts, and that technologies and skills were not always automatically transferable between contexts. These findings can inform how technologies are introduced in teaching and learning by highlighting the need for support to familiarise students with new technologies or new ways of using technologies they may have used in other contexts.

In examining technology engagement in greater depth, this study used a mixed methods approach to provide multiple perspectives on participants' technology engagement. The contribution this methodology makes to research in this area is that it facilitates the exploration of a complex and dynamic phenomenon, using methods from across disciplines. Studies in the area have tended to rely primarily on survey and/or interview methods to collect data about students' adoption and use of technology, involving mostly self-reported data. This study combined several methods to triangulate self-reported data with other sources to improve reliability and to provide more detail on the nature of students' technology engagement. The mixed methods approach was designed to acknowledge that students' use of technology is an ongoing practice. Rather than collecting data at only one point in time, as previous studies have done, data was collected over a number of weeks. This allowed for the observation of changes in the use of technology over time as different events, study tasks, and life occasions occurred. The need for a more longitudinal approach to the study of technology adoption and use has been suggested by several researchers (Jones & Healing, 2010; Mendoza, Carroll & Stern, 2010).

This study also employed a theoretical framework that allowed the phenomenon to be viewed from new perspectives. Despite suggestions from several researchers about the usefulness of adopting a theoretical perspective (Bennett & Maton, 2010; Bennett & Oliver, 2011; Jones & Czerniewicz, 2011; Phillips, Kennedy & McNaught, 2012), research in the area has been largely atheorectical. This study used technology appropriation and identity theory as a framework through which to consider how young people choose and adapt technologies to their needs across the contexts of their lives. The use of technology appropriation was useful in considering the influences and motivations which impact students' selection and ongoing use of technologies for different purposes across their everyday lives and as part of their academic study. For example, in the context of academic study, it was found that students are heavily influenced in their choice of technologies to

use to support their studies by the requirements of their course and the technologies the university provides. However, a weakness of the model of technology appropriation was its limited consideration of social influences. To address this weakness, identity theory was used to provide another perspective through which to consider the social influences on technology engagement. Identity theory was useful in considering how students used particular technologies in particular contexts, and the differences in how they used these technologies across contexts. The theoretical framework used in this study enabled analysis of the complexity of students' engagement with technology from multiple perspectives, however there are still many elements of this phenomenon that fell outside the scope of these theories. This suggests that further use of theory in future research can provide new understandings of the phenomenon that can inform the role of technology in education.

Practical Implications

This study provides an in-depth insight into ways students are actually engaging with technology, beyond simple frequencies, which can inform the way that technology is used to support teaching and learning. The findings show that there is considerable diversity in the ways that young people use technology across the contexts of their lives. There was also diversity in their digital literacy. Participants demonstrated particular digital skills that allowed them to undertake common activities directly related to their interests and needs, but didn't necessarily have the wide-ranging digital literacy suggested by literature on digital natives (Dede, 2005; Prensky, 2001; Tapscott, 1998). It was also found that the skills participants possessed for using technology in one context (i.e. everyday life) were not always instinctively transferable to other contexts (i.e. academic study). This finding is consistent with several other studies (Kennedy et al., 2008; Margaryan et al., 2011; So et al., 2012; Valtonen et al., 2011). In addition, the study showed that, contrary to the assumptions inherent in the digital natives concept (Prensky, 2001), students did not demonstrate radically different approaches and preferences towards learning.

Such findings suggest that it is not useful to rely on the notion of a homogenous generation of digital natives when discussing the integration of technology in teaching and learning in higher education. At an institutional level, decisions concerning educational technology infrastructure need to be made with regard to the diversity of students' access to and engagement with technology. Similarly, pedagogical design decisions should not be made on the basis of unsupported assumptions. This research, and other subsequent studies,

provide a more detailed examination of the motivations and influences on students' engagement with technology that can help educators to make more informed decisions. The patterns of technological behaviour observed across the contexts of students' lives can help to interpret usage patterns in blended and online learning environments. In addition, the closer examination of the motivations and strategies behind students' study behaviours demonstrate that current teaching and learning methods in higher education are still compatible with their academic needs.

In relation to teaching and learning practice, the findings of this study suggest that learning activities should be designed to cater for a variety of learners with diverse levels of digital literacy. Adequate support for working with technology as part of learning activities need to be incorporated into the activity design for those students with lower levels of digital literacy (Gros et al., 2012; Thompson, 2013). In acknowledging that not all young people have the high levels of digital literacy, as was suggested by the digital natives literature (Prensky, 2001; Tapscott, 1998; Dede, 2005), there is a need to develop students' digital literacy skills to ensure they are adequately prepared to use technologies for academic purposes. The importance of building digital literacy, not just for use in academic contexts but also for future employment contexts, is now the focus of research and government planning in the UK (Payton, 2012) and Australia (Australian Communications and Media Authority, 2009).

The results of this study showed that, while students were generally open to the use of new and innovative technologies in teaching and learning, they emphasised the need for these technologies to have a clear purpose. This view of the use of technology in education has been around for some time. However, in light of the hype around the introduction of technology in the classroom stirred by ideas such as digital natives, it is important that educators ensure that technologies are used only when they support the pedagogical design of the learning activity (Buzzard et al., 2012; Toliver, 2011). From an administration perspective, caution should be exercised when setting targets for the use of technology in teaching and learning to prevent the use of technology for technology's sake.

Limitations of the Study

There were a number of limitations in relation to this study that warrant consideration. The size of the sample makes it difficult to provide any generalisations as to the technological behaviour of first year students in all institutions. While the sample size for the survey was considered appropriate based on the population (Krejcie & Morgan, 1970),

the sample was drawn from a single institution. It also did not incorporate all disciplines (engineering and medicine were not included) nor consider international or part time students. The decision to exclude international and part time students was made so that the sample would be reflective of the typical first year student at the university based on enrolment data. The sample for the second phase of the study was chosen using a purposive sampling approach (Creswell, 1998; Walter, 2006) to include a variety of cases that could be compared to each other and the typical profile of a 'digital native'. The number was limited due to the substantial data collection for each case as a result of the mixed methods approach used, but was still above the minimum recommended for case study research (Creswell, 2002).

Several challenges to the research arose due to the complex and dynamic nature of the phenomenon. The scale of technology engagement across the multiple contexts of young people's lives meant that not all aspects of the phenomenon could be addressed in a single study. The research was only able to ask particular questions, which were guided by the theoretical framework. The length of the study was designed to examine technology use over time, but was limited to three weeks. This time frame was insufficient to observe major changes in technology use over time, as students progressed through their degrees and technologies developed and improved. There was also a lack of shared language around the definition of technology. This sometimes made it difficult for participants to articulate their engagement with technology-based activities. The complexity and fluidity of technology-based activities had an impact on the reliability of the survey-based method used. This was mitigated to some extent by the ability to triangulate these findings with the experience sampling, interview and observation data.

Limitations were apparent in the use of identity theory as part of the theoretical framework for the study due to the fact that students had difficulty articulating how their identity related to their use of technology. While data collected through the other methods were used to build a picture of participants' identity, this remained a limitation of the study. The two particular theories that made up the theoretical framework for the study enabled the phenomenon to be studied from these different, but complementary perspectives. However, there are many other theories that could be used to provide further insight into young people's technology engagement, and in particular, certain aspects such as social influences on choices about technologies. Within the identity field, other theories of identity such as self categorisation theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) could be used to focus on the participants' own view of their roles in

society. Actor-network theory (Latour, 2005) could be used to offer a different perspective on the link between technology use and identity. Recent research in the field has also started to explore the use of agency (Jones & Healing, 2010) and Bordieu's habitus (Bennett & Maton, 2010; Czerniewicz & Brown, 2012) to examine students' use of technology across different contexts. There is scope for future studies to examine this phenomenon using different theories to build a greater understanding of how technology can be used to support teaching and learning.

Suggestions for Future Research

This study adds to the research into young people's engagement with technology by exploring the trends of access and use of technology in greater depth across multiple contexts. However there are still many aspects of this phenomenon that require further research. More research is needed to explore the motivations and influences behind young people's engagement with technology to capture how the release of new technologies impact access and usage patterns over time. In the educational context, a longitudinal study which examines the changes in technology appropriation throughout the different phases of a students' degree would help to better understand the factors which influence technology adoption and adaption for a variety of educational stages and tasks. An examination of the changes in technology engagement as students enter the workplace could inform how technology can be used in final year or capstone subjects to build technological skills that will be useful in their post-university lives.

Methodologically, it is recommended that research into young people's engagement with technology move beyond the current reliance on survey methods, which have been shown to have limited reliability, towards more sophisticated mixed methods approaches. The complexity of young people's engagement with technology is difficult to capture in terms of only access and usage statistics. The development of methodologies which can capture technological experiences using qualitative methods can expand our knowledge of the influences and contexts of technology use. For example, the use of in-depth interviews or focus groups to explore the influences and motivations behind the quantitatively measured frequencies of students' technology use could be used to inform how technologies can be more effectively used in learning activities. Observations of the technologies that students choose to use to complete an educational activity and tracking of how they use these technologies could also contribute to ways in which to better integrate technology in the classroom.

In this study it was also demonstrated that the use of theory provided useful perspectives through which to view the research. To date, there has only been limited use of theory in research in this area leaving significant scope for the use of theory to examine different aspects of technology engagement. In particular, theory could be used to develop a greater understanding of the contextual factors that influence technology activities. The combination of theories used in this study provided new perspectives on the phenomenon, but did not adequately capture the social influences on the appropriation of technology, which indicates that other theories are necessary to support this approach. There is also potential for the use of psychological theories that could facilitate the examination of how the use of technology supports learning processes. For example, theories on motivation and self-regulation of learning could be used to examine the relationship between the factors that influence students' appropriation of technology and how students adapt these technologies to support their learning goals. More research is needed to understand the relationship between students' use of technology and learning to respond to new trends and potential changes in higher education.

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APPENDICES

Appendix A: Research Ethics Approval

University of Wollongong

INITIAL APPLICATION APPROVAL
In reply please quote: HE08/197
Further Enquiries Phone: 4221 4457

18 July 2008

Ms L Corrin
Room 23.122
Faculty of Education

Dear Ms L Corrin

Thank you for your response dated 17 July 2008 to the HREC review of the application detailed below. I am pleased to advise that the application has been approved.

Ethics Number:	HE08/197
Project Title:	Examining digital natives: an investigation of students' learning through their use of technology
Researchers:	Ms Linda Corrin, Dr Susan Bennett, A/Professor Lori Lockyer
Approval Date:	17 July 2008
Expiry Date:	16 July 2009

The University of Wollongong/SESIAHS Humanities, Social Science and Behavioural HREC is constituted and functions in accordance with the NHMRC *National Statement on Ethical Conduct in Human Research*. The HREC has reviewed the research proposal for compliance with the *National Statement* and approval of this project is conditional upon your continuing compliance with this document. As evidence of continuing compliance, the Human Research Ethics Committee requires that researchers immediately report:

- proposed changes to the protocol including changes to investigators involved
- serious or unexpected adverse effects on participants
- unforseen events that might affect continued ethical acceptability of the project.

You are also required to complete monitoring reports annually and at the end of your project. These reports are sent out approximately 6 weeks prior to the date your ethics approval expires. The reports must be completed, signed by the appropriate Head of School, and returned to the Research Services Office prior to the expiry date.

Yours sincerely

PP A/Professor Steven Roodenrys
Chair, Human Research Ethics Committee

cc Dr S Bennett, Faculty of Education

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Appendix B: Sampling Survey

SURVEY

Examining Digital Natives:
An investigation of students' learning through their use of technology

We are surveying students about their use of technology. Your responses to this survey will contribute to a research project which is seeking to gain a greater understanding of how students' use of technologies can inform how technology can be integrated into learning and teaching in universities. Participation in this study is voluntary and confidential. The questionnaire should only take 10-15 minutes to complete.

A. About You

1. In what year were you born? _____

2. Gender ☐ Male ☐ Female

3. What degree are you studying? _____

4. Are you in your first year of study at university? ☐ Yes ☐ No

5. Are you a domestic or international student? ☐ Domestic ☐ International

6. Are you a full time or part time student? ☐ Full time ☐ Part time

7. Where do you live during semester? ☐ Home (with family) ☐ Share house ☐ By yourself ☐ Uni Residence

8. How long does it take you to travel to university each day? _____hrs _____mins

9. How would you rate your general level of ability with technology? ☐ Basic ☐ Intermediate ☐ Advanced

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B. Access to Technology

Please indicate the level of access you have to each of the following technologies.

Technology	I own it and/or have access to it at anytime	Shared access with other people	Limited or restricted access	No access
Desktop computer	☐	☐	☐	☐
Laptop/Notebook computer	☐	☐	☐	☐
Electronic organiser (PDA, Palm, Pocket PC)	☐	☐	☐	☐
Portable music player (i.e. iPod, MP3)	☐	☐	☐	☐
Digital camera (still and/or video)	☐	☐	☐	☐
Mobile phone	☐	☐	☐	☐
Video (3G) capable phone	☐	☐	☐	☐
Memory stick (flash drive, USB stick)	☐	☐	☐	☐
Video game console (xBox, Playstation, Nintendo Wii)	☐	☐	☐	☐
GPS Navigation	☐	☐	☐	☐
Dial-up Internet access	☐	☐	☐	☐
Broadband Internet access	☐	☐	☐	☐

C. Use of Technology in your Everyday Life

Below are some examples of activities that you might do using technology. Please indicate how often you do these activities as part of your **everyday life (not part of your university study)**.

Activities you do as part of your EVERYDAY LIFE	**Frequency**			
	Daily	Weekly	Occasionally	Never
Use a computer to create or edit audio and/or video	☐	☐	☐	☐
Share photos online with friends and family	☐	☐	☐	☐
Write a blog	☐	☐	☐	☐
Build or maintain a website	☐	☐	☐	☐
Download and listen to podcasts	☐	☐	☐	☐
Read other people's blogs	☐	☐	☐	☐
Use RSS feeds	☐	☐	☐	☐
Use a computer/game console to play games	☐	☐	☐	☐
Use a computer/mobile phone/PDA as a personal organiser	☐	☐	☐	☐
Buy or sell items online	☐	☐	☐	☐
Do your banking and pay bills online	☐	☐	☐	☐
Send and/or receive emails	☐	☐	☐	☐
Use a mobile phone to make calls	☐	☐	☐	☐
Use a mobile phone to send text (SMS) messages	☐	☐	☐	☐
Use social networking websites (i.e. MySpace, Facebook)	☐	☐	☐	☐
Use instant messaging or chat (i.e. MSN, Yahoo messenger)	☐	☐	☐	☐

D. Use of Technology for your University Study

Please indicate how often you would do the following activities as part of your **university study**.

Activities you do as part of your UNIVERSITY STUDY	**Frequency**			
	Daily	Weekly	Occasionally	Never
Use a computer to create or edit audio and/or video	☐	☐	☐	☐
Share photos online	☐	☐	☐	☐
Write a blog	☐	☐	☐	☐
Build or maintain a website	☐	☐	☐	☐
Use a computer to create presentations (i.e. PowerPoint)	☐	☐	☐	☐
Access information online	☐	☐	☐	☐
Download and listen to podcasts	☐	☐	☐	☐
Read other people's blogs	☐	☐	☐	☐
Use RSS feeds	☐	☐	☐	☐
Use a computer/game console to play games	☐	☐	☐	☐
Use a computer/mobile phone/PDA as a personal organiser	☐	☐	☐	☐
Access eLearning space (UOW's online learning website)	☐	☐	☐	☐
Send and/or receive emails	☐	☐	☐	☐
Use a mobile phone to make calls	☐	☐	☐	☐
Use a mobile phone to send text (SMS) messages	☐	☐	☐	☐
Use social networking websites (i.e. MySpace, Facebook)	☐	☐	☐	☐
Use instant messaging or chat (i.e. MSN, Yahoo messenger)	☐	☐	☐	☐

Thank you for your time in filling in this survey

Appendix C: Information Sheet for the Sampling Survey

University of Wollongong 

Examining Digital Natives:
An investigation of students' learning through their use of technology

Researcher: Linda Corrin (Faculty of Education, UOW)
Supervisors: Dr Sue Bennett & Dr Lori Lockyer

You have been invited to participate in the project entitled "Examining Digital Natives: An investigation of students' learning through their use of technology" conducted by Ms Linda Corrin from the Faculty of Education at the University of Wollongong. The aim of this study is to examine how first-year students' use of technology supports learning with a view to informing learning and teaching practices in higher education. The results of this study will assist to inform the development of strategies for the effective use and integration of technology into higher education.

You have been asked to complete a survey which will ask you questions about your access to and use of technology in your everyday and academic life. This survey is anonymous and should take approximately 10 minutes to complete.

You are also invited to take part in the main study. The main study consists of several stages. If you consent to participate, you will be asked to

1. participate in an interview to find out more about how you use technology in everyday life.
2. respond to a set of brief questions about your use of technology over a three week period. We will prompt you to answer these questions at different times of the day to get a picture of your everyday technology use.
3. comment on any trends, irregularities or abnormal situations of your technology use at the end of the three week period
4. participate in a final interview, at the end of the semester, to see if there have been any changes in your perspectives on and use of technology.
5. to enable the researcher to observe some of your online activities, by negotiation.

You have two options:

Option 1: Complete and return the survey only. As the survey is anonymous it does not require your separate consent.

Option 2: Complete and return the survey and provide your contact details on the consent form if you are interested in participating in the main study.

In recognition of the time taken to participate in the main study you will be given a $30 Dymocks book voucher upon completion.

The following measures will be adopted to protect the identities of participants in the study:

- Data collected will be stored securely in a locked filing cabinet and/or a password protected computer in the Faculty of Education, and will only be accessed by the researcher.
- Only statistical findings and anonymous quotes will be used in publications arising from this study.

Your participation in this research is voluntary; you are free to refuse to participate and may withdraw from the research at any time by advising Ms Corrin. Your refusal to participate or withdrawal of consent will in no way affect your relationship with the University of Wollongong.

If you have any enquiries about the research, you can contact the researcher by phone on or by email at lcorrin@uow.edu.au or her supervisor, Dr Lori Lockyer on or llockyer@uow.edu.au. If you have any concerns or complaints regarding the way the research is or has been conducted, you can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457.

Appendix D: Consent form to be contacted for the main study

University of Wollongong 

CONSENT FORM
TO BE CONTACTED FOR MAIN STUDY

Examining Digital Natives:
An investigation of students' learning through their use of technology

Researcher: Linda Corrin (Faculty of Education, UOW)
Supervisors: Dr Sue Bennett & Dr Lori Lockyer

I have been given information about the Examining Digital Natives research project.

I understand that I am consenting to be contacted about participating in the main study.

If I agree to participate in the stages of the main study it will include:

1. To participate in an interview to find out more about how I use technology in my everyday life.
2. To respond to a set of brief questions about my use of technology over a three week period.
3. At the end of the three week period I will be shown the information which I provided and be given an opportunity to comment on any trends, irregularities or abnormal situations.
4. To participate in a final interview at the end of the semester to see if there have been any changes in my perspectives on and use of technology.
5. To enable the researcher to observe some of my online activities, by negotiation.

If I have any enquiries about the research, I can contact Linda Corrin or lcorrin@uow.edu.au or her supervisor, Dr Lori Lockyer on or llockyer@uow.edu.au. If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, University of Wollongong (02 4221 4457).

I understand that the information collected from my participation may be used in a research thesis and also for journal, conference and other academic papers, and I consent for it to be used in that way. I understand that it will not be possible to identify me from any material published or otherwise communicated by the researcher. I understand that any data I provide will be stored securely in a locked filing cabinet and only available to the researcher and not to any other project, person or unit of the university.

I have had an opportunity to ask the researcher questions about the research and my participation.

I understand that my participation in this research is voluntary and that I am free to refuse to participate; to refuse to discuss specific topics; or to withdraw from the research at any time.

My refusal to participate or withdrawal will have no adverse effect on my enrolment and/or studies at the University of Wollongong.

By signing below I am indicating my consent to be contacted for the main study, as it has been described to me in the information sheet.

Signed Date

..../...../.....

Name (please print)

.....

Contact Phone Number Email Address

....

Appendix E: Information sheet for participation in the main study

University of Wollongong 

INFORMATION SHEET
PARTICIPATION IN THE MAIN STUDY

Examining Digital Natives:
An investigation of students' learning through their use of technology

Researcher: Linda Corrin (Faculty of Education, UOW)
Supervisors: Dr Sue Bennett & Dr Lori Lockyer

You have been invited to participate in the project entitled "Examining Digital Natives: An investigation of students' learning through their use of technology" conducted by Ms Linda Corrin from the Faculty of Education at the University of Wollongong. The aim of this study is to examine how first-year students' use of technology supports learning with a view to informing learning and teaching practices in higher education. The results of this study will assist to inform the development of strategies for the effective use and integration of technology into higher education.

Thank you for completing the survey. You are now also invited to take part in the main study. The main study consists of several stages. If you consent to participate, you will be asked to

6. participate in an interview to find out more about how you use technology in your everyday life.
7. respond to a set of brief questions about your use of technology over a three week period. We will prompt you to answer these questions at different times of the day to get a picture of your everyday technology use.
8. comment on any trends, irregularities or abnormal situations of your technology use at the end of the three week period
9. participate in a final interview, at the end of the semester, to see if there have been any changes in your perspectives on and use of technology.
10. to enable the researcher to observe some of your online activities, by negotiation.

In recognition of the time taken to participate in the main study you will be given a $30 book voucher upon completion.

The following measures will be adopted to protect the identities of participants in the study:

- Data collected will be stored securely in a locked filing cabinet and/or a password protected computer in the Faculty of Education, and will only be accessed by the researcher.
- Only statistical findings and anonymous quotes will be used in publications arising from this study.

Your participation in this research is voluntary; you are free to refuse to participate and may withdraw from the research at any time by advising Ms Corrin. Your refusal to participate or withdrawal of consent will in no way affect your relationship with the University of Wollongong.

If you have any enquiries about the research, you can contact the researcher by phone on 0 or by email at lcorrin@uow.edu.au or her supervisor, Dr Lori Lockyer on or llockyer@uow.edu.au. If you have any concerns or complaints regarding the way the research is or has been conducted, you can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457.

Appendix F: Consent form to participate in the main study

University of Wollongong 

CONSENT FORM
TO PARTICIPATE IN THE MAIN STUDY

Examining Digital Natives:
An investigation of students' learning through their use of technology

Researcher: Linda Corrin (Faculty of Education, UOW)
Supervisors: Dr Sue Bennett & Dr Lori Lockyer

I have been given information about the Examining Digital Natives research project.

I understand that I am consenting to participate in the main study.

I agree to participate in the stages of the main study it will include:

1. To participate in an interview to find out more about how I use technology in my everyday life.
2. To respond to a set of brief questions about my use of technology over a three week period.
3. At the end of the three week period I will be shown the information which I provided and be given an opportunity to comment on any trends, irregularities or abnormal situations.
4. To participate in a final interview at the end of the semester to see if there have been any changes in my perspectives on and use of technology.
5. To enable the researcher to observe some of my online activities, by negotiation.

If I have any enquiries about the research, I can contact Linda Corrin 4 or lcorrin@uow.edu.au or her supervisor, Dr Lori Lockyer on or llockyer@uow.edu.au. If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, University of Wollongong (02 4221 4457).

I understand that the information collected from my participation may be used in a research thesis and also for journal, conference and other academic papers, and I consent for it to be used in that way. I understand that it will not be possible to identify me from any material published or otherwise communicated by the researcher. I understand that any data I provide will be stored securely in a locked filing cabinet and only available to the researcher and not to any other project, person or unit of the university.

I have had an opportunity to ask the researcher questions about the research and my participation.

I understand that my participation in this research is voluntary and that I am free to refuse to participate; to refuse to discuss specific topics; or to withdraw from the research at any time.

My refusal to participate or withdrawal will have no adverse effect on my enrolment and/or studies at the University of Wollongong.

By signing below I am indicating my consent to participate in the main study, as it has been described to me in the information sheet.

Signed Date

..../...../.....

Name (please print)

.....

Contact Phone Number Email Address

....

Appendix G: First Interview Protocol

FIRST INTERVIEW PROTOCOL

Technology use

What are the technologies that you use most frequently in your everyday life?

a) How often do you use them?
b) What is the main purpose of the use?

Could you briefly describe how you would normally use:

a) Your mobile phone
b) Your computer (laptop/desktop)
c) [Any other technologies to which the participate has access as identified in the sampling survey – that haven't been covered in the first question]

When using the Internet are there any:

a) Social networking sites you use
b) Sites that you visit on a regular basis
c) Games that you play
d) Tools you use to communication (IM, Skype, etc.)

What are the main technologies that you use as part of your studies?

Are there any technologies that you use for your personal study that are not integrated as part of your courses at university?

Are there any technologies that you use in your everyday life that you think could be useful in your studies?

Learning goals and strategies

Why did you decide to come to uni?

What do you want to get from your degree?

How do you decide the subjects you are going to study as part of your degree?

How would you describe the way you prefer to study?

a) Do you like work as part of a group? Is there a difference in your preference for group work depending on whether the activity is being assessed or not?
b) Do you prefer to work as an individual?

Are there any learning activities that you have done as part of your course so far that you found really engaging?

How confident do you feel in engaging in discussions as part of your course?

a) in the classroom
b) online

If there is something that you don't know as part of your studies, what strategies do you typically use to find it out?

How do you usually 'study' for assessments/exams?

Competence/Confidence with technology

How confident do you feel in using technologies generally?

How confident would you feel in using [technology] vs. [technology] – (The technologies used here will be dependent on the participant's responses in the survey)

Do you find it easy to 'pick up' new technologies?

What methods do you use to learn how to use new technologies?

Adoption of technologies

What factors influence your decision to purchase and/or start using a new technology?

a) in your everyday life?
b) in your academic studies?

How do you find out information about new technologies?
(I,e. How did you decide which [mobile phone] you were going to buy?)

Are there any technologies you are currently considering purchasing?

Appendix H: Experience Sampling Method Booklet

Experience Sampling Questions

Experience Sampling Questions

Thank you agreeing to take part in this part of the research. The aim of this activity is to gain an insight into your everyday activities and how technology features in your lives.

Over the next three weeks you will receive a text message three times a day to prompt you to fill in one page of this booklet. Try to complete the booklet as soon as you receive the message, but if that is not possible for any particular reason, then try to think back to what you were doing at the time the message came through.

At the end of each day, please fill in the 'End of Day' page which provides a summary of your technology-based activities for the day.

If you have any questions or concerns please don't hesitate to contact me (Linda) on lcorrin@uow.edu.au or 0432 975 470.

Thanks again.

Cheers,
Linda

Monday Morning **Date: _____**

Please fill in the following table when prompted by text msg.

What time is it?	___ : ___ AM/PM		
Where are you?			
Who are you with?	☐ Friends	☐ Family	☐ Partner
	☐ By Myself	☐ Work Colleagues	☐ Other _____
What are you doing?	☐ Studying	☐ Attending Lecture	☐ Attending Tutorial
	☐ Playing sport	☐ Exercising	☐ Playing games
	☐ Watching TV	☐ Reading	☐ Listening to music
	☐ Going online	☐ Preparing Food	☐ Eating/ Drinking
	☐ Travelling	☐ Working	☐ Taking a break
	☐ Shopping	☐ Housework	☐ Sleeping
	☐ Grooming	☐ Other: _____	
Are you using technology?	☐ Yes	☐ No	
What technology are you using?			
How are you using the technology?			
Comments			

Monday End of Day **Date: _____**

Please fill in this table at the end of the day.

How many text msgs did you send today?	
How many emails did you send today?	

Please indicate which activities you did today and the context of the activity:

Activities	Everyday Life	Academic Study	Personal Study
Shared photos	☐	☐	☐
Read a blog	☐	☐	☐
Listened to a Podcast	☐	☐	☐
Played games	☐	☐	☐
Accessed information online	☐	☐	☐
Shopped online	☐	☐	☐
Did banking &/or paid bills online	☐	☐	☐
Used a mobile to make calls	☐	☐	☐
Used a social networking site	☐	☐	☐
Used Instant Msging or Chat	☐	☐	☐
Accessed eLearning space	☐	☐	☐
Comments			

Appendix I: Experience Sampling Method Alert Schedule

ESM ALERT SCHEDULE

Participant: _____

Day		Alert 1	Alert 2	Alert 3
Monday	1	10:30am	2:30pm	7:30pm
Tuesday	2	9:30am	3:00pm	8:00pm
Wednesday	3	9:00am	1:00pm	6:00pm
Thursday	4	10:00am	4:00pm	9:00pm
Friday	5	11:00am	2:00pm	5:30pm
Saturday	6	11:30am	4:30pm	8:30pm
Sunday	7	10:30am	1:30pm	5:00pm
Monday	8	9:30am	3:30pm	6:30pm
Tuesday	9	9:00am	2:30pm	7:00pm
Wednesday	10	10:00am	3:00pm	7:30pm
Thursday	11	11:00am	1:00pm	8:00pm
Friday	12	11:30am	4:00pm	6:00pm
Saturday	13	10:30am	2:00pm	9:00pm
Sunday	14	9:30am	4:30pm	5:30pm
Monday	15	9:00am	1:30pm	8:30pm
Tuesday	16	10:00am	3:30pm	5:00pm
Wednesday	17	11:00am	2:30pm	6:30pm
Thursday	18	11:30am	3:00pm	7:00pm
Friday	19	10:30am	1:00pm	7:30pm
Saturday	20	9:30am	4:00pm	8:00pm
Sunday	21	9:00am	2:00pm	6:00pm

Appendix J: Online Observation Protocol

The following observation protocol will be used to observe the participants' online activity as negotiated.

Time of observation: _____

Website: _____

Activity	Frequency			
	High	**Medium**	**Low**	**None**
Create				
Consume				
Communicate				

Description of activity:

_____

_____

_____

_____

_____

_____

Appendix K: Second Interview Protocol

SECOND INTERVIEW PROTOCOL

ESM Questions
Interview participants will be shown a summary of the data collected during the experience sampling period.

Do you feel that the data accurately represents your typical technology use?
a) Is there anything that is underrepresented by the data?
b) Is there anything that is overrepresented by the data?

Were there any unusual circumstances/occurrences over the past 4 weeks that would have an impact on the data collected?

During the experience sampling period have you adopted any new technologies?
a) If yes, what did you adopt?
b) Why did you adopt it?
c) What influenced your decision to adopt the new technology?

During the experience sampling period did you stop using any technologies?
a) If yes, what did you stop using?
b) Why did you stop?
c) What influenced your decision to stop using the technology?

Of the technologies/uses that we discussed in the previous interview, have there been any changes in how you use technology?

How did you find taking part in the experience sampling part of the research?
a) Was there anything that you found difficult/confusing?
b) Do you have any suggestions about how this could be done more effectively?

Technology Use
How do first year students select and adapt technologies to suit their learning goals and strategies?

Let's talk a bit more about how you use technology to support your studies.
Describe to me in your own words how you use technology as part of your studies.

How much technology would you like to use as part of your academic studies?
A lot less Less Same More A lot more

Identity
How do first year students' use of and preferences for particular technologies in different everyday and academic contexts relate to the identities they adopt on those contexts?

In terms of how you use [technology], how do you see yourself...

How do you define yourself online?

Appendix L: Digital Natives: Everyday life versus academic study

Corrin, L., Bennett, S., & Lockyer, L. (2010). Digital natives: Everyday life versus academic study. In L. Dirckinck-Holmfeld, V. Hodgson, C. Jones, M. de Laat, D. McConnell & T. Ryberg (Eds.) *Proceedings of the Seventh International Conference on Networked Learning 2010* (pp. 643-650). Aalborg: Aalborg University.

Abstract

Access to and use of technology by 'digital native' students studying in our universities has been an area of much speculation, though relatively little empirical research. This has led some pundits to call for a radical rethink of how higher education uses technology to deliver education. Others are more circumspect and think it is necessary to hear directly from these digital natives about their actual technology practices before jumping to such conclusions. This paper reports on a study that aimed to do just that; the study comprised a survey of the technology access and practices in both everyday life and for academic study of first year university students. The findings suggest that, for the participants of this study, access and usage of technology does not neatly fit into the stereotype of the 'digital native'. Access to and use of some technologies was found to be quite high whilst others have significant levels of non-adoption. A comparison was made between technologies and activities undertaken as part of students' everyday life in contrast to their academic study and it was found that the usage rates were generally lower for academic study. Access to and use of different technologies for different purposes is variable and university teachers and policymakers need to take this variability into account when making changes at the course or institution levels. What is also required is more in-depth investigation of the technology practices of these digital natives to understand how technology is transforming their social and academic lives and, importantly, how they are shaping technology to suit their lives.

Introduction

Over the last 15 years the emergence of a new generation of students in higher education has been reported in the literature. This generation is said to be comprised of digital natives who have grown up surrounded by technology and are characterised by their ability to multitask, their dependence on technology to maintain social contact, their openness to share content, and their ability to rapidly understand and adopt new

technologies (Oblinger & Oblinger, 2005; Prensky, 2001; Dede, 2005). Many generalisations have been made about this group of young people; however recent studies suggest that the homogeneity of this generation cannot be assumed and that in reality the technological characteristics of the digital natives are significantly diverse in nature, especially in relation to technology use as part of students' academic study (Lang, 2007; Kennedy, 2006). This variance in technological experience and ability challenges many of the assumptions which currently form the basis of recent educational technology implementation strategies in higher education (McLoughlin & Lee, 2008).

The Evolving Digital Natives Debate

The origins of the digital natives debate can be found in the mid-1990s when commentary began to emerge about a technological disparity between the youth of the time and their parent and teachers. Essayist John Perry Barlow (1995) in his Declaration of the Independence of Cyberspace warned parents that "You are terrified of your own children, since they are natives in a world where you will always be immigrants" (¶. 12). The term 'digital native' was popularised by Prensky (2001) who claimed that technology had created a discontinuity, resulting in a radical change in the characteristics of the new generation of students entering our universities.

This concept was based primarily on age and defined to include those born after 1980 when the personal computer became commonplace (Oblinger & Oblinger, 2005). This notion of generational technology homogeneity is similar to Tapscott's (1998) idea of the 'Net Generation' and the 'Millennials' proposed by social commentators Howe and Strauss (2000). Prensky (2001) expanded on this idea of a disparity between young people and the older generations by introducing the concept of 'digital immigrants' – those who were not born into the digital world and who, it is claimed, do not think learning and technology can be 'fun' and will ever be able to master the use of technology to support engaging education. This has remained a central idea in Prensky's work, despite some later concessions about the variance of technological experience of digital natives (Prensky, 2007). The supposed divide between students and academics has prompted arguments for radical changes in higher education teaching approaches and professional development in an attempt to bridge the gap (Oblinger & Oblinger, 2005). This is despite the fact that many of these claims have been largely based on anecdotal evidence with no solid foundation in research (Kennedy et. al., 2006; Bennett et. al., 2008). As Helsper & Eynon (2009, p.16) stated in their critique of current thinking about digital natives and digital

immigrants, “We are not saying education should not change, but debates about change must be based on empirical evidence and not rhetoric”.

Regardless of the lack of empirical data, these ideas have led to the emergence of a significant body of literature describing the characteristics of digital natives. These characteristics generally include a high level of digital aptitude, the ability to multitask, literacy in multiple media, constant connectivity, the need for speed in delivery of information, a culture of sharing information and a unique attitude towards education (Barnes et. al., 2007; Prensky, 2004; Oblinger & Oblinger, 2005; Dede, 2005). Many of these proposed characteristics are based on anecdote and are yet to be empirically tested.

As the discussion of digital native characteristics developed, studies began to emerge which measured, usually by survey methods, students’ ownership and general activities of use of technology (Kennedy et. al., 2007; Garcia & Qin, 2007). These studies found that ownership levels of technologies such as computers and mobile phones were increasing, as was students’ participation in online activities such as writing blogs, using social networking sites or instant messaging with their friends (Oliver & Goerke, 2007). However, as more researchbased studies have emerged, the debate has begun to move away from age as the main criteria for membership of a group that might fit the digital native label. The significant variance in the identified levels of digital activity across all ages has prompted authors to advocate usage levels and experience with technology as measures of whether a person can be considered a digital native, rather than their age (Dede, 2005; Bullen et. al. 2009). Although this proposition appears to make more sense because it acknowledges that people of any age can develop technological expertise, it still assumes a simple homogeneous notion of technological expertise.

However, there is still a lack of studies that go beyond ownership and pre-categorised general uses to examine how students have adapted technology to support their learning. Helsper & Eynon (2009) also suggest that the complexity and diversity in the ways young people use technology is often ignored in research supporting the concept of digital natives. The assumption that students are digital natives who adapt well to the introduction of new technologies has underpinned a number of technology-specific classroom implementation studies from podcasting to the use of virtual worlds such as Second Life (Lee & Chan, 2007; Skiba, 2007). What is unclear is whether the motivation for these implementations of new technologies in the classroom stems from the needs and abilities of the students or simply the emergence or availability of the technology. Kennedy

et. al. (2007) argue that further research is needed to identify which technologies students are choosing to use in their everyday lives and how these technologies overlap with or can become 'learning technologies'. It is often assumed that the overlap between the two contexts is considerable, however several recent studies have found that student inclination to integrate common technologies, such as the Internet, into their studies has been less than expected (Selwyn, 2008). The study described in this paper goes some way to exploring the differences in the use of technology to support academic study in contrast to technology use as part of everyday life.

Methodology

The research reported in this paper involved the administration of an anonymous survey to first year students at an Australian university in the second semester of the 2008 academic year. The design of the survey was informed by the technologies and activities identified in previous digital native studies, in particular the studies of Kennedy et. al. (2007) and Trinder et. al. (2008). The first part of the survey collected demographic information about the respondents. In addition to the general demographics of age, gender and degree, more specific questions about enrolment (ie. domestic/international, full/part-time, year in program) and living arrangements were included in order to determine whether respondents fit within the target participant group.

Several criteria were applied in the identification of the participant group to make the sample reflective of the average first year student. It was identified from the university's enrolment information that the majority of first year students were domestic, full time students. In regards to age, the participant group was restricted to those students born from 1980 onwards. This criteria was applied for two reasons, firstly as the age group most commonly identified in the literature as being the generation most likely to be digital natives and secondly due to the fact that the number of respondents born before 1980 was very low (5.2%). The demographics section also collected data on the respondents' living arrangements, daily travel time to university and asked students to rate themselves in terms of their general level of ability with technology. This data was used to characterise the nature of the student population.

The next section of the survey collected data about students' access to technology. Students were presented with a list of common technologies and asked to indicate their level of access to the technology ranging from ownership or exclusive use, through shared or limited access, to no access at all. Due to the fact the study looked specifically at first

year students it was decided to measure access rather than ownership as it is possible that some students may not be able to afford to purchase some of this equipment outright but can still access it, particularly if they were still living in the family home (71.7%). This list of technologies included those most commonly associated with use in academic contexts such as desktop/laptop computers, memory sticks and media devices, along with technologies generally associated with everyday life activities such as game consoles, GPS devices, and digital cameras.

The third section of the survey asked students to indicate how often they undertook certain technology-related activities. Identity theory (Stryker & Burke, 2000) informed the definition of the context in which these activities take place. Previous studies have concentrated on students' technology use in general, although very few have considered technology use across multiple contexts. Those that have found adoption of technology was more likely by those who had a strong identity as a student (Benson & Melolichick, 2007). Two lists of technology-related activities were presented to students, one for the context of everyday life and the other for the context of academic study. Where possible similar activities between the contexts were included to allow for comparative analysis across everyday and academic life. In addition, several context-specific activities were included to further explore each area (ie. buy or sell items (everyday life), access the University's learning management system (academic study)).

Results

The survey was administered in lectures and tutorials for nine subjects across seven faculties of the university. The collection of data occurred over the first three weeks of the teaching session. Data was collected in the second session of the first year so that students had already had some experience of university study in their first session to be able to respond to questions about their technology use in relation to their study. A total of 547 responses were collected and of these 470 responses fell within the participant criteria. The resulting sample represents 16.5% of the total 2008 university enrolment of students who meet these criteria. The distribution of ages within the post-1980 criteria is skewed towards those students born between 1988 and 1990 as these ages represent students who have come either directly from secondary school to university or have done so after a 12 month break. In terms of gender, a higher proportion of the respondents were female (64%) opposed to 35.7% of male respondents. Whilst this ratio is slightly higher that the university average (52% female/48% male), this can be explained in part by a large number of respondents belonging to the Education faculty where the proportion of female

students is significantly higher than males. Overall 44% of respondents came from Humanities and Social Science disciplines (Arts, Commerce, Creative Arts, Education, Informatics, and Law) and 56% came from science-based disciplines (Science and Health and Behavioural Science).

Students were asked to rate their own general level of ability with technology. Students could rate themselves as either beginner, intermediate or advanced. A majority of students in this study classified their ability with technology as intermediate (67%) with only 23.2% rating themselves as advanced users and 8.5% as beginners. This calls into question the popular assertion that all young people have a high level of digital literacy because of their exposure to technology (Prensky, 2001; Oblinger & Oblinger, 2005).

The findings relating to students' access to technology demonstrated a high level of access to certain technologies including computers, mobile phones, and portable music players, whilst other technologies, such as PDAs and GPS, showed significantly lower access rates (see Table 3). The ownership and/or access to computers showed that students in this group were more likely to use a laptop computer (73.4%) than a desktop computer (61.5%). Nearly half of all students surveyed (44.4%) indicated that they owned both a laptop and desktop computer. Almost all students indicated that they have some form of access to either a laptop or desktop computer and only 0.4% (two students) had only limited or restricted access to either.

Table 3

Access to technology

Technology	n	it and/or have access to it at anytime	Shared access with other people	Limited or restricted access	No access
Desktop computer	466	289 (61.5%)	145 (30.9%)	24 (5.1%)	8 (1.7%)
Laptop/Notebook computer	470	345 (73.4%)	51 (10.9%)	33 (7%)	41 (8.7%)
Electronic organiser (PDA, Palm, Pocket PC)	467	26 (5.5%)	11 (2.3%)	38 (8.1%)	392 (83.4%)
Portable music player (i.e. iPod, MP3)	468	404 (86%)	12 (2.6%)	13 (2.8%)	39 (8.3%)
Digital camera (still and/or video)	470	339 (72.1%)	79 (16.8%)	17 (3.6%)	35 (7.4%)
Mobile phone	470	469 (99.8%)	1 (0.2%)	0	0
Video (3G) capable phone	462	201 (42.8%)	13 (2.8%)	35 (7.4%)	213 (45.3%)
Memory stick (flash drive, USB stick)	469	435 (92.6%)	19 (4%)	3 (0.6%)	12 (2.6%)
Video game console (xBox, Playstation, Nintendo Wii)	468	245 (52.1%)	86 (18.3%)	47 (10%)	90 (19.1%)
GPS Navigation	464	74 (15.7%)	63 (13.4%)	68 (14.5%)	259 (55.1%)
Dial-up Internet access	448	55 (11.7%)	27 (5.7%)	20 (4.3%)	346 (73.6%)
Broadband Internet access	469	392 (83.4%)	62 (13.2%)	7 (1.5%)	8 (1.7%)

The technology to which students had the highest level of access is the mobile phone, with 99.8% of students having full access to a mobile and only one respondent having shared access. A large proportion of participants (42.8%) claimed to have a 3G phone, which is notably higher than the Australian standard of 25% as reported in a survey of mobile phone usage conducted around the same time by the Australian Interactive Media Industry Association (AIMIA, 2008). In terms of connectivity, the transition from dial up Internet access towards broadband access is evident, with 96.6% of students having either full or shared access to broadband Internet.

The responses relating to the use of technology in everyday life (see Table 4) showed a significant variation in the frequency of the use of certain types of technology. The percentages of daily activity in activities such as writing a blog, building a website, and using RSS feeds are low, with a majority of students having never undertaken these activities. There were also a large percentage of students who have never used the Internet to buy or sell things or do banking transactions and pay bills. Conversely, communication-based activities were more likely to be undertaken on a frequent basis, especially mobile phone communication via text message (93%) or voice call (82.1%). Online communication activities facilitated by social networking sites and instant messaging services were generally undertaken on a daily or weekly basis; however it is interesting to note that around 10% of students reported that they had never used these communication channels. This finding contradicts the themes suggested in much of the digital natives' literature which emphasises the digital natives' need for constant connectivity and communication (Prensky, 2001; Philip, 2007).

In relation to academic study the percentages of daily and weekly use for a number of activities were generally low. However, unlike the self-directed use of technology in everyday life, a number of the activities listed in the academic study section of the survey would only be likely to occur if incorporated into coursework (ie. write a blog, build a website) and the fact that the usage rates were low for these types of activities suggest that they are not commonly being offered as learning activities. Despite the possible lack of directed activities, the figures do suggest that these students are not adopting and adapting these technologies as part of their personal study methods, contrary to findings reported elsewhere in the literature (Conole et. al., 2008).

Table 4

Use of technology in everyday life

Activities	n	Daily	Weekly	Occasionally	Never
Use a computer to create or edit audio and/or video	469	27 (5.7%)	47 (10%)	212 (45.1%)	183 (38.9%)
Share photos online with friends and family	470	85 (18.1%)	150 (31.9%)	207 (44%)	28 (6%)
Write a blog	469	13 (2.8%)	21 (4.5%)	127 (27%)	308 (65.5%)
Build or maintain a website	465	44 (9.4%)	34 (7.2%)	60 (12.8%)	327 (69.6%)
Download and listen to podcasts	467	43 (9.1%)	74 (15.7%)	158 (33.6%)	192 (40.9%)
Read other people's blogs	468	41 (8.7%)	87 (18.5%)	187 (39.8%)	153 (32.6%)
Use RSS feeds	454	13 (2.8%)	15 (3.2%)	57 (12.1%)	369 (78.5%)
Use a computer/game console to play games	469	61 (13%)	96 (20.4%)	205 (43.6%)	107 (22.8%)
Use a computer/mobile phone/PDA as a personal organiser	468	230 (48.9%)	49 (10.4%)	94 (20%)	95 (20.2%)
Buy or sell items online	470	21 (4.5%)	21 (4.5%)	238 (50.6%)	190 (40.4%)
Do your banking and pay bills online	469	50 (10.6%)	142 (30.2%)	121 (25.7%)	156 (33.2%)
Send and/or receive emails	468	300 (63.8%)	134 (28.5%)	29 (6.2%)	5 (1.1%)
Use a mobile phone to make calls	470	386 (82.1%)	65 (13.8%)	16 (3.4%)	3 (0.6%)
Use a mobile phone to send text (SMS) messages	470	437 (93%)	26 (5.5%)	4 (0.9%)	3 (0.6%)
Use social networking websites (ie. MySpace, Facebook)	470	301 (64%)	81 (17.2%)	40 (8.5%)	48 (10.2%)
Use instant messaging or chat (ie. MSN, Yahoo Messenger)	470	218 (46.4%)	75 (16%)	118 (25.1%)	59 (12.6%)

The notable exceptions to low usage in the academic context were the use of the University's elearning environment and the ability to access information online, which both showed high percentages of daily use (see Table 5). The continuous nature of course activities and assessments would seem to account for this trend which could be considered, at least to some extent, part of the directed nature of the course. However the use of communication tools, which are more likely to be adapted by students to suit their individual needs, showed that students use mobile technologies daily, weekly or occasionally to send text messages (87.7%) at a level only slightly lower than email (98.7%). For the purposes of academic study, regular use of social networking and instant messaging technology for communication was much lower than mobile phone and email communication.

Table 5

Use of technology in academic study

Activities	n	Daily	Weekly	Occasionally	Never
Use a computer to create or edit audio and/or video	469	8 (1.7%)	22 (4.7%)	131 (27.9%)	308 (65.5%)
Share photos online	468	9 (1.9%)	27 (5.7%)	105 (22.3%)	327 (69.6%)
Write a blog	469	5 (1.1%)	6 (1.3%)	53 (11.3%)	405 (86.2%)
Build or maintain a website	464	6 (1.3%)	6 (1.3%)	35 (7.4%)	417 (88.7%)
Use a computer to create presentations (ie. PowerPoint)	465	22 (4.7%)	80 (17%)	315 (67%)	48 (10.2%)
Access information online	465	300 (63.8%)	133 (28.3%)	29 (6.2%)	3 (0.6%)
Download and listen to podcasts	465	23 (4.9%)	35 (7.4%)	129 (27.4%)	278 (59.1%)
Read other people's blogs	465	8 (1.7%)	22 (4.7%)	86 (18.3%)	349 (74.3%)
Use RSS feeds	455	5 (1.1%)	6 (1.3%)	31 (6.6%)	413 (87.9%)
Use a computer/game console to play games	463	4 (0.9%)	17 (3.6%)	32 (6.8%)	411 (87.4%)
Use a computer/mobile phone/PDA as a personal organiser	463	147 (31.3%)	68 (14.5%)	83 (17.7%)	165 (35.1%)
Access eLearning space (the University's online learning website)	465	381 (81.1%)	76 (16.2%)	6 (1.3%)	2 (0.4%)
Send and/or receive emails	466	238 (50.6%)	156 (33.2%)	66 (14%)	6 (1.3%)
Use a mobile phone to make calls	465	192 (40.9%)	89 (18.9%)	111 (23.6%)	73 (15.5%)
Use a mobile phone to send text (SMS) messages	464	229 (48.7%)	74 (15.7%)	103 (21.9%)	58 (12.3%)
Use social networking websites (ie. MySpace, Facebook)	465	87 (18.5%)	64 (13.6%)	131 (27.9%)	183 (38.9%)
Use instant messaging or chat (ie. MSN, Yahoo Messenger)	465	74 (15.7%)	47 (10%)	118 (25.1%)	226 (48.1%)

Much of the discussion around digital natives implies that the high levels of technology use in a young person's everyday life should translate directly into their use of technology for their academic purposes. In order to investigate this idea a comparison was made between similar activities across the everyday and academic contexts. Table 6 combines this data to allow easy comparison (where 'EL' refers to everyday life and 'AS' to academic study). A number of activities including the creation of audio/video, writing a blog, building websites, listening to podcasts, using RSS feeds, using technology as a personal organiser, and using email show similar patterns in relation to frequency of use, however with each the frequency is slightly higher in the context of everyday life. Inconsistent patterns of frequency of use were found in relation to reading other people's blogs, playing games, and use of mobile phones for calling and messaging. Inverse relationships were evident for the activities of sharing photos online, using social networking sites and the use of instant messaging.

Table 6

Comparison of everyday and academic use of technology

Activities	EL/AS	n	Daily	Weekly	Occasionally	Never
Use a computer to create or edit audio and/or video	EL	469	27 (5.7%)	47 (10%)	212 (45.1%)	183 (38.9%)
	AS	469	8 (1.7%)	22 (4.7%)	131 (27.9%)	308 (65.5%)
Share photos online	EL	470	85 (18.1%)	150 (31.9%)	207 (44%)	28 (6%)
	AS	468	9 (1.9%)	27 (5.7%)	105 (22.3%)	327 (69.6%)
Write a blog	EL	469	13 (2.8%)	21 (4.5%)	127 (27%)	308 (65.5%)
	AS	469	5 (1.1%)	6 (1.3%)	53 (11.3%)	405 (86.2%)
Build or maintain a website	EL	465	44 (9.4%)	34 (7.2%)	60 (12.8%)	327 (69.6%)
	AS	464	6 (1.3%)	6 (1.3%)	35 (7.4%)	417 (88.7%)
Download and listen to podcasts	EL	467	43 (9.1%)	74 (15.7%)	158 (33.6%)	192 (40.9%)
	AS	465	23 (4.9%)	35 (7.4%)	129 (27.4%)	278 (59.1%)
Read other people's blogs	EL	468	41 (8.7%)	87 (18.5%)	187 (39.8%)	153 (32.6%)
	AS	465	8 (1.7%)	22 (4.7%)	86 (18.3%)	349 (74.3%)
Use RSS feeds	EL	454	13 (2.8%)	15 (3.2%)	57 (12.1%)	369 (78.5%)
	AS	455	5 (1.1%)	6 (1.3%)	31 (6.6%)	413 (87.9%)
Use a computer/game console to play games	EL	469	61 (13%)	96 (20.4%)	205 (43.6%)	107 (22.8%)
	AS	463	4 (0.9%)	17 (3.6%)	32 (6.8%)	411 (87.4%)
Use a computer/mobile phone /PDA as a personal organiser	EL	468	230 (48.9%)	49 (10.4%)	94 (20%)	95 (20.2%)
	AS	463	147 (31.3%)	68 (14.5%)	83 (17.7%)	165 (35.1%)
Send and/or receive emails	EL	468	300 (63.8%)	134 (28.5%)	29 (6.2%)	5 (1.1%)
	AS	466	238 (50.6%)	156 (33.2%)	66 (14%)	6 (1.3%)
Use a mobile phone to make calls	EL	470	386 (82.1%)	65 (13.8%)	16 (3.4%)	3 (0.6%)
	AS	465	192 (40.9%)	89 (18.9%)	111 (23.6%)	73 (15.5%)
Use a mobile phone to send text (SMS) messages	EL	470	437 (93%)	26 (5.5%)	4 (0.9%)	3 (0.6%)
	AS	464	229 (48.7%)	74 (15.7%)	103 (21.9%)	58 (12.3%)
Use social networking websites (ie. MySpace, Facebook)	EL	470	301 (64%)	81 (17.2%)	40 (8.5%)	48 (10.2%)
	AS	465	87 (18.5%)	64 (13.6%)	131 (27.9%)	183 (38.9%)
Use instant messaging or chat (ie. MSN, Yahoo Messenger)	EL	470	218 (46.4%)	75 (16%)	118 (25.1%)	59 (12.6%)
	AS	465	74 (15.7%)	47 (10%)	118 (25.1%)	226 (48.1%)

Discussion

The analysis of the responses from the survey indicates that, for these students, access and usage of technology does not neatly fit into the stereotype of the 'digital native'. The wide variance of use, especially between everyday and academic contexts, suggest that first year university students do not form a homogenous group in relation to experience, ability and adoption of technology. This highlights the 'mismatch' that is reported in the literature between how institutions perceive students' use of technology and their actual use (Conole et. al., 2008). While general ownership and usage rates of some technologies have increased slightly in comparison with similar studies (e.g., Kennedy et. al., 2007), there are

still a significant number of students who are not participating in activities which are typically associated with being a member of the digital native generation.

In examining the relationship between students' everyday life and academic study uses of technology again the variances are significant in relation to a number of activities. This research indicates that generally the frequency of use of technology for study activities is lower than everyday life usage for these students. It is unclear if this is caused by a lack of integration of technology into teaching or if students are not motivated to use technology to support their learning. Opinion on this issue diverges between those who claim that students are actively adopting and personalising technologies to support their learning (Conole et. al., 2008) and those who warn that students' inclination to adopt technology for use in their studies cannot be assumed (Selwyn, 2008). Oliver and Goerke (2008) suggested that bridging the gap between usage in academic and everyday life contexts needs to be supported by academics both in design and rationale of teaching and learning activities. In light of the differences in access and use of technology it is important to recognise that decisions about educational strategies need to be supported by empirical evidence. As Guo et. al. (2008, p.237) suggest, it is dangerous to apply generational titles to large groups of students because it may encourage academics to overlook "the intricacies of how individuals engage [with] digital media". The adoption and usage rates of certain technologies indicate that there are potential opportunities for a larger role for technology in learning and teaching in higher education (Kennedy et. al., 2008); however generational assumptions should not be the driver for such change.

The findings of this survey highlight the differences in students' access to and usage rates of technology, however it has been suggested in the literature that research into this area needs to specifically examine student perspectives of how and why they use technology in the way they do (Hargittai, 2007; Siemans, 2007; Fitzgerald, 2006; Lei, 2009). The survey upon which this research is based forms the first part of a larger PhD study into students' use of technology which investigates more specifically usage and students' adoption and adaptation of technology to support their learning needs using a case study approach incorporating interviews, experience sampling and online observation. When analysis of this data is complete it is anticipated that the findings will provide a better understanding of students' perspectives and use of technology to support learning so that policy-makers and academics can be better placed to make more effective decisions about the use of technology in higher education.

Conclusion

Generational supposition has been a key underlying theme of a large proportion of the literature around the use of technology in higher education in recent times. The findings reported in this paper show that not all students meet the reported criteria as members of this generation (digital natives) in terms of access to and usage of technologies. Instead there is a wide variance of experiences and ownership and a significant proportion of nonadoption. In comparing the use of technology between the contexts of everyday life and academic study it was also seen that students who participated in this study were less likely to use technology to support their study.

These are important considerations for educators implementing technology as part of academic study and in the development of policies and strategies for learning and teaching in higher education. While these results help inform the debate, future research is needed to investigate how and why students adopt technologies to support their academic study and examine the implications for the use of technology in higher education.

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Appendix M: The Life of a 'Digital Native'

Corrin, L., Lockyer, L., & Bennett, S. (2011). The Life of a 'Digital Native'. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 2942-2951). Chesapeake, VA: AACE.

Abstract

There have been many claims about the characteristics of the new generation of 'digital native' students participating in higher education. The lack of empirical evidence upon which many of these early claims were based has been highlighted in a number of studies investigating students' technology ownership. However, very few studies to date have explored in detail students' day-to-day interactions with technology and the impact on their academic studies. In the current project multiple case studies were compiled to provide an in-depth exploration of technology use across university students' everyday life and academic study contexts. This paper reports on one of these case studies as a profile of a 'digital native' student who, whilst considering themselves advanced users of technology, still demonstrated a wide variance in adoption and appropriation of technology challenging the notion of a homogeneous generation who share common technology-related characteristics.

Introduction

When the notions of digital natives (Prensky, 2001) and the net generation (Tapscott, 1998) first prompted discussion around the characteristics of students entering higher education these students were said to have a high digital aptitude, a preference for multitasking, literacy across multiple media, a culture for sharing information, a need for speed of information delivery, and a desire to be constantly connected (Barnes et. al., 2007; Prensky, 2004; Oblinger & Oblinger, 2005; Dede, 2005). Early literature in this area tended to rely on anecdotal evidence to support the development of these generalisations which resulted in numerous calls for radical changes to higher education in order to best 'cope' with this new generation of learners. Over time more empirical evidence has been added to the discussion which demonstrated a more diverse picture of the digital native generation and their adoption and aptitude towards technology.

Whilst these studies have provided insight into the range and frequency of technology-based activities they have not provided an in-depth analysis of the influences and

motivations that have led students to adopt and use particular technologies. The current study aims to delve further into the stories behind students' use of technology employing multiple methods of data collection to provide a holistic picture of students' interactions with technology across their everyday life and academic study contexts. In particular it explores some the technological assumptions that have been made about this generation in relation to their access, preferences, frequency of use, self-efficacy and attitude towards technology.

Assumptions that, to date, have been primarily based on inadequate data from non-empirical sources. These cases provide educators with a more in-depth understanding of the diversity of the technological practices among this generation of learners. This understanding can help educators make more informed choices about the integration of technology into teaching and learning in higher education. This paper presents one of the fourteen case studies compiled as part of a larger study. Jessica, a first year education student, demonstrated a high level of technological literacy and a wide variety of technology adoption. An exploration of Jessica's motivations and identity in relation to technology adoption and use is presented.

Literature Review

The evolution of the discussion around the digital native generation has seen a move from bold anecdotal claims about homogenous technology adoption and literacy among young people to a more considered examination of the diverse nature of technology use supported by empirical evidence. The digital native generation has been identified in the literature as young people born in or after 1980 (Oblinger & Oblinger, 2005, Palfrey & Gasser, 2008). It was suggested that because this generation of young people have grown up surrounded by technology they have developed an innate ability and dependence on technology across all contexts of their lives (Prensky, 2001, Tapscott, 1998, Howe & Strauss, 2000). These assumptions originally lead to the development of characteristics said to be consistent across the members of the digital native generation referring to their ability, literacy, multitasking, connectivity and attitude towards technology. Whilst some used these claims to call for radical changes to the delivery of teaching using technology in higher education, others cautioned against the reliance on non-empirical rhetoric as the basis for such decisions (Bennett, Maton & Kervin, 2008; Helsper & Eynon, 2009).

To address the empirical research gap, several survey and interview-based studies emerged which showed that, whilst technology ownership and usage rates have increased,

the technological characteristics of digital native students showed a significant level of diversity (Kennedy et. al., 2007, Oliver & Goerke, 2007; Margaryan, Littlejohn & Vojt, 2011). These studies surveyed ownership and use of technologies of university students including an exploration of the differences between technology use in students' everyday lives and how these technologies are used by students as part of their academic studies.

As Kennedy et. al. (2007) suggested, research in this area needs to explore how the technologies students use as part of their everyday life can be adapted to become 'learning technologies'. Whilst these recent studies have gone some way to addressing this issue, there is still a lack of research that goes beyond ownership and pre-categorised uses of technology to examine this transference to academic contexts. Questions have also been raised about the reliability of these types of surveys to measure technology use due to the lack of a shared technological language and understanding of context (Corrin, Lockyer & Bennett, 2010). Helsper and Eynon (2009) submit that research around the concept of digital natives often ignores the complexity and diversity of how students are using technology. Some studies have attempted to collect a broader range of data through multiple methods to address this issue (Jones & Healing, 2010; Czerniewicz & Brown, 2010). Whilst these studies have collected more in-depth data about students' motivations for technological adoption, they still primarily rely on self-reported data from students in the form of surveys and interviews.

The current study delves even further into students' technological activities by incorporating a wider range of data collection methods including the experience sampling method and online observation. The combination of these multiple data sources should provide a more detailed insight into the factors that influence students' adoption and use of technology. This examination of how technologies fit into students' whole lives from this cross-section of the so-called digital native population will allow for further testing of the assumptions that form the basis of the digital natives notion. A deeper understanding of the diversity in students' approaches to technology can provide alternative perspectives on the possibilities for the use of technology in learning and teaching in higher education.

Methodology

This study employed a mixed methods approach that comprised a quantitative sampling survey and multiple case studies to explore the adoption and use of technology of fourteen first year students at an Australian university. The design of the study was informed by models of technology appropriation (Carroll, Howard, Vetere, Peck & Murphy, 2002) and

theories of identity (Benson & Makolichick, 2007). This theoretical basis was used to provide different perspectives through which to view students' technology use and the choices they make in adopting and adapting technologies to their personal and academic needs.

Participants for the study were identified via the use of a sampling survey which was administered to 470 students across seven of the nine faculties of the University in the second session of the 2008 academic year. The sampling survey collected demographic data including age, gender, degree, enrolment specific data (ie. domestic/international, full/part-time, year in program) and living arrangements. This demographic data was then used to determine if the respondents met the participant group criteria which were applied to ensure the participants were reflective of the average first year student as identified through the University's enrolment data (ie. domestic, full-time students). In order to test the assumptions about digital natives an age limit was applied. This was a deliberate strategy to ensure the sample contained only students born in 1980 or after corresponding with the age ranges suggested in the digital natives literature (Tapscott, 1998; Palfrey & Gasser, 2008).

Students were next asked to rate themselves in terms of their level of ability with technology and indicate their ownership and/or access to certain of technologies including desktop/laptop computers, media devices, electronic personal organisers, game consoles, GPS devices, digital cameras, and Broadband/dialup Internet. The students were then presented with two lists of technology-related activities, one relating to the context of everyday life and the other relating to the context of academic study and asked to indicate the frequency which they undertake these activities. To allow for comparative analysis similar activities were included in both lists where possible. The sampling survey was a useful tool in characterising the nature of the student population (Corrin, Lockyer & Bennett, 2010). This then allowed participants to be identified for the main part of the study which represented a cross-section of technology adoption, ability and experience ranging from those who rarely use technology to those who engage heavily with technology.

Case studies were then developed for each student employing both quantitative and qualitative methods to explore in detail their experience with technology as part of their everyday life as well as how they use technology to support their academic studies. Students who were identified for the main study were first invited to a semi-structured

interview designed to collect more detailed data about students' adoption and use of technology as well as their learning goals and strategies. This interview was also used to delve further into students' technology use for academic purposes examining technologies that students use because it is a requirement of their program of study (ie. Learning Management Systems, presentation software, etc.) in contrast to technologies they have personally adopted to facilitate their own study (ie. online calendars, RSS feeds, social networking, etc.).

Students then took part in an experience sampling period of three weeks. The Experience Sampling Method (ESM) originated as a methodology in psychology research designed to explore experiences in the context of everyday life (Hektner, Schmidt & Csikszentmihalyi, 2007). During this time the students were prompted at three random times throughout the day and required to fill in a short survey about where they were, what they were doing, who they were with and whether they were using technology.

As all participants had indicated that they owned a mobile phone in the sampling survey, text messages were used to prompt the students to fill in each survey. In addition to the experience sampling surveys, students were also asked to fill in an end of day summary that provided information about their overall technological activities of the day (ie. how many emails/text messages they had sent, whether they had logged into their social networking sites, etc.).

In parallel with the experience sampling period, participants' online social networking activities were observed giving further insight into the students' technology activities and any cross between the contexts of their lives. During the initial interview the online activities of students were explored and permission sought to observe activities on social networking and/or communication websites for the three weeks of the ESM. A peripheral-member-researcher role (Alder & Alder, 1994) was adopted and a separate research persona profile was set up on a number of websites including Facebook, MySpace, the World of Warcraft forum and the Xbox 360 forum. This avoided the researcher's personal social networking interactions impacting the participants. The participants' online activity was monitored each night between 11pm and 1am. Screen shots of participants' social networking/communication sites were taken to capture their online activities. These screen shots were then analysed and inputted into an observation template which classified the types of activities students were undertaking online into three categories: Consume, Communicate, Create.

At the end of the experience sampling period the participants were asked to participate in second interview. This interview was designed to review the experiences recorded by the students during the experience sampling period. A copy of data collected was presented to each student and they were given the opportunity to comment on how much they thought this data was representative of their average technology experiences including any trends, irregularities or abnormal situations. Further exploration was also undertaken of the students' technology aptitude in the form of a technology self-efficacy survey.

Each individual case in this study demonstrated a wide diversity of technological experience. One of the fourteen case studies has been chosen to be presented in this paper as an example of a student – Jessica - who demonstrated a high level of technology adoption and use. Whilst a broad look at Jessica's technological characteristics would place her in the digital natives generation in line with the claims of the original literature in this area (Prensky, 2001; Tapscott, 1998), a number of exceptions and inconsistencies become apparent when exploring her motivations and activities in more detail. The level of detail in this case allows for a greater understanding of the true nature of technology use for this particular student across all aspects of her life.

Jessica

Jessica was an 18-year-old Bachelor of Primary Education student in her first year of study. She lived at home with her family and had a daily two-hour commute to university by train. Education wasn't necessarily Jessica's first choice of degree, she had also considered and been accepted into a journalism degree. In the end she chose Education as the university offering the journalism degree was too far away to commute and Jessica felt she wasn't ready to leave home. Jessica said that since deciding she wanted to become a teacher she felt that a higher education degree would equip her with the knowledge, both practical and theoretical, to do well in her job.

Jessica said that she was generally a good student who regularly attended classes, was an active participant in class activities, and was quite organised when it comes to preparing for assessments and examinations. She explained that she chose her elective subjects within her degree to capitalise on her interests and strengths. In terms of studying, Jessica said that she makes handwritten notes from lecture and tutorial slides as she finds the process of writing out the material helps her to remember it. She also would make audio recordings of key terms and descriptions of important concepts which she would listen to repetitively in preparation for exams.

Everyday life interactions with technology

Jessica considered herself an advanced user of technology and owned or had access at any time to a laptop computer, a desktop computer, an iPod, a digital camera (still), a mobile phone (not-3G enabled), a USB memory drive, a games console and broadband Internet at home. Jessica said that she mainly used her laptop, which is not connected to the Internet at home, for using Photoshop and playing games. Whenever Jessica needed to do anything online at home she used the family desktop computer.

In relation to her use of Photoshop, Jessica referred to herself as a "Photoshop-aholic". She claimed to be an avid photographer and liked to share photos online of events such as birthdays and parties with her friends. She explained that prior to uploading photos (to Facebook) Jessica used Photoshop to edit and add effects to the photos.

Playing games both on computer and game consoles is something that Jessica did on an almost daily basis, in particular adventure games and racing games. Jessica showed a preference for games of skill and strategy over "button mashing" games such as first person shooter games. The portability of her Nintendo DS allowed Jessica to play games in multiple locations which was evident during the experience sampling period when Jessica reported that she was playing games at home, at her boyfriend's house, and on the train. In total she played games on 19 of the 21 days surveyed (90.5%). Jessica explained in the interview that the Nintendo DS was a technology that Jessica had purchased just before the experience sampling period began. She had purchased this with her boyfriend and they would take it in turns to have the console on alternate days. She identified the large number of games the Nintendo DS provides as a benefit of this technology as she was able to find and play games at particular times that would suit her mood. She also liked the ability for her friends and her to connect up their Nintendo DSs wirelessly so they could play games together on the train.

Jessica was a heavy user of her mobile phone for text messaging but didn't make as many voice calls. During the three weeks of the experience sampling period she sent 328 text messages which is an average of 15.6 messages a day. In the second interview Jessica confirmed that this high level of text messages was normal for her although it can fluctuate with Jessica having sent 50 messages the day before the interview. She explained that she uses text messages to keep up with what is happening, so on days where she is not at university she will often send a large number of messages to friends who are at university so she can keep up with what's going on. When she does make voice calls these tend to be

in order to locate people or if she has a question for which she requires an immediate answer.

Whilst Jessica has access to a mobile phone with many multimedia features she didn't regularly make use of all of these, instead seeing her mobile more as just a communication device:

> My mobile phone has Internet and photographs and video recording, but I never actually use any of that because the quality is pretty shoddy, so when I have, you know, my actual camera that I love I use that instead. So usually it's just to communicate.

Jessica regularly used her iPod to listen to music, podcasts and to watch television shows. Due to her long commute to university, Jessica used her iPod on the train and also watched television shows on her iPod in bed before going to sleep. The podcasts she listened to are mainly repeats of radio shows that she didn't always get to listen to live due to her travel schedule.

From an online perspective Jessica had a blog but admitted that she didn't update it very often. Jessica was convinced by her friends to set up a Facebook account which she claimed to only check "every now and then". This was confirmed by her experience sampling data which showed her usage of social networking sites on only 43% of days. Online observation showed that Jessica would actively participate on Facebook 55% of the time whilst just logging in and reading the news feed the other 45% of the time. Jessica indicated that she only tended to visit Facebook when she had received an email alert informing her that she had a message or had been tagged. She also noted that her usage of Facebook reduced when assessment pressures at university increased.

On her Facebook profile page Jessica provided information about herself including her favourite books, movies, TV shows and quotations. To describe herself Jessica posted the following:

> Activities: hmm… I'm a bit of a video game nerd. And I read a lot. I also like to photoshop… and pretend I'm hardcore and creative. Cuz it's what the cool kids do.
>
> Interests: Myself. And others. But mostly myself :P

About Me: I am awesome. And that's all you've gotta know *winks*

In the interview Jessica indicated that she didn't portray herself or act any differently online than she did face-to-face. When asked if she censors the information she makes available about herself online she said that whilst she is generally an open person, she wouldn't put anything online that she wouldn't be happy to show people face-to-face.

Jessica's Facebook activity during the three weeks showed she had accepted three friend requests, updated her status six times, changed her profile picture three times, written on friends walls seven times, added a photo album of 60 photos, and commented on five photos from friends' albums. Her conversations with friends via wall postings were generally of a social nature with the main mention of university being arranging social meetings with friends on campus. One conversation between Jessica and some of her university friends indicated that they were all getting involved in playing a new version of a computer game (SIMS) which her friends felt would have a negative impact on their studies due to the time they would like spend playing the game.

Accessing information on the Internet is something that Jessica did on a regular basis. She didn't tend to generally browse the Internet, instead she went to the Internet when she had a specific question for which she needs to look up information to provide an answer. This is something she said that she often did with her family when questions arose in general conversation, Jessica would often go to the family computer and look up the answer.

Jessica indicated that she had previously been a frequent user of instant messaging services to chat with her boyfriend and friends when at high school. However, once she got to university she saw her boyfriend and friends on a regular basis and therefore only used instant messaging occasionally. This was also impacted by the fact that Jessica could only connect to MSN Instant Messenger when using the family desktop computer which had broadband Internet access which wasn't as accessible as her laptop.

Whilst Jessica was generally a heavy user of technology in her everyday life, there are tools and services that she did not use regularly. Jessica indicated that she didn't often buy things online which was mostly attributed to the fact that she didn't have her own credit card. Sometimes she would borrow her mother's credit card to make a purchase but she said that she didn't like using her mother's credit card for security reasons. The same

security fears deterred her from doing her banking and paying bills online. She also did not make use of RSS feeds.

Academic Studies

From an academic perspective Jessica said she engaged with a number of technologies as part of her studies. She was a regular user of the University's learning management system to access course resources and to participate in online discussion forums. Jessica said she made use of podcasts of lectures to catch up on any material missed if she was unable to attend the lecture but also to review material she didn't understand the first time. She also made use of presentation software such as PowerPoint to create presentations for assessments.

When searching for information for study purposes, Jessica said that she first used library catalogue searches with the aim of finding more relevant and scholarly results. Only when she could not find relevant resources through the library would she resort to a general Internet search which she generally avoided due to the large number of irrelevant results.

In terms of communication Jessica said she regularly used email to communicate with her lecturers and tutors to ask questions about content and procedures on which she is unclear, but did not use email to communicate with peers apart from to send files when working on group assignments. Jessica made extensive use of the online discussion boards to communicate with other students and lecturers/tutors both asking questions when she is unsure of something and helping out other students with their questions on assignments. However, she indicated that she didn't make use of social networking sites, text messages or instant messaging to communicate with peers for study purposes.

Jessica said she enjoyed being introduced to new technologies or methods using technologies as part of her studies. From using the Internet in new ways to research assignment topics to using animation capture software to create teaching resources for science education, Jessica is keen to experience new technologies to generate ideas for methods she will use in the classroom when she becomes a teacher. When asked if Jessica would like to see more technology used in learning and teaching in her university course she was satisfied with the current level of use. She recognised that technology is relevant in some subjects but not as relevant in others and was happy for some subjects not to incorporate technology at all.

Adoption and adaption of technology

Throughout the research process it became clear that Jessica was very willing to try new technologies. When faced with a new technology Jessica's approach to learning how to use it was to try and figure out how it works on her own, only seeking help from others or referring to a manual if she got stuck. Over time Jessica would explore the features of the technology and determine which ones she would continue to use. This method of adaption of technology was evident with Jessica's mobile phone, as mentioned above, where Jessica explored the photographic and video features of the phone but determined that the quality of these features was not sufficient and therefore continued to use her digital camera for photographic needs and her phone simply for communication purposes.

When asked what considerations Jessica would make when purchasing new technology she identified ease of use, relevance, appearance, price ("not super-duper expensive"), and durability. She qualified her criteria of appearance by saying:

> When I said "look good" I mean not a pretty package but be sort of atheistically pleasing and easy to see where I have to go. Like clear headings, clear labels, things like that.

In investigating new technology to purchase Jessica would often consult with friends and see what types and models of technology they use. She also liked to research the features of technologies she was considering purchasing by visiting manufacturers' websites. However, Jessica said she only considered buying new technology when there is a need for it and does not simply upgrade because she can. In relation to her digital camera she said:

> Well it's just your basic camera. It takes photos. I bought it a few years ago now but it still does everything I want it to do. I don't need any of the new features that cameras have. It works fine, it's good… [I'll] wait until it breaks or I need it. Because I need it to do something else.

Jessica indicated that occasionally she would cut herself off from her online communication and social networking channels as life and study pressures increased. During these times Jessica said she would only check her Facebook or emails as a response to her friends sending a text to say they had sent a message.

> So I just like sort of cut myself off 'cause I had so many assignments, it's been crazy! So I just cut myself off from the online world.

Only when things started to slow down would she then log into these systems and catch up with what is going on.

Discussion

Jessica and her technological preferences and habits are consistent with recent research that found a high level of diversity of technological experience of the digital native (Kennedy et. al., 2007, Oliver & Goerke, 2007; Margaryan, Littlejohn & Vojt, 2011). Born in 1990, Jessica fell within the age range of the so-called digital native generation. She also considered herself an advanced user of technology which is consistent with the characteristic of high technology literacy. However, she doesn't fit quite as neatly within the some of the other characteristics said to be common to all members of the digital native generation.

Jessica displayed literacy across a number of technological media and a high level of engagement in terms of game playing. She supported the culture of sharing by uploading photos to share with friends on Facebook and was the (infrequent) author of a personal blog. Whilst she did not specifically refer to a need for speed of information delivery, her use of the Internet to research answers to questions that arise in general conversation indicated that this is a characteristic to which Jessica subscribes.

However, in other aspects she varied from the generational generalisations. For example, throughout the data collection Jessica did not refer to an ability or preference for multitasking. Whilst she was always in contact with friends via text messages on her mobile phone, she indicated that she would often cut herself off from online services for weeks at a time if other life pressures became too great. This challenges to some extent the notion of digital natives' need for constant connectivity.

In other ways Jessica demonstrated traits said to be common to the digital native generation, in particular a high level of self-confidence. On her Facebook profile page in her 'Interests' and 'About Me' section the persona which Jessica displays portrays a very self-confident bordering on self-obsessed person. This demonstration of high levels of self-liking and narcissistic traits is consistent with Twenge's (2009) study of generational changes which found an increase in these particular traits in current students.

However, the outward persona Jessica demonstrated online was not born out in the rest of the data, especially in her interview data. Whilst Jessica claimed that she didn't act any

differently online to in her face-to-face interactions with people, the high level of self-confidence was not evident in her interview conversations or her technology self-efficacy survey. This mismatch of online and offline self-confidence could be attributed to the fact that the online social networking medium, through profile pages and status updates, encourages and shapes users' self-portrayal in certain ways that would not always occur in face-to-face interactions.

Jessica's considerations around the adoption of new technologies appeared to be less driven by a need to keep up with the latest technological developments, and more by practical matters such as cost and utility of specific features. When Jessica purchased a new technology she adapted itto her personal needs within her context of everyday life. The understanding of this process of adaption is something that the current research can add to the digital natives' discussion as assumptions are still being made in the literature that equate ownership of certain technologies (ie. mobile phones) with extensive use and customisation (Traxler, 2010). However, as Jessica's case has shown, although Jessica was the owner of a mobile phone with multimedia capabilities, her adaption of the technology to her needs and priorities meant that she used her phone almost exclusively for communication purposes.

Throughout this case study it was not evident that Jessica used her adaption process in appropriating technologies into her studies. In terms of her use of technologies to support her academic study, Jessica tended to primarily use the technologies prescribed as part of her course and had not adopted new technologies to support her 'personal study'. This is consistent with Margaryan, Littlejohn and Vojt's (2009) study which found students mainly engaged with technologies prescribed as part of the degree and did not observe a significant shift in patterns of learning and the use of technology amongst students of the digital natives generation. This was also supported by Selwyn's (2008) study which found that students were not as inclined to integrated use of the Internet to support their studies as had been assumed. In Jessica's case she did make use of the Internet on occasion to conduct research, but had indicated that she would check with people, including lecturers and tutors, to find answers to her questions prior to going online. She also favoured university-driven information seeking sites through the library over general Internet search engines.

Jessica indicated that she was happy with the amount of technology that was integrated into her course overall. Despite the fact she was keen to experience new technologies that

might prompt ideas for delivery of teaching in the classroom for her future students, she acknowledged that technology is appropriate to some learning situations more than others. Again this is contrary to some of the earlier literature claims which called for radical change in education to meet the demands of the learners for more integration of technology into the classroom (Prensky, 2001).

This in-depth examination of the technology habits of a 'digital native' student has demonstrated the importance of considering students as whole people when looking at their interactions and choices regarding technology. Whilst Jessica appears on face value to fit into the digital native stereotype, closer observation shows a different and diverse story. The level of learner diversity identified in this and many other recent studies (Jones, Ramanau, Cross & Healing, 2010; Margaryan, Littlejohn & Vojt, 2011) serves as a warning to higher education educators not to base pedagogic design purely on unsupported assumptions.

Digital natives research appears to have reached a point where sufficient doubt has been cast on the supposed homogeneous generational characteristics. In observing the specific elements of technology diversity of higher educational students in this study further research opportunities have emerged that will help educators teach more effectively with technology. From an identity perspective, further study of the relationship between students' online persona in everyday and academic contexts may help to understand the barriers and enablers to students' transition from personal to academic technologies. From an academic perspective it would be helpful to educators to understand how the patterns of technological behavior observed across both contexts of students' lives can help to interpret usage patterns in online learning environments.

Conclusions

Whilst the analysis of the case of a single digital native student does not present findings generalisable to all higher education students, it is effective in exploring the diversity of technological experience and demonstrates the importance of investigating the motivations and influences behind students' technology adoption and adaptation. This level of detail reminds us to question the generational assumptions so commonly used to justify technological changes in higher education. It has been frequently recommended in recent literature (Bennett & Maton, 2010; Jones, Ramanau, Cross & Healing, 2010) that we need to delve further into the stories behind the ownership and use of technologies by members of the digital native generation in order to inform decisions about technology

integration into academic studies. This study's methodology facilitates a deeper exploration of technology adoption and use by students which can contribute to the continuing research agenda and discussions around strategy and pedagogy for learning and teaching with technology in higher education.

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Appendix N: Analysis Coding Framework

Category	Source	Code	Definition	Example
Technology Appropriation	Model of Technology Appropriation (Carroll et al., 2003)	Fashion/style	The physical characteristics and 'look' of the technology	"Probably has to look good"
		Cost	The amount required to purchase the technology	"Not be super-duper expensive"
		Expected usefulness/ Usefulness	The functions that the use would expect the technology to be able to perform	"It has to be relevant to what I'm wanting to do"
		"Our stuff"	The technology is appropriate for the user's age and social groups	"My friends made me get a Facebook"
		Ease of use	That the technology is not difficult to use	"It has to be easy to use"
		Features	The technology provides a significant range of tools/functions	"How many things it can do, because we don't live in an age where one thing just does one thing anymore"
		Social management	The ability to use the technology to contact people and provide a scheduling function	"It's not a means of catching up, it's just a means of organising your timetable"
		Ease of learning	The technology is not hard to learn to use	"Easy to see where I have to go, like clear headings, clear labels, things like that"
	Additional appropriation influences that emerged from the data	Durability	That the technology is likely to last a long time before needing to be replaced	"So I need a phone that's also durable and can last for a long time"
		Necessity	The user was required to purchase the technology as part of a hobby or for work purposes.	"Wait until it breaks or I need it, because I need it to do something else"

		Compatibility	That the technology is compatible with other technologies the student may already own/access	"We had to have all these programs to make it compatible so you could transfer things across"
	Other appropriation themes	Researching new technologies	Methods the student uses to find out about new technologies	"When I bought my current mobile phone I actually went on the manufacturer's website and looked at what sort of features it had, the battery life, things like that. And I did that with quite a few phones I was thinking of buying and I compared them over the Internet like that"
		Future technologies for adoption	What new technologies the student plans to purchase in the future	"Um, not really… I really sort of have everything that I need"
		Change in use	Nature of the change in the use of a technology or disappropriation	"I got an iPod for my birthday and that was great. And then I got my new phone, and … I just put all my music on my phone and I haven't used the iPod in ages – well why carry two things when you can just carry one?"
Identity		Hobbies	Personal interest of participants that fall outside their academic and work commitments.	"I'm a massive video gamer and tech head nerd. But I also … I'm a bit of a muso, like massive music head. And then I was also a drama kid. Cause I love my drama"
		Online portrayal	How participants choose to represent themselves in online, in particular on social networking sites.	"No, I think I'm still me. I don't act any different online than I would face-to-face"
	Benson & Mekolichick, 2007	Commitment to student identity	When a person sees the role of student as a core part of their lives	"I would be defined by what I do… I do uni"

		Desire to use digital technology	The extent to which students want to incorporate new technologies in their lives	"New technology always sounds interesting"
Learning Goals and Strategies		Reason for study	Why the student choose to come to university and what they want to get from their degree	"Well hopefully at the end of it be able to obtain a job, but also just knowledge and stuff that I wouldn't have learnt if I hadn't been in uni"
		Study strategies	The methods that students use to study for their classes/assessments	"When I study for exams… I look at what I've written during the year and then go back and I look at the lecture slides and I just take the points I think will be on the exam and I summarise it so that it is short, easy things to remember"
		Individual vs. group study	Whether the student prefers to study on their own or in a group	"I need to study on my own"
		Learning activity preferences	What kinds of learning activities the student finds	"I had a history assignment where I had to research my community, my environment, and talk about that. That was quite good, because I learnt a bit more about my community that I wouldn't have learnt otherwise"
		Help seeking	Strategies students use if they need help with their studies	"If I need help with something, if I don't understand something that's been said or that's been said in a tute and I haven't been able to ask questions I'll ask questions by email"
Competence/ confidence in using technology	Identity - Benson & Mekolichick, 2007	Confidence	How confident students feel in their ability to use technology	"Very confident"
		Learning new technologies	Methods student use to learn how to use new technologies	"Instead of looking at the tutorial I tried to figure it out myself and I picked it up pretty easily"

Experiences with technology in academic study		Technologies for personal study	The technologies students have chosen to support their personal study strategies	“When I need to learn key words and key terms… I walk around with a tape recorder and I tape record myself saying it and I listen back to it… And now I can record myself on my laptop and put it on my iPod so that’s a lot easier”
		Level of technology in university classes	The amount of technology that students like to have in their classes	“At the moment I think it’s about right”
		Everyday life technologies suitable for the academic context	Technologies that students would like to have incorporated their classes	"Wish I could use games for study"