Are digital natives a myth or reality? University students’ use of digital technologies

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ABSTRACT

This study investigated the extent and nature of university students’ use of digital technologies for learning and socialising. The findings show that students use a limited range of mainly established technologies. Use of collaborative knowledge creation tools, virtual worlds, and social networking sites was low. ‘Digital natives’ and students of a technical discipline (Engineering) used more technology tools when compared to ‘digital immigrants’ and students of a non-technical discipline (Social Work). This relationship may be mediated by the finding that Engineering courses required more intensive and extensive access to technology than Social Work courses. However, the use of technology between these groups is only quantitatively rather than qualitatively different. The study did not find evidence to support popular claims that young people adopt radically different learning styles. Their attitudes to learning appear to be influenced by lectures’ teaching approaches. Students appear to conform to traditional pedagogies, albeit with minor uses of tools delivering content. The outcomes suggest that although the calls for transformations in education may be legitimate it would be misleading to ground the arguments for such change in students’ shifting patterns of learning and technology use.

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1. Introduction

An idea that has gained currency is that the generation born after 1980 grew up with access to computers and the Internet and is therefore inherently technology-savvy (Oblinger & Oblinger, 2005; Palfrey & Gasser, 2008; Prensky, 2001; Tapscott, 1998). This generation has been termed Digital Natives, Millennials, or Net Generation. In Prensky’s (2001) definition, those born in or after 1980 are ‘digital natives’ while those born before 1980 are ‘digital immigrants’. The proponents of this idea claim that, not only does this generation have sophisticated skills in using digital technologies, but also that, through their exposure to these technologies, they have developed radically new cognitive capacities and learning styles (Prensky, 2001). The new learning styles are said to include ‘fluency in multiple media, valuing each for the types of communication, activities, experiences, and expressions it empowers; learning based on collectively seeking, sieving, and synthesizing experiences rather than individually locating and absorbing information from a single best source; active learning based on experience that includes frequent opportunities for reflection; expression through non-linear associational webs of representations rather than linear stories; and co-design of learning experiences personalized to individual needs and preferences’ (Dede, 2005a, p. 10). The proponents claim that the current education system is not equipped to accommodate the changing needs of this new generation of learners and call for “wide-spread discussion among members of the academy about the trends, regardless of whether at the end of that dialogue those involved agree with these speculative conclusions.” (Dede, 2005b, p. 15.19). Universities are urged to act on this ‘speculative conclusions’ by making “strategic investments in physical plant, technical infrastructure, and professional development… Those who do will gain a considerable competitive advantage in both recruiting top students and teaching them effectively” (Dede, 2005b, p. 15.19).

Although these arguments have been well-publicised and uncritically accepted by some, there is no empirical basis to them. Recently, counter-positions emerged, emphasising the need for robust evidence to substantiate the debate and to provide an accurate portrayal of technology adoption among students (Bennett, Maton, & Kervin, 2008; Schulmeister, 2008; Selwyn, 2009). Therefore, empirical research is
needed to improve our understanding of the nature and extent of technology uptake by students. In parallel to understanding what tools students use and how they use them, it is also important to elucidate the role of digital technologies in students’ learning, because “it is not technologies, but educational purposes and pedagogy that must provide the lead, with students understanding not only how to work with ICTs, but why it is of benefit for them to do so.” (Kirkwood & Price, 2005, p. 257).

A nuanced understanding of the extent and nature of technology use by university students requires insight into the contexts in which the technologies are being used, for instance the pedagogic design of courses; students’ socio-economic background and their life circumstances such as affluence, geographic proximity to friends and family, and personal psychological characteristics such as sociability and openness to new experiences (Schulmeister, 2008). Disciplinary difference is one key contextual variable. Previous research identified higher rates of technology use amongst technology and business students, and lower rates among arts, languages and health and social welfare courses (Kirkwood & Price, 2005). However, these results must be viewed with caution since most of the data is over a decade old and is focused on now fairly established technologies such as computers and CD-ROMs.

The aim of this paper is to contribute empirical evidence towards building a more accurate picture of the patterns and the contexts of technology adoption by university students and to begin to explore the motivations driving technology adoption. Empirical data is essential in substantiating the conceptual debate and underpinning the design of educational systems and policy-making in universities. To this end, our study explored the nature and extent of students’ use of technologies in formal and informal learning and socialising. An investigation of students’ use of technologies for learning and their views on the educational value of technologies was supplemented by an analysis of faculty’s use of technologies in teaching and their perceptions of the educational benefits of tools.

Selected recent studies examining the extent and nature of technology uptake by university students have been reviewed to provide a wider context in which to contextualise our findings. While a systematic review of the corpus of empirical work published to date is beyond the purpose of this paper, we use these recent studies as examples to characterise the state-of-the-art in this area. The following parameters were applied to guide our scoping of the literature:

- Given the fast-paced nature of changes in this domain, we focus on peer-reviewed published work that reports data collected from 2005 onwards;
- We focused only on studies that dealt with university students rather than secondary school pupils
- We included a balanced set of examples from a range of countries.

Following a brief discussion of these examples of extant research, we present and discuss the results of our small-scale mixed-method study conducted in January–May 2007, within two disciplines (Social Work and Engineering) in two UK universities. We explored age variations in the nature and extent of technology use and analysed disciplinary variation in technology adoption comparing use in a technical (Engineering) and a non-technical (Social Work) discipline. Finally, drawing upon the combined qualitative and quantitative data and the perspectives of both students and faculty, we conclude by outlining implications of our findings for the validity of the ‘digital natives–digital immigrants’ binary and propose foci for future research.

2. Background

A range of empirical studies investigating students’ use of technologies have been published in recent years. In Australia, Kennedy, Judd, Churchward, Gray, and Krause (2008) surveyed 2120 undergraduate students from different faculties. This study focused on the extent of students’ access to and use of established and emerging technologies for learning. The study examined what tools were used and how frequently. However, the nature and the context of technology use – how technology was used and for what purpose – was not investigated. The findings showed heterogeneity in technology adoption patterns, particularly when moving beyond established technologies such as mobile phones and email. Kennedy et al. (2008) concluded that “the widespread revision of curricula to accommodate the so-called Digital Natives does not seem warranted” (p. 10) because “we cannot assume that being a member of the Net Generation is synonymous with knowing how to employ technology strategically to optimise learning experience in university settings” (p. 10). However, these findings should be treated with caution for a number of reasons. Firstly, patterns of technology use may have changed since the data was collected in 2006. Secondly, while the results are drawn from a large sample, the representativeness of the sample is limited (27.2% of the first year students). Thirdly, the sample comprised mainly “Digital Natives” (n = 1973/2120 representing 25.3% of first year students). Comparing technology use of younger students (‘Digital Natives’) with older learners (‘Digital Immigrants’) may create a more nuanced understanding of adoption patterns. Fourthly, this study’s reliance on quantitative data alone limits development of an in-depth understanding of students’ reasons and motivations underpinning technology use. Acknowledging this limitation, the authors called for more qualitative studies of students’ and teachers’ perspectives on technology use for learning from a broader range of universities.

In a more recent study conducted at Graz University of Technology in Austria, Nagler and Ebner (2009) surveyed 821 first-year undergraduate students (56% of all first-year students). They examined technology use for both learning and socialising, focussing on patterns of internet access, use of hardware devices and students’ preferences for and experiences with tools ranging from Virtual Learning Environments (VLEs) to Web 2.0 tools. Nagler and Ebner found an almost ubiquitous use of Wikipedia, YouTube and social networking sites while social bookmarking, photo sharing and microblogging were much less popular. The study concluded that “the so-called Net Generation exists if we think in terms of basic communication tools like e-mail or instant messaging. Writing an email, participating in different chat rooms or contributing to a discussion forum is part of a student’s everyday life” (p. 7). While the findings of this study are based on a more representative sample than in Kennedy et al. (2008), the age groups are not specified, making it impossible to determine what proportion of students were ‘digital natives’. Similar to Kennedy et al. (2008), Nagler and Ebner (2009) focused on types of technologies used and the extent rather than the nature of use. In addition, their research design too did not include qualitative data, nor did it consider faculty’s perspectives and other contextual factors. Finally, the results may have been biased since data was drawn from a technical university, where students may have had more technical know-how.

In Canada, Bullen, Morgan, Belfer, and Qayyum (2008) investigated students’ fit to the ‘millennial’ profile (Oblinger & Oblinger, 2005). This study used semi-structured focus group and informal interviews with a sample of 69 students representing a cross-section of this institution
Prior to interviewing students, the researchers interviewed 16 faculty members. However, the faculty interview results are not reported in their paper. Results suggest that students “use a limited toolkit” (p. 8) and that the adoption of these tools was driven by the familiarity, cost and immediacy considerations. Their findings show that “while there was no evidence to suggest that students have a ‘deep’ knowledge of technology … students use technology in very context sensitive ways… within an identified set of tools students were able to identify which was better suited to a given task” (pp. 8–9). While authors found that students fitted some descriptors associated with Millennial learners, they questioned the accuracy of associating these descriptors with a specific generation, pointing out that there was “little evidence to support a claim that digital literacy, connectedness, a need for immediacy, and a preference for experiential learning were characteristics of a particular generation of learners” (p. 10). They conclude that technology use “was driven by…the student and instructor dynamic within a course or program, the technical requirements of the discipline, and the affordances that a tool provided within a given context” (p. 10). While adoption of a qualitative methodology is a strength of this study, the data coding approach used is somewhat problematic: the interview questions were not specifically designed to elicit responses around ‘millennial descriptors’ which were used to code the data.

In the UK, Jones and Cross (2009) explored undergraduate students’ access to hardware and Internet, and their use of digital technologies in learning and leisure activities. The study used a mixed-method research design, including questionnaire survey supplemented by interviews and cultural probing. It was conducted across five UK universities, using a sample drawn from a wide range of disciplines. The majority of respondents were students born after 1981. While older students were included in the study, the paper does not report on any comparisons between the two groups. Although the sample was relatively large (n = 596/1809), the response rate was low (33%). The majority of the respondents shared great importance to activities such as accessing content and using the Internet to communicate rather than to create and share content. Authors suggest that “the idea that the Net generation are more likely to be inclined to participation [on the web] may be somewhat exaggerated” (Jones & Cross, 2009, p. 15). The study recorded low levels of usage of blogs, wikis and particularly virtual worlds. When asked about their confidence in using specific technologies, the majority of students reported “slight, basic confidence” in using established technologies such as presentation software, online library resources and spreadsheets. Over a third reported no confidence or minimal skills in using conventional VLEs, writing and commenting on blogs or using wikis. Jones and Cross conclude that “it does not seem that [students] are marked by their exposure to digital technologies from an early age in ways that make them a single and coherent group” (p. 19). They caution policy makers “against adopting technological determinist arguments that suggest that universities simply have to adapt to a changing student population who are described as a single group with definite and known characteristics” (p. 19).

In the US, Hargittai (2010) conducted a quantitative study of undergraduate students’ Internet use. The study focused on the role of ‘context’ – socioeconomic status, self-reported skills, experience and autonomy in technology use – in bringing about differentiated use of technology. Although Hargittai’s study is focused primarily on the issues of digital divide and digital inequality, the study empirically tests assumptions about the know-how of ‘digital natives’. Her sample comprised 1060 (82% response rate) undergraduate students in a public, research university. In 2007 when the data was collected 97% of her respondents were 18–19 years old. Hargittai found a “considerable variation…even among fully wired college students when it comes to understanding various aspects of Internet use. These differences are not randomly distributed. Students of lower socioeconomic status, women, students of Hispanic origin, and African Americans exhibit lower levels of Web know-how than others.” (p. 108) and suggested that “differentiated contexts of uses and experiences may explain these variations”(p. 108). Hargittai concluded that her data “does not support the premise that young adults are universally knowledgeable about the Web” (p. 109).

These empirical studies, conducted in different countries and in different types of universities, are reaching very similar conclusions suggesting that the ‘digital native’ label may be too simplistic to explain the ways young people use technologies. While these studies provide valuable and much needed contribution to the body of empirical evidence in this area, they share a number of limitations. The first set of issues related to methodological problems, which limit the robustness of conclusions that can be drawn. Methodological issues include sample representativeness or over-reliance on either qualitative or quantitative methods. Qualitative data that could identify the complexities of students’ choice of technologies and in-depth patterns of use is scarce. Few studies adopt mixed method designs which are, arguably, more appropriate to provide rich insight than any single method. Furthermore, the use of dissimilar data collection instruments reduces the possibility of comparing the ways in which variables are operationalised and measured across the studies. Secondly, research in this area tends to focus on the types of technologies used and any frequency of use, often overlooking the nature of technology use. This leads to the third general issue – lack of focus on the context within which technologies are adopted and used. A particular problem is the exclusion of variables such as the personal characteristics of users, their socioeconomic background, disciplinary differences, pedagogy and assessment regimes within which university students operate, teachers’ perspectives on educational value of technologies, and so on. Individual differences between participants are seldom taken into account.

This study aims to address some of these gaps. While exploratory in nature, the study is significant because of a combination of characteristics that set it apart from other studies in this area. The first distinction is that we use two types of data triangulation (Denzin, 1978). While most previous studies have used either a quantitative or qualitative approach, this study employs a mixed method design, drawing upon both types of dataset. The study triangulates the data through use of more than one source, comparing students’ use of technologies for learning with lecturers’ use of technologies in teaching. Second, the study explores technology use for both formal (on the course) and informal learning (outside the course) as well as socialising. This contrasts with previous studies that focused on either formal learning or socialising, or both, and largely ignored informal learning. Third, our study analyses both the extent (what tools, how frequently) and the nature of technology use (what is the technology used for) in learning and socialising attempting to begin to surface students’ perceptions of educational value of technology tools and their motivations behind using particular types of technologies. Fourth, it takes into consideration age variation in technology use as well as disciplinary variation: respondents, drawn from Engineering and Social Work include both ‘digital natives’ and ‘digital immigrants’.

3. Institutional context of the study

The study was conducted in two UK universities: a post-1992 university (University A) and a pre-1992 university (University B). There are a number of dimensions to this distinction, but principally it denotes institutions (previously colleges or polytechnics) that gained university status during or after 1992, as part of a policy drive towards promoting ‘widening participation in Higher Education’, and universities that were established prior to 1992. A key distinction is that post-1992 universities tend to admit proportionately more students from less
advantaged socio-economic background. Post-1992 universities typically focus on teaching rather than research, and on applied rather than fundamental disciplines. At the time of the study there were 10,495 undergraduate students enrolled at University A, and 9990 students at University B.

4. Methodology

The study employed a mixed methods research approach, with a quantitative phase followed by a qualitative phase, both of which were ascribed equal status (Johnson & Onwuegbuzie, 2004). Mixed methods research aims to maximise the strengths of both quantitative and qualitative approaches. An initial questionnaire survey explored the types of technology tools students adopted and the frequency with which they used these tools for formal and informal learning and socialising (extent of technology use). The key question guiding the quantitative phase was: “What technology tools do students use?”

Subsequently, in-depth interviews were conducted with students and staff. The aim of this qualitative phase was to illuminate the complexities of students’ choice to use specific technologies, in other words ‘how’ students use technologies. Student interviews focused on the ways in which students were using technologies and the purposes and contexts of technology use (nature of technology use). A key question was: “How do students use technology?” To begin to elucidate the relevant aspects of the pedagogic landscape within which students were using the tools, the qualitative phase also involved in-depth interviews with a selected number of lecturers and support staff.

4.1. Phase 1: quantitative study

4.1.1. Data collection method, instrument and procedure

In Phase 1, data was collected using a paper-based questionnaire. The questionnaire consisted of four sections: 1) student background information (age, course, access to internet); 2) student’s use of technology on the course; 3) technology used for learning in relation to the course (i.e. in addition to the technologies provided by the course) and 4) technology used for socialising and recreation. Each item required students to indicate the extent to which they used these technologies ranging from daily, weekly, monthly to never. The full questionnaire is available in the Supplementary material.

To recruit participants, we initially contacted the Heads of the Departments of Social Work and Engineering in both universities. They directed us to faculty members teaching on a range of Engineering and Social Work courses. We then contacted these faculty members to request their permission to distribute the questionnaires during a lecture. A researcher attended the agreed classes at the end of the lecture and gave a brief presentation about the study, then distributed consent forms and questionnaires. Students completed the questionnaires in-situ and immediately returned these to the researcher.

4.1.2. Data analysis procedure

Raw data from the questionnaires was digitised, manually coding them using SPSS statistical analysis software. Participant characteristics and associations were analysed using chi-square statistics. Further differences and associations between variables (e.g. technology tools used in formal and informal settings) were analysed using non-parametric tests, Mann–Whitney U statistics and Spearman’s correlation, as the dataset including all subsamples was not normally distributed. Finally, a multiple regression was conducted; one of the predictor variables consisted of more than two categories, and thus dummy coding was employed.

4.1.3. Respondents

The questionnaire was completed by 160 Year 3 Social Work and Engineering students at University A (n = 80, 50%) and University B (n = 80, 50%). Of the total sample, the majority were male (n = 121, 75.6%) and engineering students (n = 130, 18.75%). There were 30 respondents (18.75%) from Social Work and only 39 of the overall sample were female students (24.4%). Female participants were more likely to study Social Work, while male participants were more likely to study Engineering ($\chi^2 = 54.8$, df = 1, $p < .001$). This gender imbalance is characteristic of the student population studying these disciplines in the UK universities (Filer, 2000; Hussein, Moriarty, & Manthorpe, 2009).

The mean age of survey respondents was 23 years ($sd = 6.32$) with ages ranging from 19 to 50 years. Engineering students were significantly younger than Social Work students ($mean = 21$, $sd = 2.4$ vs mean = 33, $sd = 8.7$) ($U = 203.00$, $p < .001$).

The sample was divided into two subgroups consisting of ‘digital natives’ (born in or after 1980) and ‘digital immigrants’ (born before 1980). In our sample, Engineering students were more likely to be ‘digital natives’, and Social Work students were more likely to be ‘digital immigrants’ ($\chi^2 = 90.87$, df = 1, $p < .001$).

4.1.4. Response rate and sample representativeness

All students who attended the lecture on the day of data collection completed and returned the questionnaires. While this sampling strategy provided clear advantages in terms of time- and cost-savings, it did not account for the number of potential participants who may have been omitted from the study. Therefore the data can only be considered a snapshot of students’ views and may not be representative of the entire student population at the two universities. Nevertheless the total sample size (n = 160) ensures statistical power. The difference in subsample sizes (numbers of Social Work and Engineering students) reflects real-life proportions, with fewer students enrolled in Social Work modules compared to Engineering modules at both universities. Therefore, foregoing some methodological weaknesses, the study offers a valuable contribution to the growing body of data in this field.

4.2. Phase 2: qualitative study

4.2.1. Data collection and analysis method, instruments and procedure

The qualitative phase involved semi-structured, in-depth interviews with students and staff. Interviews lasted 1 h, on average, and were audio-recorded. Two separate interview schedules were designed: one for student and one for staff interviews. The interview schedule for
students was based on the questionnaire responses. Students were asked to describe how they used the technologies that they selected in
their questionnaire and to share their views of the educational value of these tools. Students’ perceptions of barriers to technology use for
teaching and learning were also explored. Staff interviews included questions on their experiences of using technologies in teaching, reasons
for selecting specific tools, their observations of the nature and extent of students’ technology use, as well as their understanding of the
educational value of technologies. Interviews were transcribed and coded for both predefined categories (as reflected in the interview
questions) as well as analysed for emergent topics and themes.

4.2.2. Respondents
Student interviews: In the Phase 1 questionnaire, students had an opportunity to provide contact details if they wished to volunteer for
a follow-up interview. To maximise the response rate, students were offered £5.00 as an incentive for participating in the interview (no
incentive was provided for responding to the questionnaire). We acknowledge that while increasing the response rate, this procedure may
have introduced a sample bias: it is possible that only those students who were motivated primarily by the financial reward, agreed to be
interviewed. Out of 28 volunteers identified through Phase 1, eight students were eventually recruited for interview – four from each
institution, two from each discipline. It was impossible to schedule interviews with all students who had initially volunteered, because they
either did not reply to interview invitations or were no longer available for interview.

Staff interviews: Eight members of staff were interviewed, four from each institution. This included: five lecturers (3 in Social Work and 2 in
Engineering) and three support staff (IT, learning technology and staff development).

4.2.3. Response rate and sample representativeness
The exploratory nature of this study meant that the interview samples were small. While it is possible that the sample may not be
representative of the overall student group, there are no marked differences between the survey responses of those students who did and
those who did not volunteer for interviews. The interviews indicated that the student-respondents were largely similar to each other in
terms of the extent and the nature of the use of technologies for learning and socialising.

Staff participants – particularly lecturers – were selected on the basis of their interest in the use of technology for learning. All had
experienced with some technology tools to support their teaching. While this may have introduced some sampling bias, the study did not
seek a representative sample of staff but, rather, aimed to record the views of staff who were already using digital technologies to support their
teaching. Such sampling bias is a common problem in qualitative research, where a sufficiently diverse sample is difficult to achieve. Indeed, it
can be advantageous to interview people who can draw from personal experience when answering questions (Daly & Lumley, 2002).

5. Results

5.1. Phase 1 results

5.1.1. General ownership and use of hardware devices
The majority of participants owned a range of tools: mobile phones \( n = 159, 99.4\% \), personal computer \( n = 127, 79.4\% \), portable media
player \( n = 111, 69.4\% \), laptop computers \( n = 106, 66.3\% \), digital camera \( n = 92, 57.5\% \) and games consoles such as play station \( n = 85,
53.1\% \). Fewer students owned handheld computers \( n = 10, 6.9\% \) and portable games consoles \( n = 29, 18.1\% \). Table 1 summarises results
related to ownership of devices according to discipline and age.

The patterns of technology ownership by age are broadly similar to those by subject, with the exception of the ownership of personal
computers and digital cameras (a larger proportion of ‘digital immigrants’ than ‘natives’ own these).

5.1.2. Technology use for formal and informal learning
Students were asked to indicate the extent to which they used technology tools on the course (formal learning) and to support their
learning outside their university course (informal learning). Findings indicate that in formal learning, the most popular tools included
general websites, Google, course websites and, to a lesser extent, text messaging. Findings in relation to tools used for informal learning
reflect these results, with the addition of mobile phones (Table 2).

Large numbers of students indicated that they never used virtual chat, MP3 players, handheld computers, podcasts, simulation games,
MySpace, YouTube or blogs for learning. The sets of tools listed in two sections of the questionnaire (Section B, Formal Learning and Section
C, Informal Learning) were different, because not all items are equally relevant in formal and informal learning contexts.

<table>
<thead>
<tr>
<th>Hardware device</th>
<th>Ownership by subject</th>
<th>Ownership by age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engineering Social work</td>
<td>Digital natives Digital immigrants</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>130 (100%)</td>
<td>29 (96.7%)</td>
</tr>
<tr>
<td>Portable media player</td>
<td>97 (74.6%)</td>
<td>14 (46.7%)</td>
</tr>
<tr>
<td>Personal computer</td>
<td>104 (80%)</td>
<td>23 (76.7%)</td>
</tr>
<tr>
<td>Handheld computer</td>
<td>10 (7.7%)</td>
<td>–</td>
</tr>
<tr>
<td>Laptop computer</td>
<td>89 (68.5%)</td>
<td>17 (56.7%)</td>
</tr>
<tr>
<td>Games console</td>
<td>73 (56.1%)</td>
<td>12 (40%)</td>
</tr>
<tr>
<td>Portable games console</td>
<td>23 (17.7%)</td>
<td>6 (20%)</td>
</tr>
<tr>
<td>Digital camera</td>
<td>75 (57.7%)</td>
<td>17 (56.7%)</td>
</tr>
<tr>
<td>Other*</td>
<td>9 (6.9%)</td>
<td>1 (3.3%)</td>
</tr>
</tbody>
</table>

* Devices mentioned under “other” included dvd player (and portable), video camera, pen drive, car computer/GPS/traction control, guitar fx pedals/drum machine/synthesiser, electronic speaking dictionary and thesaurus.
Use of Virtual Learning Environment (VLE): We asked students about the use of the virtual learning environment (VLE) as the main support platform used for formal learning in both universities. Findings illustrate a divide between the two disciplines in relation to the extent to which courses incorporated a VLE. While the majority of Engineering students reported that VLE was used on all or most of their modules (n = 125, 97.6%), around 2 in 5 social work students (n = 12, 41.4%) indicated that VLE was used on a few or none of their modules. This, combined with the significantly different sample sizes for both comparison groups, technical vs non-technical (χ² = 62.5, df = 1, p < .001) and ‘digital natives’ vs ‘digital immigrants’ (χ² = 78.48, df = 1, p < .001), indicates that results should be interpreted with caution.

5.1.3. Technology use for socialising

Table 3 outlines the types of tools students used for socialising, according to the extent of use (daily, weekly, monthly and never). Most popular were music download tools (e.g. iTunes, MP3 players), while social networking, blogging, gaming and file sharing were less popular than may have been expected. Virtual worlds, chat rooms, and discussion groups were predominantly never used.

Many tools listed in formal learning category appeared never to be used by most students (e.g. more than half of the respondents reported they never used 68% (n = 13) of tools listed in Table 2). Therefore, the data was condensed by merging frequencies in ‘daily, weekly and monthly’ into one category titled ‘Used’ and compare this to ‘never’ titled ‘Not used’. This data transformation allowed an analysis of the use of technologies by comparing results related to Engineering students with those of Social Work students, and ‘digital immigrants’ with ‘digital natives’.

5.1.4. Variation in technology use by age and discipline

Compared to ‘digital immigrants’, ‘natives’ used more tools in formal learning (U = 810.5, df = 1, p < .005), informal learning (U = 989.5, df = 1, p < .05) and for socialising (U = 622.0, df = 1, p < .001). As Engineering students were more likely to be ‘digital natives’, so it may not be surprising that, when compared to Social Work students, Engineering students used more technology tools for formal learning (U = 911.0, df = 1, p < .001), informal learning (U = 1102.5, df = 1, p < 0.05) and for socialising (U = 938.0, df = 1, p < .001).

5.1.5. Association between use of technology across learning and recreational contexts

For Engineering students, there was a positive relationship between the number of technology tools used in informal and formal learning (rₛ = .593, p < .001), in formal learning and recreational use (rₛ = .251, p < .01) and in informal learning and recreational use (rₛ = .457, p < .001). For Social Work students, however, only the relationship between tools used in formal and informal learning was significant (rₛ = .459, p < .05). This suggests that Engineering students generally make use of more technology tools and that they transfer their use of tools across different contexts. Amongst Engineering students, the increase in the use of technologies for socialising was associated with an increase in use of technologies for learning purposes. Such a relationship was not observed among Social Work students, suggesting that for the latter there may be clearer boundaries in place between technologies they use for learning and socialising. We cannot say from our data whether these boundaries are self-constructed or necessitated by exogenous factors. Understanding the reasons for such separation of learning and social spaces could be an interesting area for future research.

Since Engineering students are also more likely to be ‘digital natives’, this pattern was also found amongst ‘digital natives’ and ‘digital immigrants’. This means that amongst ‘digital natives’, increased use of technologies in formal learning was associated with an increase in technology use in informal learning (rₛ = .591, p < .001), and an increase in recreational settings (rₛ = .253, p < .005). Likewise, an increase of technology tool use in informal learning was related to an increase in use of technology tools in leisure (rₛ = .479, p < .001). Amongst digital immigrants, only the relationship between informal and formal learning was significant (rₛ = .632, p < .005).

### Table 2

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<tbody>
<tr>
<td>Course website (e.g. lecture notes)</td>
<td>81 (51.6%)</td>
<td>48 (30.6%)</td>
<td>7 (4.4%)</td>
<td>21 (13.1%)</td>
<td>60 (38.5%)</td>
<td>46 (29.5%)</td>
<td>18 (11.5%)</td>
<td>32 (20.5%)</td>
</tr>
<tr>
<td>MP3 player</td>
<td>34 (21.3%)</td>
<td>12 (7.5%)</td>
<td>5 (3.1%)</td>
<td>109 (68.1%)</td>
<td>27 (17.3%)</td>
<td>18 (11.5%)</td>
<td>13 (8.3%)</td>
<td>98 (62.8%)</td>
</tr>
<tr>
<td>Digital camera</td>
<td>7 (4.4%)</td>
<td>18 (11.3%)</td>
<td>42 (26.3%)</td>
<td>93 (58.1%)</td>
<td>5 (3.2%)</td>
<td>14 (9.0%)</td>
<td>39 (25.0%)</td>
<td>98 (62.8%)</td>
</tr>
<tr>
<td>Handheld computer</td>
<td>10 (6.3%)</td>
<td>3 (1.9%)</td>
<td>3 (1.9%)</td>
<td>144 (90.0%)</td>
<td>7 (4.4%)</td>
<td>7 (4.4%)</td>
<td>6 (3.8%)</td>
<td>136 (87.2%)</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>66 (41.3%)</td>
<td>13 (8.1%)</td>
<td>6 (3.8%)</td>
<td>75 (46.9%)</td>
<td>78 (50.0%)</td>
<td>23 (14.7%)</td>
<td>7 (4.5%)</td>
<td>48 (30.8%)</td>
</tr>
<tr>
<td>Podcasts</td>
<td>6 (3.8%)</td>
<td>1 (0.6%)</td>
<td>13 (8.1%)</td>
<td>140 (87.5%)</td>
<td>2 (1.3%)</td>
<td>3 (1.9%)</td>
<td>14 (9.0%)</td>
<td>137 (87.8%)</td>
</tr>
<tr>
<td>Internet websites</td>
<td>110 (68.8%)</td>
<td>34 (21.3%)</td>
<td>5 (3.1%)</td>
<td>11 (6.9%)</td>
<td>81 (51.9%)</td>
<td>44 (28.2%)</td>
<td>9 (5.8%)</td>
<td>22 (14.1%)</td>
</tr>
<tr>
<td>Google/Google scholar</td>
<td>97 (60.6%)</td>
<td>41 (25.6%)</td>
<td>8 (5.0%)</td>
<td>14 (8.8%)</td>
<td>63 (40.6%)</td>
<td>44 (28.4%)</td>
<td>11 (7.1%)</td>
<td>37 (23.9%)</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>40 (25.0%)</td>
<td>51 (31.9%)</td>
<td>32 (20.0%)</td>
<td>77 (47.1%)</td>
<td>39 (25.2%)</td>
<td>43 (27.7%)</td>
<td>31 (20.0%)</td>
<td>42 (27.1%)</td>
</tr>
<tr>
<td>Simulations, games</td>
<td>13 (8.1%)</td>
<td>12 (7.5%)</td>
<td>26 (16.3%)</td>
<td>109 (68.1%)</td>
<td>11 (7.1%)</td>
<td>11 (7.1%)</td>
<td>15 (9.6%)</td>
<td>119 (76.3%)</td>
</tr>
<tr>
<td>Message boards</td>
<td>23 (14.5%)</td>
<td>28 (17.6%)</td>
<td>28 (17.0%)</td>
<td>80 (50.3%)</td>
<td>15 (9.7%)</td>
<td>26 (16.8%)</td>
<td>25 (16.1%)</td>
<td>89 (57.4%)</td>
</tr>
<tr>
<td>Text messaging</td>
<td>68 (42.5%)</td>
<td>18 (11.3%)</td>
<td>7 (4.4%)</td>
<td>67 (41.9%)</td>
<td>73 (46.8%)</td>
<td>24 (15.4%)</td>
<td>8 (5.1%)</td>
<td>51 (32.7%)</td>
</tr>
<tr>
<td>MySpace</td>
<td>15 (9.4%)</td>
<td>9 (5.6%)</td>
<td>8 (5.0%)</td>
<td>128 (80.0%)</td>
<td>8 (5.1%)</td>
<td>13 (8.3%)</td>
<td>9 (5.6%)</td>
<td>126 (78.8%)</td>
</tr>
<tr>
<td>Blog</td>
<td>10 (6.3%)</td>
<td>4 (2.5%)</td>
<td>9 (5.6%)</td>
<td>137 (85.6%)</td>
<td>5 (3.2%)</td>
<td>11 (7.1%)</td>
<td>14 (9.0%)</td>
<td>126 (80.8%)</td>
</tr>
<tr>
<td>YouTube</td>
<td>17 (10.6%)</td>
<td>24 (15.0%)</td>
<td>25 (15.6%)</td>
<td>94 (58.8%)</td>
<td>17 (10.9%)</td>
<td>15 (9.6%)</td>
<td>18 (11.5%)</td>
<td>106 (67.9%)</td>
</tr>
<tr>
<td>Video/audio clips</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>21 (13.5%)</td>
<td>34 (21.8%)</td>
<td>28 (17.9%)</td>
<td>73 (46.8%)</td>
</tr>
<tr>
<td>Chat</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>40 (25.6%)</td>
<td>19 (12.2%)</td>
<td>10 (6.4%)</td>
<td>87 (55.8%)</td>
</tr>
<tr>
<td>Second life</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5 (3.2%)</td>
<td>2 (1.3%)</td>
<td>5 (3.2%)</td>
<td>144 (92.3%)</td>
</tr>
<tr>
<td>Virtual/real time chat facility</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Video conferencing</td>
<td>2 (1.3%)</td>
<td>5 (3.1%)</td>
<td>152 (95.6%)</td>
<td>2 (1.3%)</td>
<td>5 (3.2%)</td>
<td>144 (92.3%)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Online assessments (e.g. multiple choice quizzes)</td>
<td>3 (1.9%)</td>
<td>6 (3.8%)</td>
<td>63 (39.9%)</td>
<td>86 (54.4%)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Online discussion groups</td>
<td>12 (7.5%)</td>
<td>27 (16.9%)</td>
<td>28 (17.5%)</td>
<td>93 (58.1%)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
5.1.6. Prediction of use of technology in formal learning

A multiple regression was conducted to investigate if students’ use of technology in formal learning could be predicted by the variables found to be of statistical significance so far. Predictors included: number of technology tools used in informal learning; number of technology tools used for socialising; discipline; age (‘digital native vs digital immigrant’ dichotomy); and extent to which students’ courses integrated use of technology, in particular VLE. The outcome variable was the number of technology tools used in formal learning. The model identified was found to be significantly better than chance ($F(5, 135) = 14.91$, $p < .001$), and was able to account for 43% of variance in students’ use of technology tools in formal learning. Findings suggest that the use of technology in formal learning increases in parallel to increase in use of tools in informal learning ($\beta = .55$, $p < .001$). The predictor variable indicating the extent to which technology was used in university modules only just missed statistical significance (at $p = .051$). Table 4 outlines the $b$, SE $b$ and $\beta$ values.

In summary, students studying a technical discipline and ‘digital natives’ used more technology tools than students from a non-technical discipline and ‘digital natives’. Furthermore, ‘digital natives’ and students of a technical discipline used more technology tools in formal and informal learning and for recreational purposes when compared to ‘digital immigrants’ and students of a non-technical discipline. This relationship may be further mediated by the finding that university courses for technical disciplines provide and require more intensive and extensive access to technologies (VLE).

5.2. Results of qualitative study

Student and staff interview results are compared and contrasted under three key themes that guided the interviews: nature of technology use; perceived educational value of technologies; and perceived factors impacting adoption of technology for learning. The participants’ names are fictitious.

5.2.1. Nature of technology use

Phase 1 data revealed that the institutional VLE was a central tool used for formal learning at both universities. University A’s Social Work (SW) department also used a locally developed VLE (Clydetown). Clydetown is a web-based multimedia environment comprising simulated case studies of various families living in different areas of a fictitious city. Social Work students used the environment to view and discuss the case studies and upload assignments. In addition, the Engineering departments (Eng) in both universities used a range of specialist software. All eight student interviewees indicated that the VLE was predominantly used by lecturers as a content repository, allowing students access to lecture notes, announcements and other course information. This way of using the VLE was viewed positively by all students we interviewed, because, in their view, it afforded easy access to lecture notes. However, lecturers’ use of the VLE in different ways and this proved challenging for students:

“Some [lecturers] put [resources] on straight away, others you have to email them to ask for it and it can take a week” (Tracy, SW)

“Sometimes lecturers make [notes] available before the lecture...sometimes it was after, but it would really be better if we got it before the lecture” (Amadika, SW)

In students’ view, the variability in lecturers’ use of VLE was due to lecturers’ personal preferences or skills.

“Only certain lecturers put up stuff, I think they all have access to it but I think some people are more comfortable using it than others” Tracy (SW).

### Table 3

<table>
<thead>
<tr>
<th>Tool</th>
<th>Technology used for socialising and recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily (%)</td>
</tr>
<tr>
<td>Music</td>
<td>129 (81.1)</td>
</tr>
<tr>
<td>Photo sharing</td>
<td>27 (17.0)</td>
</tr>
<tr>
<td>Video sharing</td>
<td>40 (25.2)</td>
</tr>
<tr>
<td>Blogging</td>
<td>19 (11.9)</td>
</tr>
<tr>
<td>Social networking</td>
<td>52 (32.7)</td>
</tr>
<tr>
<td>File sharing</td>
<td>41 (25.8)</td>
</tr>
<tr>
<td>Discussion group</td>
<td>13 (8.2)</td>
</tr>
<tr>
<td>Chat rooms</td>
<td>9 (5.7)</td>
</tr>
<tr>
<td>Wikis</td>
<td>33 (20.8)</td>
</tr>
<tr>
<td>Virtual worlds</td>
<td>3 (1.9)</td>
</tr>
<tr>
<td>Internet gaming</td>
<td>17 (10.7)</td>
</tr>
</tbody>
</table>

### Table 4

<table>
<thead>
<tr>
<th>Tool</th>
<th>$b$</th>
<th>Standard error $b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.59</td>
<td>2.88</td>
</tr>
<tr>
<td>VLE use in most modules</td>
<td>−.20</td>
<td>.61</td>
</tr>
<tr>
<td>VLE use in few modules</td>
<td>−.22</td>
<td>1.13</td>
</tr>
<tr>
<td>VLE use in no modules</td>
<td>−.32</td>
<td>1.7</td>
</tr>
<tr>
<td>Technology use in informal learning</td>
<td>.48</td>
<td>.06</td>
</tr>
<tr>
<td>Technology use for socialising</td>
<td>−.02</td>
<td>.11</td>
</tr>
<tr>
<td>Discipline</td>
<td>1.06</td>
<td>.99</td>
</tr>
<tr>
<td>Age</td>
<td>.02</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Note: $^* p < .001$; $^* p = .051$; $^* p = .054$. 
“All modules are up and running in [VLE], but some lecturers just don’t use them. There was nothing on it, all it had was the link and it just opened up a blank page. It was because the lecturer apparently didn’t like the new version of it and refused to use it” Cathy (Eng).

Staff interviews revealed differences in experience and comfort level in using technology for teaching. Overall, Engineering faculty appeared to be more confident in using technology than the Social Workers. Staff interviews confirmed the student observations that the VLE was used chiefly as a content repository or course administration tool, and, only occasionally, to support online discussions or multiple-choice tests.

The survey revealed that Google, Google Scholar, Wikipedia, course websites, and text messaging were the most popular tools that students used for learning. However, their use was not ubiquitous: 2/8 interviewees had never heard of Google Scholar, 2/8 were not familiar with Wikipedia and 2/8 did not know what a ‘podcast’ was (in each case these were different interviewees). Five out of eight interviewees either did not know what a blog was and/or had never read or written a blog entry.

The most ubiquitous tools were mobile phones and text messaging. Students used mobile phones mainly to contact peers to organise project meetings, to collaborate on group assignments, to prepare for exams or to record lectures. None of the interviewees used their phones to access the Internet, due to the cost. All interviewees indicated a preference for text messaging rather than voice calling, because texting was considered quicker and cheaper.

Instant messaging (IM) was another popular, but not ubiquitous, tool. IM was used regularly by 4/8 interviewees for both learning and socialising purposes, such as for communicating with classmates about assignments or chatting with friends socially. Students preferred IM to asynchronous communication tools such as VLE-based discussion fora:

“I never use forums [sic] because sometimes you just go on and it’s like months old and they just stay up there forever and nobody visits them.” (Gordon, Eng)

Preferences for different forms of communication appear to be partially governed by familiarity with particular tools, confidence in experimenting with new tools and an expectation of teacher guidance:

“Rather than me just going off and learning it on my own, something, maybe involvements from course tutor setting it up. I’m not a great explorer to say ‘well I’ll try this, I’ll try that’. I will try it if it’s part of my learning. That’s not to say I’m not open to new experiences.” Harry (SW)

Low level of use of social media, including social networking sites (SNS) and personal web publishing (blogs), was recorded. MySpace and Bebo SNS were used by 3/8 interviewees, to keep in touch with their university peers and former school classmates. SNS were used predominately in contexts which students related to socialising rather than learning. Only one student reported regularly reading and commenting on friends’ blogs. The remaining interviewees never wrote or read blogs, because they “just never thought of using them” (Alen, Eng) or were “slow taking up technology” and didn’t consider blogs “academically useful” (Harry, SW). One student appeared perplexed by the concept of blog:

“It seems kind of bizarre to me that so many different people want to say what they did during the day and there’s so many people want to read it… I’ve never really read any [blogs] so I’m probably shooting in the dark here.” (Cathy, Eng)

The most frequently cited tool used for recreation was YouTube. However, YouTube was used by students mainly for consuming rather than creating and sharing content: while 5/8 students said they regularly viewed music or product videos on YouTube, none of the interviewees had ever uploaded content. Alen (Eng) suggested that “there’s been a few people on the course who have put stuff on”, but it was not clear whether these were videos made by the students themselves or mashups and excerpts from existing material.

We asked students to describe their use of gaming and photo sharing practices which are frequently cited as activities that ‘digital natives’ excessively engage in. The survey revealed that gaming was not a ubiquitous activity. Only two of the students we interviewed played computer games, and of these only one was a regular gamer. Both students preferred to play individually rather than in online, multiplayer games, due to their lack of gaming skills. Photo sharing was limited and mainly took place through social networking sites or email, rather than specialised sharing sites such as Flickr. Only 2/8 interviewees reported engaging in photo sharing via their Bebo/MySpace sites.

5.2.2. Perceived educational value of technologies

Students did not appear to understand the potential of technology to support learning. Instead they looked to their lecturers for ideas on technology enhanced learning:

“If [lecturers] found a way for everyone to use these [tools] then it would be quite good” (Alen, Eng)
“If they taught us a bit about it before just saying ‘go and do it’” (Gordon, Eng).

Students expected “to be taught”, yet voiced critical comments about the quality of teaching:

“I am paying my student fees and so I notice when I am not getting something that I should be getting in terms of being taught something. [Lecturer] missed a lecture and didn’t make up for it in the end and put in [in VLE] a lecture slide saying ‘for this part of the course read that chapter, that’ll do’. Other times instead of teaching us he got somebody to come and talk to us and I was like that’s very nice, but he should be teaching us the course first, you know.” (David, Eng)

“The lecture slides are never good enough on their own to learn from, they are just meant to jog my memory and write notes next to, but [the lecturer] just reads out what’s on the slides and she doesn’t expand on it. Some of the things the lecturers do I’m kind of like ‘well, that’s just a cop out’, that’s just because they can’t be bothered teaching us” (Gordon, Eng).

Students expected lecturers to use largely conventional approaches to teaching. This expectation may explain students’ satisfaction with the limited use of the VLE by faculty as a content dissemination tool.

When probed by the interviewer, most students had difficulties in suggesting ideas on how they could use technologies to support teaching and learning. A couple of students suggested lecture podcasts, but most students were unsure how they could draw upon
technologies to support their learning. For example, the interviewer’s probing for ideas around the use of collaborative technologies to support group work and knowledge sharing resulted in the following response:

“I am not really bothered by what other groups are doing. I know what my group is doing and sometimes I think something else might be quite conflicting or put us off course… For everybody to share their knowledge might cause confusion or make it harder” (Tracy, SW).

In another example, when asked if it could be beneficial to use a wiki in a team project, a student responded:

“I don’t know because the chances are that the things we’d be doing would have been already explained in whatever notes we are getting and I could maybe see a reason to do that if we were breaking new ground and wanting to keep other people informed, but if the notes are there why not use the notes rather than trying to write our own notes” Cathy (Eng)

When the interviewer suggested that a wiki could be used to share and co-develop materials to support team project work, the student replied:

“I hadn’t thought of that…it might be useful to go through the process and to keep a log of it or to keep updating”. Cathy (Eng)

This pattern suggests that students may not fully understand the nature and potentialities of technologies, either because they use them in very limited ways or do not use them at all.

Staff interviews showed that while some lecturers recognised the potential of personal, mobile devices and publically available web-based tools in supporting learning (principally mobile phones, texting and instant messaging), they believed these technologies were “too crude for organised educational use” (Peter, Eng. Lecturer). In their view texting and IM did not allow a clear delineation of the personal and the educational and the blurring of boundaries between the two was undesirable.

Engineering staff viewed handheld devices as having the greatest potential for learning. These were seen as a potential supplement to technologies already used in classrooms (e.g. voting systems) and as a medium to access content rather than as a way of supporting communication and interaction:

“They can do voting with it. It changes the whole concept of what happens in the classroom if they can all communicate through their phones, not with each other, but get information from the web” (Colin, Eng. Lecturer).

Staff did not see educational value in social networking sites. They viewed SNS and other emergent technologies, including virtual worlds, as “transient” phenomena - therefore not worth investing the resources necessary to integrate them in mainstream education. An Engineering lecturer described his experimentation with a virtual world:

“I have showed [sic] a group of students Second Life. After we had all stopped laughing and we used it for weeks - and these are techy engineering types - they just said ‘no and we don’t ever want to use that again’. My experiment just showed that it’s not just for the techy types, it’s for the ultra geeks who’ve got the time to put beards and hairstyles on and fly around the landscape”.

There was a perception, mainly among Engineering lecturers, that social technologies were only suitable for “soft” disciplines or pre-university education. A Social Work staff member suggested that social technologies may have a greater potential in workplace learning rather than formal learning. However, the majority of staff interviewed acknowledged that they did not have first-hand experience of using emergent social technologies, so the basis of these opinions is difficult to ascertain.

5.2.3. Perceived factors impacting adoption of technologies for learning

We asked students and staff to describe their views regarding factors preventing use of technologies in university learning. Three broad types of issues consistently emerged: digital skills, reluctance to change, and systemic problems such as lack of time and infrastructure issues.

Both students and staff considered lack of skills in using technology a key issue – and this related to both students’ and staff’s skills:

“People in the class aren’t really up to speed… Some people are still wary of new technology, but it’s quite surprising sometimes it’s young people” (Harry, SW student)

“Some of them [lecturers] look really kind of confused by certain things, even overhead projectors and stuff like that. We’ve had lectures where the guy can’t figure out how to bring down the whiteboard or get the projector to turn. They totally choke on it. I think it’s even harder for people who have been doing it for a long time, to get into it as well. Either they just get scared of it or the just don’t understand, then they think ‘oh just forget about it.” (Gordon, Eng. student)

In turn, staff suggested that lecturers’ IT skills were frequently inferior to students’ IT skills. A Social Work lecturer suggested that technology use within the social work profession in general was “pretty crude and primitive” and that this overall technophobia affected some mature students’ uptake of the VLE and other technologies. While Engineering staff often voiced a preference to “figure out” new technologies themselves, Social Work staff appeared to require support to get up to speed with current technologies.

Students and staff discussed a number of systemic factors that prevented lecturers from experimenting with technology. Students highlighted lecturers’ lack of engagement in teaching:

“In Engineering departments, some lecturers get a bit lazy because they only get so much money for research, they won’t necessarily like the lecturing side of it” (Cathy, Eng)

Meanwhile, lecturers viewed students’ expectations and characteristics as a driving force for trying new approaches to teaching, believing that students entering university were more technology-savvy than the staff themselves or previous generations of students:

“Schools have changed very quickly and are now using technology and PowerPoint and a whole range of things…so I think it would be the truth to say [younger] students come in with probably much greater knowledge and expertise and awareness of its [technology’s] potential than staff” (Jennifer, SW Lecturer)
Unsurprisingly, lack of time to experiment with technology and readiness to consider alternative ways of teaching were consistently described by staff as key factors preventing integration of technologies into teaching methods. Staff also mentioned students’ reluctance to use personal devices on campus. In their view, students were unwilling to bring laptops and other devices to university because of security considerations caused by a lack of lockers on campus. Other infrastructure-related issues reported included a lack of broadband access in classrooms, or poor wireless access in the classrooms.

6. Discussion

Johnson and Onwuegbuzie (2004) emphasise that to be considered a mixed-method design, findings must be integrated during the interpretation of the results. Therefore, the discussion is structured around key themes arising from both the quantitative and qualitative phases.

6.1. Technology adoption is influenced by complex interdependencies

Findings indicate that both in case of learning and socialising students who were ‘digital natives’ and those who were enrolled in a technical subject (Engineering) used more tools than ‘digital immigrants’ and students of a non-technical discipline (Social Work). However, the tools these students used were largely established technologies, in particular mobile phones, media player, Google, Wikipedia. The use of handheld computers as well as gaming, social networking sites, blogs and other emergent social technologies was very low. This finding is consistent with the results of other studies, in particular Bullen et al. (2008), Jones and Cross (2009), and Kennedy et al. (2008). Students’ reluctance to use personal, mobile devices illustrates that they are far from being ‘constantly connected’ and may be a reflection of a complex mix of cost considerations as well as simply not wanting to be always connected.

Our findings also suggest that students’ technology use may be mediated by use of technology on university courses. Based on these results, we can conclude there is a complex relationship between age, subject, the extent of technology use and the university’s promotion of using digital technology in learning.

6.2. Students’ expectations of learning are influenced by lecturers’ approaches to teaching

Our study found no evidence to support previous claims suggesting that current generation of students adopt radically learning styles, exhibit new forms of literacies, use digital technologies in sophisticated ways, or have novel expectations from higher education. Our findings show that, regardless of age and subject discipline, students’ attitudes to learning appear to be influenced by the teaching approaches used by lecturers. This finding is of course not novel: a qualitative relationship between the lecturer’s teaching methods and students’ learning approaches was established through earlier empirical studies. Trigwell, Prosser, and Waterhouse (1999) demonstrated that, when teachers taught using methods focused on a knowledge transmission paradigm, students were more likely to adopt a surface approach to learning. Furthermore, Virtanen and Lindblom-Ylänne (2009) emphasised that a learning approach is not a fixed student characteristic and that the same student can adopt different approaches in different context and even in different situations within the same context. They urged teachers to be aware of how approaches to teaching can affect students’ approaches to learning. These results, coupled with our finding that technology use by lecturers may be a mediating variable (see Section 6.1) suggest that technology adoption is not a simple binary relationship, but is a complex phenomenon.

Our study showed that far from demanding lecturers change their practice, students appear to conform to fairly traditional pedagogies, albeit with minor uses of technology tools that deliver content. In fact students’ emphasised that they expected to be “taught” in traditional ways. On this basis, previous claims of a growing and uniform generation of young students entering higher education with radically different expectations about how they will learn seem unwarranted.

There is little evidence in our study that lecturers have a clear understanding of ways in which technologies could support effective learning. While some lecturers recognise the educational potential of some technologies, others view these as “fads”. While many staff we interviewed experimented with different technologies, their focus was mostly on established tools and methods, such as VLE, classroom voting systems and online quizzes. The majority of staff did not have first-hand experience of using emergent social technologies. While both Engineering and Social Work staff emphasised personal attitudes and open mindset towards experimentation with new technologies as key factors impacting adoption of tools within teaching, a limited understanding of the potential application of tools and reluctance to change teaching practice were observed.

6.3. Students have a limited understanding of how technology may support learning

Although lecturers cited students’ expectations as a driving force for changing teaching practice, students do not appear to have a frame of reference of leading edge approaches to technology-enhanced learning to benchmark their current learning experiences against. Previous research has shown that students’ expectations of learning at university appear to be influenced more by prior experience of learning in formal situations than by students’ personal use of technology outside educational settings, for instance for informal learning or socialising (Littlejohn, Margaryan, & Vojt, 2010). Furthermore, previous research indicated that students expect technology-enhanced learning methods to reflect conventional learning and that these students may be uncomfortable with the application of social technologies in educational contexts (Carey, Harris, Smith, & Warren, 2009; Harris, Warren, Leigh, & Ashleigh, 2010).

Our data does not support the suggestion that young students exhibit radically different learning styles. Instead, our findings suggest a deficit of learning literacies and a dependency on guidance from lecturers amongst students. Conventional forms of teaching appear to encourage students to passively consume information.
7. Conclusions, limitations and future research

This explorative study aimed to provide a snapshot of the extent and nature of students’ use digital technologies and their perceptions of the educational value of these technologies. The results lead us to conclude that students may not have the characteristics of epitomic global, connected, socially-networked technologically-fluent ‘digital natives’. Students in our sample appear to favour conventional, passive and linear forms of learning and teaching. Indeed, their expectations of integration of digital technologies in teaching focus around the use of established tools within conventional pedagogies. Compared to ‘digital immigrants’ and Social Work students, ‘natives’ and Engineering students use more tools in formal and informal learning and socialising. This relationship appears to be mediated by more extensive use of technology in Engineering courses as compared to Social Work courses. The use of technology between these groups, however, is only quantitatively rather than qualitatively different. While students generally have expertise in the use of some (largely conventional) technology tools that sometimes exceed lecturers’ abilities, their understanding of how to use these tools for learning is limited by their knowledge of the potential affordances and applications of these tools and by their narrow expectations of learning in higher education. Students have limited understanding of what tools they could adopt and how to support their own learning. These findings challenge the proposition that young people have sophisticated technology skills, providing empirically-based insights into the validity of this assertion. The outcomes of our study suggest that, although calls for radical transformations in education may be legitimate, it would be misleading to ground the arguments for such change in students’ shifting patterns of learning and technology use.

Our study has some limitations which must be considered when interpreting the results. Firstly, the survey and interview samples are small and may not be fully representative of the overall group of students and lecturers at the two participating universities. However, these findings are largely consistent with other similar studies in the UK and elsewhere, suggesting that the sample is not entirely unrepresentative.

Secondly, since the sample is skewed towards ‘digital natives’ and Engineering students, it is difficult to make any separate assertions regarding subject or age differences. In any case, as the data reveals, differences in technology use may not be due to any one of these two factors, but could be a more complex phenomenon. Using an age- or a discipline-based dichotomy is perhaps not a useful approach for describing and understanding students’ use of technologies to support their learning.

Thirdly, our data was collected in 2007, and the patterns of technology use may have changed since then. For example, Bebo and MySpace have been largely replaced by Facebook. However, the more recent studies, for example Hargittai (2010), Jones and Cross (2009) and Nagler and Ebner (2009) are uncovering practices and results very similar to ours, suggesting that it is unlikely that the patterns of technology use have changed dramatically.

Future research on students’ use of technologies for learning could focus on a number of directions. Firstly, it could take into consideration a broader range of variables rather than only age and subject discipline. Relevant variables include the pedagogic design of courses, socio-economic background of students, their life circumstances, for example geographic proximity to friends and family, general sociability (extraversion, introversion) and so forth. Secondly, it would be useful to conduct a meta-study comparing and contrasting the increasing number of empirical studies on the topic. Understanding the nature and causes of the similarities and differences in the conclusions drawn from these studies would require a systematic approach comparing the characteristics of the samples, methodologies and measurement instruments used as well as the contexts in which these studies took place.

In terms of educational practice and policy making, we concur with the view voiced by Kennedy et al. (2008) who recommended that ‘educators and administrators should look to the evidence about what technologies students have access to and what their preferences are… to inform both policy and practice’ (p. 10). We further suggest that decisions regarding the use of technologies for learning should not only be based around students’ preferences and current practices, even if properly evidenced, but on a deep understanding of what the educational value of these technologies is and how they improve the process and the outcomes of learning. This cannot be achieved without faculty actively experimenting with different technologies in their teaching to evaluate the educational effectiveness of the technologies tools in practice and, most importantly, publishing the results of such explorative evaluative studies such that the field benefits from an improved understanding.

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Appendix. Supplementary data

Supplementary data associated with this article can be found in the online version, at doi:10.1016/j.compedu.2010.09.004.

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