Immigrants and natives: Investigating differences between staff and students' use of technology

Gregor Kennedy
Biomedical Multimedia Unit
The University of Melbourne

Barney Dalgarno
Faculty of Education
Charles Sturt University

Sue Bennett
Faculty of Education
University of Wollongong

Terry Judd, Kathleen Gray, Rosemary Chang
Biomedical Multimedia Unit
The University of Melbourne

The corollary of the 'Digital Native' – young, technologically avid and literate – is the 'Digital Immigrant' – older, less familiar and comfortable with technology. The accompanying rhetoric posits that in the higher education sector, staff and students are ensconced firmly on either side of a 'digital divide', with critical implications and consequences for teaching and learning. This proposition was tested by surveying 108 staff and 2588 first-year undergraduate students across three Australian Universities about their use of a large selection of common and emerging technologies. These technologies were grouped into eight coherent categories using factor analysis. A MANOVA was then used to analyse different uses of these technologies according to participants' role (staff or student), gender and age. Significant main effects were reported for each of these independent variables and differences were seen particularly for technologies related to mobile phone use and gaming. However, the absolute magnitudes of most differences between groups were small and, critically, there were no role, gender or age effects for technology-based activities associated with Web 2.0 technologies, and the overall use of these technologies was low. These findings support a growing evidence base that, while some differences exist, the 'digital divide' between students and staff is not nearly as large as some commentators would have us believe.

Keywords: digital natives, digital immigrants, net generation, web 2.0, higher education

Introduction

The idea that a new generation of technologically adept students is entering our schools and universities has captured widespread attention and prompted debate amongst educational commentators and the research community. Advocates of the notion argue that because of the increasing prevalence of technology in everyday life younger generations who have been born into and brought up in the digital age have a greater interest in and aptitude for using ICTs (information and communication technologies). For these 'digital natives' (Prensky, 2001) technology has become seamlessly embedded into their lives to the point where it has become invisible as 'technology' (Frand, 2000). By contrast, older generations are said to be 'digital immigrants' (Prensky, 2001), many of whom can use technology but still experience it as something 'foreign'. Prensky goes on to claim that the technologically-rich environments experienced by 'digital natives' have caused them to behave, think and learn differently to previous generations. On this basis, the argument has been made that education is not keeping pace with technology-driven societal change and is at risk of alienated learners by failing to appropriately integrate ICTs into education (Levin & Arafeh, 2002; Prensky, 2001; Oblinger & Oblinger, 2005; Tapscott, 1999). Given its potential significance, there is a clear imperative for educational researchers to take a critical stance and investigate these claims to provide an empirical basis for any response.

Despite intense interest in the 'digital native' idea there has, until recently, been very little empirical evidence of generational differences with which to test these claims, many of which have relied on conjecture and anecdote (Bennett, Maton & Kervin, in press). Recent large scale surveys have focused on determining the characteristics of younger people with regard to their access to and use of particular technologies (Kennedy, Judd, Churchward, Gray & Krause, 2008; Kennedy et al., 2007; Kvavik & Caruso, 2005; Oliver & Goerke, 2007; Salaway & Caruso, 2007; Selwyn, 2008). These are complemented by qualitative inquiry seeking detailed in-depth understanding (e.g. Conole *et al*., 2006; Lohnes *et al*., 2008). The results of these studies show that access and use of particular types of technology are very high amongst a majority of young people, but also that some technology activities are lower than might be expected or that frequency of use varies according to factors other than age (for example gender or socio-economic status).

Furthermore, it is not clear how even the observed differences in the technology-oriented behaviours of individuals from different generations should be interpreted (Garcia & Qin, 2007). Trying to determine differences according to broad generational characteristics, such as the inclination towards face-to-face communication often attributed to older people compared to the supposed preference for electronic communication amongst the younger generation, may be too crude to generate meaningful understanding and action. For example, age may be a poor predictor if there is significant variability of important types of technology-related experiences due to other factors, such as socio-economic background in the home, within age groups. The role that a person adopts may also play a part. University lecturers, for example, might use a range of technology based tools to support their teaching and research activities, and these tools that may differ significantly from those used by their students due to the differing demands – work, social or otherwise – placed on each group. It is therefore entirely possible that lecturers might be more frequent and adept users of some technologies than their students.

The research described in this paper investigated some of the claimed differences between 'digital natives' and 'digital immigrants' by asking university students and staff from three Australian universities about how often they engaged in an array of technology-based activities. In the analysis presented we consider three variables – role (student or staff), age and gender. Age is considered because this is the measure suggested by the hypothesis that the there are fundamental differences in the extent to which younger and older people use technology. Role is important because we wanted to determine whether there were any differences in the frequencies of different types of activities between staff and students because of the type activities their role demanded. Finally, differences according to gender were also included because previous research has suggested that gender is correlated to particular types of technology-based activities (Kvavik & Caruso, 2005; Salaway & Caruso, 2007; Selwyn, 2008).

Method

This paper reports on one aspect of a national project investigating the 'Net Generation' of university students and their teachers that is being undertaken at the University of Melbourne, the University of Wollongong and Charles Sturt University (see Kennedy, Krause, Gray, Judd, Bennett, Maton, Dalgarno, & Bishop, 2006; Kennedy et at 2007). The data presented in this paper are drawn from a comprehensive survey of 108 University staff and 2588 first year students about their use of technology. The university staff surveyed as part of this study were full time and sessional academic staff who had teaching responsibilities. The student questionnaire asked students about the degree to which they accessed and used technology-based tools, how they currently used technology to create and exchange information and knowledge, their skill levels with different technologies, and their perceptions of how technologies could be used in their studies. The items on the staff questionnaire broadly replicated those contained in the student questionnaire. The items presented for analysis in this paper – those concerning the frequency with which technologies are used – were identical for staff and students. Respondents could indicate the frequency with which they used 41 technologies or technology based tools on an eight point scale where '1' was 'not used', '2' was 'once or twice a year', '3' was 'every few months', '4' was 'once or twice a month', '5' was 'once a week', '6' was 'several times a week', '7' was 'once a day' and '8' was 'several times a day'. The questionnaires are available upon request from the lead author.

The student survey was distributed through classes of first year students across the three participating institutions in the second half of 2006. Data collection was carried out in accordance with the human ethics requirements of each institution, and participation was voluntary and confidential. More students from the University of Melbourne completed the survey (45.4%) than from the two other institutions (Wollongong: 27.5% ; Charles Sturt: 27.0%) and more females than males responded (Females: 68.9%; Males 31.0%). The vast majority of students were 25 years of age or younger (84.4%).

Staff surveys were distributed (via mail and electronically) to key teaching staff associated with the student samples (lecturers and tutors). Snowball sampling was employed to gather further staff responses. More staff from Charles Sturt University completed the survey (61.1%) than from the two other institutions (the Melbourne, 24.1% Wollongong: 14.8%) and slightly more males than females responded (Males 53.3%; Females 46.7%). Only a small number of staff surveyed (7.5%) were 25 years of age or younger.

Results

Factor analyses were conducted on all responses in order to refine respondents' use of 41 common technology-based activities into a series of categories. A principal components factor analysis with a varimax rotation yielded eight factors that explained 60.9% of the variance. One item, "Use the web to share photographs or other digital material", had a low factor loading and was excluded from further analyses. After a preliminary examination of eigen values, scree plots and individual item factor loadings, the factor analyses was run again, specifying six, seven and eight factor solutions. A further two problematic items were removed at this stage – "Use the web to download podcasts" because of a uniformly low factor loading and "Use the web/internet for instant messaging/chat " because it consistently loaded across multiple factors.

The remaining 38 items were resolved using an eight factor solution which accounted for 62.4% of the variance. The eight resulting factors are displayed along with reliabilities and descriptive statistics in Table 1. Although the final two factors contained only two items – factors should typically contain over three items – the clear conceptual association between the items included in these factors was considered a strong reason to include them in further analyses. Labels and descriptions for each of the eight factors are as follows:

1. *Advanced Technology Use* is defined by the use of contemporary web-based communication and Web 2.0 technologies such as social bookmarking, contributing to wikis, and publishing and uploading podcasts;
2. *Advanced Mobile Use* comprises items associated with using a mobile phone's advanced features such as video calling, sending images, email and accessing the Internet;
3. *Social Web Publishing* is defined by web-based publishing including blogging, social networking and the development of websites;
4. *Standard Web and Music* includes items associated with common uses of the Internet (e.g. for email, research, study or leisure) and using computers and the web to listen to music;
5. *Digital Media Presentations* relates to the use of a computer to manage and manipulate digital images and to create audio/visual presentations;
6. *Gaming* is made up of items related to the use of online, computer and video-console games;
7. *Standard Mobile Use* refers to the conventional use of a mobile phone to make calls and for texting;
8. *Web-based Services* includes the use of online services such as internet banking and online commerce.

Independent scales were created from the items that comprised each factor. Mean scores were calculated which reflected the frequency with which participants engaged in each of the eight technology-based activities (according to the eight point scale described above). It can be seen from the mean scores reported in Table 1 that some technology-based activities, such as using mobile phones for calling and texting and standard uses of the Internet, enjoyed strong use (on average, daily or weekly). More advanced uses of technology and mobile phones, and the use of the web for publishing material were used less frequently (on average once or twice a year or every few months). The reliability coefficients reported in Table 1 are moderate to high, indicating that each of the independent scales created showed acceptable internal reliability.

Multivariate analyses of variance (MANOVA) were used to determine whether engagement in each of these eight activities differed as a function of participants' *Role* within the university (staff or student), *Age* (25 years of age and under; 26 years and over) and *Gender* (male or female). The MANOVA revealed multivariate effects for all three independent variables (Role: $F_{(8,2342)} = 3.15$, p=.002; Age: $F_{(8,2342)} = 3.66$, p<.001; Gender: $F_{(8,2342)} = 3.75$, p<.001). There were different patterns of univariate effects for each main effect which are presented in Table 2.

Table 2 reports significant univariate results for *Role*. *Role* was a significant determinant of technology-use for two of the eight defined categories – 'Gaming' and 'Standard Mobile Use' – with students engaging more frequently in both these activities. However, even for these categories, the discrepancy between student and staff frequency of use was relatively minor, representing (on average) the difference

between occasional and very occasional use for gaming and daily and more than weekly use for standard mobile activities.

Table 1: Rotated factor solution and descriptive statistics for frequency of use of technology

Item	Factor							
	1	2	3	4	5	6	7	8
Use the web for webconferencing	0.75							
Use the web to make phone calls	0.72							
Use the web to contribute to a wiki	0.68							
Use the web to publish podcasts	0.63							
Use the web to read RSS feeds	0.60							
Use social bookmarking software on the web	0.56							
Use a handheld computer (e.g. PDA) as a personal organiser	0.48							
Use a mobile phone to send pictures or movies to other people		0.76						
Use a mobile phone as an MP3 player		0.74						
Use a mobile phone to access information /services on the web		0.70						
Use a mobile phone to make video calls		0.68						
Use a mobile phone to take digital photos/movies		0.68						
Use a mobile phone to send or receive email		0.56						
Use a mobile phone as a personal organiser		0.46						
Use the web to comment on blogs or vlogs			0.84					
Use the web to read other people's blogs or vlogs			0.79					
Use the web to keep your own blog or vlog			0.79					
Use social networking software on the web			0.63					
Use the web to build and maintain a website			0.60					
Use the web to browse for general information				0.70				
Use the web to look up reference information for study purposes				0.62				
Use the web for other pastimes				0.59				
Use the web/internet to send or receive email				0.57				
Use the web to access portal Course or Learning Management System				0.57				
Use the web to listen to sound recordings				0.50				
Use a computer to play digital music files (e.g. iTunes) without accessing the internet				0.46				
Use the web to download and/or share MP3 files				0.41				
Use a computer to manage/manipulate digital photos					0.80			
Use a computer to create or manipulate digital images					0.76			
Use a computer for creating presentations					0.61			
Use a computer for creating/editing audio and video					0.60			
Use a computer to play games						0.79		
Use a games console to play games						0.75		
Use the internet/web/LAN to play networked games						0.69		
Use a mobile phone to text / SMS people							0.87	
Use a mobile phone to call people							0.87	
Use the web for other services								0.72
Use the web to buy or sell things								0.69
Reliability (Cronbach's Alpha)	0.85	0.86	0.86	0.79	0.82	0.78	0.83	0.66
Mean	1.71	2.76	2.45	5.34	3.26	2.99	7.04	3.34
(SD)	(1.23)	(1.64)	(1.78)	(1.76)	(1.32)	(1.75)	(1.05)	(1.78)

Table 2: Univariate differences between staff and students' reported use of technology

Category	Frequency of use by Role			
	Students	Staff	F	p
Gaming	**3.03** (1.75)	1.85 (1.08)	8.01	=.005
Standard Mobile Use	**7.10** (1.43)	5.62 (2.31)	10.57	=.001

Table 3 identifies significant *Gender* differences for frequency of use of technologies across three of the eight defined categories – 'Advanced Mobile Use', 'Gaming' and 'Standard Mobile Use' – with males being more frequent uses of all with the exception of 'Standard Mobile Use'. Again, most of these differences were comparatively small with only 'Gaming' having mean frequency of use values that differed by more than one (representing, on average, very occasional use by females versus, on average, monthly use by males). For example, it is worth noting that there is almost no numerical difference between males and females for 'Advanced Mobile Use', despite a marginal statistical difference being recorded. Table 4 presents univariate effects for *Age* and it is clear that younger respondents (25 year olds and under) were more frequent users of four technologies when compared to older respondents (over 25 year olds). These included standard' and advanced mobile phone use, standard web and music use and gaming related technologies.

Table 3: Univariate differences between males and females' reported use of technology

Category	Frequency of use by Gender			
	Male	Female	F	p
Advanced Mobile Use	**2.78** (1.75)	2.75 (1.59)	4.32	=.038
Gaming	**3.86** (1.90)	2.57 (1.49)	6.76	=.009
Standard Mobile Use	6.75 (1.69)	**7.18** (1.38)	9.22	=.003

Table 4: Univariate differences between age groups reported use of technology

Category	Frequency of use by Age			
	25 and under	26+	F	p
Advanced Mobile Use	**2.94** (1.68)	2.07 (1.23)	8.22	=.004
Standard Web and Music	**5.48** (1.33)	4.75 (1.34)	5.97	=.015
Gaming	**3.16** (1.75)	2.20 (1.46)	7.76	=.005
Standard Mobile Use	**7.20** (1.32)	6.39 (1.97)	6.67	=.010

Discussion

Prensky (2001) and others have suggested that undergraduate university students can be characterised as 'Digital Natives' due to their intense exposure to digital technologies while growing up, whereas their older lecturers can be characterised as 'Digital Immigrants'. The data reported in this study is only somewhat supportive of this view, with younger respondents reporting higher use of four of the eight technology-based activities defined in this investigation. The four technology-based activities that accord to some extent with Prensky's predictions about Natives and Immigrants are those in the 'Standard Mobile Use', 'Advanced Mobile Use', 'Gaming' and 'Standard Web and Music' categories. However, it is important to note that the magnitude of differences between old and young participants was relatively small in each of these cases. Moreover, the lack of a difference between older and younger respondents for some technology-based activities and the significant influence of gender and role on others, indicates that the story is more complicated than Prensky suggests.

The clearest differences between the groups considered in this investigation were for the technology-based activities in the categories of 'Standard Mobile Use' and 'Gaming', for which differences by *Role*, *Gender* and *Age* were all recorded. The high use of mobile phones for calling and texting by almost all respondents suggests that these technologies have become largely ubiquitous, and while differences did exist across all independent variables, it would be difficult to attribute lower use as a marker of lack of familiarity with the technology (or 'Digital Immigrant-ness' in the case of *Role* and *Age*). For example, the mean frequency of use of 'Standard Mobile' for younger participants was once per day which was only slightly higher than older respondents who, on average, used their phones several times per week.

The finding that males were involved in gaming significantly more than females was not unexpected and supports previous research in the area (e.g. Gorriz & Medina, 2000). While there were differences between age groups for gaming, again, the magnitude of the differences was not substantial. The mean frequency of game playing for those in the 25 years and under age group was every few months, which was only slightly more often than their older counterparts who indicated that on average they played games once or twice a year. Such a small difference and the relatively low frequency of use for younger respondents runs counter to Prensky's (2001) claim that "Today's students – K through college…have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age" (p. 1). In fact, the responses to this survey suggest that gender is as important a predictor of frequency of gaming as age. The age-based patterns of results for 'Gaming' were similar to those recorded for *Role*; that is, students were significantly more frequent users of games than university staff, but again the magnitude of the difference was small. The greater time flexibility experienced by university students may be one factor that accounts for their slightly greater frequency of game playing.

There were clear *Age* and *Gender* effects for the technology-based activities included in the 'Advanced Mobile' category, which included the use of a phone as a personal organizer, as an MP3 player and as a camera. Younger participants were, on average, using these types of technologies every few months, which was higher than for older participants, who used these technologies once or twice a year. The moderately high standard deviation in each case indicates that there is substantial diversity in usage patterns that is not explained by age. The significant – albeit marginal – gender effect for 'Advanced Mobile Use' is something of a statistical anomaly given that the mean scores for the two groups are almost identical. This result may be explained by the larger proportion of younger respondents in the female group, which should lead to a higher mean frequency for females, acting against a tendency for females to use their mobiles for these functions less frequently than males.

The final dependent variable to record significant between-group differences was 'Standard Web and Music', a category which included technology-based activities such as retrieving information from the web for a range of purposes, and downloading of music from the web. Younger participants engaged in this activity, on average, more than once a week, whereas older participants did it slightly less than weekly. Again, the fact that there is a difference is consistent with Prensky's claims, but the magnitude of the difference indicates that there is little practical difference between older and younger people on use of these technologies.

A noteworthy finding from this investigation was the lack of main effects for either *Role* or *Age* for the technology-based activities included in the categories of 'Advanced Technology Use', 'Social Web Publishing', 'Digital Media Presentations' and 'Web-based Services'. When taken together, these categories represent a wide range of technology-based activities that particularly encompass Web 2.0 technologies underpinned by social networking, file sharing, and user-created content (e.g. social bookmarking, contributing to wikis, publishing and uploading podcasts, blogging, social networking, manipulation of digital images and the use of online services). The Net Generation are regarded in some quarters as quintessential Web 2.0 technology users, with their 'nativeness' in this area setting them apart from Digital Immigrant university staff (Cairncross, 2007; Lorenzo, Oblinger & Dziuban, 2007; Towers, Smith & Bruns, 2005). As argued in a previous paper (Kennedy et al, 2007) first year university infrequent use of Web 2.0 technologies runs counter to this claim. The lack of difference found in this study – both between staff and students, and older and younger participants – suggests that differences between the 'Natives' and 'Immigrants' in the area of emerging technologies is not as profound as some would make out.

The data from this investigation not only show few differences between 'Natives' and 'Immigrants' in the use of emerging technologies but, as reported in a previous paper (see Kennedy et al, 2007), the mean frequency with which these technologies were used was low for both staff and students, old and young. The mean frequency of use for these technologies was between once or twice a year and every few

months. In commenting on the relatively infrequent use of emerging technologies it is important to reiterate that the survey was carried out in the second half of 2006, and one might expect that usage of some of the technologies in these categories would have increased in the ensuing years. For example, the social networking site *Facebook* clearly boomed during 2007 (McCarthy, 2008). Other studies of Australian students have suggested that there has been noticeable changes in the frequency of use of these types of technologies in recent years. For example, Oliver and Goerke (2007) found noticeable increases in the percentage of university students using instant messaging, blogs and podcasts between 2005 and 2007. Another important point to reiterate, which was also emphasised in a previous paper (see Kennedy et al, 2007), is that there is substantial diversity in students' frequency of use of these technologies, with a small number of students showing very high frequencies of use despite the very low means.

Future directions and conclusion

The findings reported in this paper have implications for educators and educational leaders aiming to use technologies – particularly emerging technologies – with undergraduate university students. While some differences between 'generations' were apparent from the data presented in this paper (e.g. for gaming, mobile phone use and standard use of the web), many of the first-year students surveyed as part of this investigation came to university relatively unfamiliar with a range of emerging technologies and tools. And they encountered staff who were often no more or less familiar with the same technologies. So rather than university staff and students being seen on opposite sides of a digital divide, the data from this investigation show them often united in their lack of familiarity with new and emerging technologies.

For several years now academics have been encouraged to implement these new technologies in classrooms and curricula (e.g. Barnes et al. 2007). But if, as the findings in this paper suggest, the apparent popularity of these technologies in everyday life is overstated, the current level of use of emerging technologies is unlikely to drive their widespread adoption in academia. In short, it is unlikely that teaching and learning activities that are underpinned by social networking, file sharing, and user-created content will spontaneously flourish based on an established and widespread user base.

Nevertheless, scholars and researchers are arguing that there are sound educational reasons for integrating emerging technologies into learning and teaching activities (e.g. Conole et. al, 2006; McLoughlin & Lee, 2008). Given this, clear strategies need to be articulated by Universities to support staff and students with the use of emerging technologies while at the same time acknowledging the existence of small groups of advanced technology users and the often complex challenges associated with the introduction of these technologies. These challenges include, but are not limited to, issues associated with plagiarism, assessment and academic integrity, intellectual property, and the technical infrastructure required within and/or outside the university to best support these teaching and learning activities.

Academic staff may be encouraged and supported in their use of emerging technologies for teaching and learning by:

- providing evidence of how pedagogically driven implementations of emerging technologies have been shown to be effective;
- providing examples of how emerging technologies can address specific interests and concerns of different disciplinary and interdisciplinary communities of practice;
- using emerging technologies as the medium for staff professional development activities; and
- rewarding and recognising the use of emerging technologies through, for example, competitive teaching and learning grants and their acknowledgement in academic promotion policies.

Similarly, to support students' understanding and use of emerging technologies as part of their university education, strategies could include:

- giving students appropriately structured and scaffolded access to emerging technologies at university that accounts for the known diversity in students' technological backgrounds, interests and skills;
- designing learning activities that model sophisticated 'real-life' uses of emerging technologies as they are applied in the professional and scholarly communities; and
- providing appropriate fora in which students can engage meaningfully with challenges and issues associated with using emerging technologies in university and non-university based contexts (e.g. authenticity, identity, authority and copyright).

In conclusion, it seems the technology-based experiences of incoming university students and the staff who teach them do not map easily onto the dichotomy of 'Digital Native' and 'Digital Immigrant'. The

evidence presented in this study is a salutary reminder that it is dangerous to rely on educational rhetoric as a rationale for the use of new and emerging technologies in Higher Education.

Acknowledgements

Support for this project has been provided by the Australian Learning and Teaching Council, an initiative of the Australian Government Department of Education, Employment and Workplace Relations. The views expressed in this report do not necessarily reflect the views of the Australian Learning and Teaching Council Ltd. The authors would like to acknowledge the support of other members of the team associated with this project: Kerri-Lee Krause, Karl Maton, Andrea Bishop and Jenny Waycott and the assistance provided by Rita Brien in the analysis of the data presented in this paper.

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Author for correspondence: Dr Gregor Kennedy, Biomedical Multimedia Unit, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne, Parkville, 3010 Victoria, Australia. Email: gek@unimelb.edu.au

Please cite as: Kennedy, G., Dalgarno, B., Bennett, S., Judd, T., Gray, K. & Chang, R. (2008). Immigrants and natives: Investigating differences between staff and students' use of technology. In *Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008*. http://www.ascilite.org.au/conferences/melbourne08/procs/kennedy.pdf