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Digital natives: where is the evidence?

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Generational differences are seen as the cause of wide shifts in our ability to engage with technologies and the concept of the digital native has gained popularity in certain areas of policy and practice. This paper provides evidence, through the analysis of a nationally representative survey in the UK, that generation is only one of the predictors of advanced interaction with the Internet. Breadth of use, experience, gender and educational levels are also important, indeed in some cases more important than generational differences, in explaining the extent to which people can be defined as a digital native. The evidence provided suggests that it is possible for adults to become digital natives, especially in the area of learning, by acquiring skills and experience in interacting with information and communication technologies. This paper argues that we often erroneously presume a gap between educators and students and that if such a gap does exist, it is definitely possible to close it.

Introduction

There are a number of labels to describe the young people currently studying at school, college and university. They include the digital natives, the net generation, the Google generation or the millenials. All of these terms are being used to highlight the significance and importance of new technologies within the lives of young people (Gibbons, 2007). For some, new technologies have been such a defining feature in the lives of younger generations that they predict a fundamental change in the way young people communicate, socialise, create and learn. They argue that this shift has profound implications for education (e.g. Prensky, 2001a; Rainie, 2006; Gibbons, 2007; Underwood, 2007). Typically, supporters of this concept view the differences between those who are or who are not digital natives as primarily about when a person was born. This paper will critique and show new evidence against this conception of the digital native as based purely on generational differences. The paper will separate the 'doing' from the 'being', that is, it will propose a number of digital activities (doing) that indicate digital nativeness and then examine which types of people (being) are most likely to demonstrate these characteristics. The paper will show that

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breadth of use, experience, self-efficacy and education are just as, if not more, important than age in explaining how people become digital natives.

Prior to presenting the findings, it is useful to provide a brief review of the literature on this topic. The central argument to support the concept of the digital native is that young people born in the last two decades have always been surrounded by, and interacted with, new technologies. According to Prensky (2001a, 2001b), one of the more radical consequences of this technology-rich environment is a hypothesised change in the brain structure that means young people think and process information in fundamentally different ways compared to older generations. He explains, 'Digital Natives are used to receiving information really fast. They like to parallel process and multi-task. They prefer their graphics *before* their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to 'serious' work' (2001a, p. 1). Prensky defines this younger generation as the digital natives as they are all, 'native speakers of the digital language of computers, video games and the Internet' (2001a, p. 1).

Prensky refers to people who were born before this new digital era, which began around 1980, as 'Digital Immigrants'. According to him, digital immigrants may learn to use new technologies but will still be in some way located within the past, unable to fully understand the natives. Prensky likens this to the difference between learning a new language and being a native speaker. According to him, characteristics of digital immigrants include: not going to the Internet first for information; printing things out as opposed to working on screen; and reading manuals rather than working things out online. The supporters of this concept suggest that the differences between these two groups have profound implications for education. They argue that young people now have a range of different preferences, tools and ways of processing and using information that do not fit well with current educational practices. Thus, the current pedagogies employed in education need to change. For example, Prensky suggests that educators now need to communicate in a way that fits with the needs of the digital natives, i.e. 'going faster, less step-by step, more in parallel, with more random access, among other things' (2001a, p. 2). A powerful teaching method, Prensky suggests, would be to use computer games to teach the digital natives. Supporters of this view see a gap or 'digital disconnect' between students and teachers (Underwood, 2007) that is difficult to bridge. In Prensky's terms, the natives are being taught by immigrants who are, in effect, not talking the same language (Prensky, 2001a).

The use of the digital native term has become popular in public and political debate. A quick Google search using this term provides 910 hits for UK websites created in the last year (17,400 worldwide) and a Nexis search throws up 48 UK newspaper articles that used this term in the last year (114 worldwide in English language newspapers). In comparison, Web of Science only cites two and Scopus only 12 academic articles which ever mentioned this term.[1] This suggests that while the term is popular, there is not much academic research in this area.

In fact there is very little evidence that young people are radically different in the ways they use and process information (Bennet *et al.*, 2008). To justify his claims,

Prensky draws on the widely held theory of neuroplasticity, which, simply put, suggests our brains are plastic, flexible and subject to change throughout life in response to changes in the environment. Thus young people's brains have developed differently to adults as they have grown up in a world surrounded by new technologies. However, it is not yet known what differences (if any) there are in the brain structure of adults and young people who use the Internet and other new technologies. As Prensky himself admits, exactly how the brain is changing as a result of growing up with and using technology and the implications this has for cognitive processes associated with learning are still being explored by neuroscientists (Prensky, 2001b).

There is a growing body of academic research that has questioned the validity of the generational interpretation of the digital native concept. Those in support of this digital native/immigrant distinction tend to assign broad characteristics (e.g. a specific learning style, amount and type of technology use and/or set of learning preferences) to an entire generation (Bennet *et al.*, 2008) and suggest all young people are expert with technology. Yet, while the proportion of young people who use the Internet and other new technologies is higher than the older population (e.g. Dutton & Helsper, 2007; Cheong, 2008) there are significant differences in how and why young people use these new technologies and how effectively they use them (e.g. DiMaggio & Hargittai, 2001; Facer & Furlong 2001; Livingstone & Helsper, 2007; Hargittai & Hinnart, 2008). Indeed, a number of writers have highlighted the complexity and diversity of use of new technologies by young people, which tends to be ignored or minimised in many arguments in support of the digital native.

A second, equally important aspect of this debate is the extent to which the differences between digital natives and digital immigrants can be explained by generational differences. For Prensky, age seems to be the defining factor. For Tapscott (1998) who refers to the 'generation lap' (i.e. technology is the one place where young people are better than older people) a digital native is defined by exposure to, or experience with, technology. For some writers it appears it does not matter a great deal if it is age or experience that defines if someone is a digital native or part of the net generation (Oblinger & Oblinger, 2005).

However, whether the extent to which a person is a digital native is about date of birth or about a certain amount of exposure, experience or expertise with new technologies, is an important question for policy and practice. If characteristics of a digital native are determined by age, then older generations are lost and a solution to a 'digital disconnect' between adults and younger people is out of sight. However, if being tech savvy is determined by exposure and experience, then collaboration and learning is possible in environments where younger and older generations interact. The distinction between generational and experience aspects of 'digital nativeness' has been less well researched because the majority of previous studies examining young people's use of technology tend to focus on young people and their parents (e.g. studies by Facer *et al.*, 2003; Livingstone & Bober, 2005) not young people as part of the wider population. In addition, the vast majority of the evidence cited in support of the concept of the digital native is based on data from the USA. Before

educational policy makers and practitioners begin to change the educational system in the UK in response to these claims, we need more empirical evidence to inform the debate (Kennedy *et al.*, 2008).

This paper aims to add to this discussion by providing evidence on how the British population access and use the Internet and other new technologies from a nationally representative face-to-face survey (the Oxford Internet Surveys). While this cannot tell us anything about the structure of the brain or cognitive processes, these data enable us to explore and test the basic assumptions of the digital native/digital immigrant concept. An answer to this question will inform the extent to which it is possible to get teachers to 'talk the same language' as their students and add to the debate about what and how we should be educating young people, it also has implications for the current policies to support family learning, i.e. the extent to which carers and parents can support their children using new technologies in the home.

Specifically, we will untangle the different aspects of what a native is by exploring whether acting like a digital native is determined by:

1. age – the youngest generation who has grown up with technology and does not know any other context;
2. experience – those who have been on the Internet the longest, while they might not have grown up with the Internet when young, they have been 'submerged' in it for the longest period of time; or
3. breadth of use – those for whom the Internet is integrated into almost every aspect of their everyday lives independent of their age or experience.

In this paper we examine this by exploring the importance of these three variables in determining if someone is a digital native. While an exact definition of being a digital native is not often presented in the literature we define it here as someone who multi-tasks, has access to a range of new technologies, is confident in their use of technologies, uses the Internet as a first port of call for information and—given the educational focus of this article—uses the Internet for learning as well as other activities.

Methods

The data upon which this article is based are taken from the 2007 Oxford Internet Survey (OxIS), carried out by the Oxford Internet Institute (University of Oxford), which provides authoritative information on Internet use and non-use in Britain. The surveys are multistage probability sample surveys of individuals aged 14 years and older and are carried out face-to-face. The 2007 survey was conducted during March and April 2007 with 2350 respondents (a response rate of 77%) of which 1578 were Internet users. Areas covered in the survey include information about: Internet users (who uses/doesn't use the Internet and how they gain access to it); Internet uses (including e-learning, e-government, e-entertainment and e-finance); and impacts of the Internet on everyday life (including changing habits and practices, privacy concerns and attitudes to technology).

In this paper we make the distinction between those who are more and less comfortable with the Internet. We focus just on those who have some exposure to the technology and do not focus on non-Internet users or ex-users. For a more detailed discussion of non-users please see Dutton and Helsper (2007). Since young people are currently more likely to use the Internet than the elderly and retired, this influences the final sample and will be taken into consideration in the conclusions drawn in this paper.

We start this paper by carrying out descriptive analyses of age; experience and breadth of use in relation to media-richness of the household (i.e. the number of information and communication technologies [ICTs] in the household); their level of Internet self-efficacy; if someone goes to the Internet first for information; if they multi-task; and what they use the Internet for. The OxIS asks a number of questions about the kinds of activities people carry out online and from these 12 general categories of Internet uses were constructed based on an exploratory factor analysis. The following 12 types of Internet use were identified: fact checking, training, current affairs and interests, travel, finance, shopping, entertainment, social networking, diary functions, person to person networking, e-government and civic participation (see Helsper *et al.*, 2009).

As this analysis did not provide a clear answer to our question we then carried out a series of linear regressions to identify the variables that explain who has the most media-rich household; who has high levels of Internet self-efficacy; who goes to the Internet first for information; who multi-tasks; and who is more likely to use the Internet for learning. All of the 12 different types of Internet use identified from the factor analysis could arguably be seen as indicators of learning. However, there are three factors that seem most directly related to learning and education: fact checking (using the Internet to look up a definition of a word or checking a fact); training and learning (looking for jobs, distance learning for an academic degree, getting information for a school-related project, getting information for a work-related project, finding out opportunities for further study) and current affairs and interests searching (news, sports, local events, health). These three factors were chosen for the linear regression because they seem the most closely related to potential learning opportunities and thus most relevant to the focus of this paper.

Results

As noted above we explored the significance of generation, experience and breadth of use in defining a digital native. Prior to utilising these variables it is valuable to define them and examine the relationship between them.

Age is a self-explanatory variable, nevertheless since the concept of the digital native is so closely linked to generations it is important to define which generation is considered digitally native. Prensky's original definition considered those born after 1980 digitally native, but in most of the recent literature this category seems to have shifted. Arguably the rise of Web 2.0 applications might have created a second generation of digital natives, which can be separated from the first due to its familiarity and

immersion in this new, Web 2.0, digital world. The current generation of teenagers born after 1990 (currently 18 or younger) is here identified as second-generation digital natives, while the young adults born between 1983 and 1990 (currently between 18 and 25 years old) are considered the first generation of digital natives.

It is important to define what we mean by experience and breadth of use. Experience is operationalised as years of using the Internet. Breadth of use is operationalised as the number of different activities a person undertakes online. Breadth of use is calculated based on a factor analysis of all the uses of the Internet measured in OxIS (see Helsper *et al.*, 2009) and then summing all these activities into a scale from 0 to 12. Since we are looking at Internet users only, the scale runs from 1 to 12 because they undertake at least one of the 12 types of activities on the Internet. In addition, OxIS measures an individual's level of self-efficacy ('How good are you at using the Internet?') to have a subjective indicator of expertise.

Descriptive analyses of OxIS showed that breadth and self-efficacy were strongly correlated with age, but experience was not. That is, younger generations might have expertise, measured by a wide range of uses ($r = -.17$; $p < .01$), and high levels of self-efficacy ($r = -.20$; $p < .01$), but they have not necessarily spent more or fewer years using the Internet ($r = .02$; $p = .45$). The latter is important because it offers an opportunity to understand the differential effect of experience and generation on the 'digital nativeness' of an individual by comparing people of different age groups with the same number of years of experience.

Let us first look at each of these three variables more closely in relation to those factors that we earlier earmarked as indicators of digital nativeness: use of the Internet; media-richness; the importance of the Internet as an information source; and types of Internet use. That is the extent to which generation, experience or breadth of use can help us to define digital 'nativeness'.

Generation

Looking at the population as a whole, younger people were more likely to be digital natives as they have a wider variety of ICTs at home and were more likely to be Internet users (see Table 1). Interestingly the biggest drop in the proportion of Internet users was when users were over 55 years old, which means that the majority of educators and parents of younger children do use the Internet.

Table 1. Media richness and Internet use in different age groups in Britain

	Age in years						
	14–17	18–24	25–34	35–44	45–54	55–65	65+
Number of ICTs in households (scale: 0–8) * (SD)	4.27 (1.53)	3.56 (1.79)	3.27 (1.70)	3.45 (1.70)	3.15 (1.97)	2.40 (1.67)	1.52 (1.48)
Internet users (%) * (SD)	90 (.30)	86 (.35)	78 (.42)	78 (.41)	77 (.42)	57 (.50)	32 (.47)

Notes: base: all ($n = 2350$); *Differences between age groups significant at $p < .01$

Table 2. Media richness of the household, Internet prominence (first port of call), multi-tasking and self-efficacy amongst Internet users in different age groups

	Age in years						
	14–17	18–24	25–34	35–44	45–54	55–65	65+
Average number of ICTs in households (scale 0–8) *	4.45	3.77	3.62	3.83	3.51	3.11	2.49
(SD)	(1.42)	(1.75)	(1.58)	(1.59)	(1.90)	(1.62)	(1.70)
Average number of activities for which the Internet is the first port of call (scale 0–5) *	3.57	3.24	3.33	3.07	2.99	2.56	1.99
(SD)	(1.57)	(1.77)	(1.66)	(1.78)	(1.83)	(1.85)	(1.66)
Internet first for school/work information (%) *	80	72	77	76	71	57	54
(SD)	(.40)	(.45)	(.42)	(.43)	(.46)	(.50)	(.50)
Multi-tasking* (%)	87	74	75	64	52	51	43
(SD)	(.34)	(.44)	(.43)	(.48)	(.50)	(.50)	(.50)
Self-efficacy (good or excellent skills) (%) *	82	76	72	65	49	45	47
(SD)	(.39)	(.43)	(.45)	(.48)	(.50)	(.50)	(.50)

Notes: base: all Internet users (n = 1578); * differences between age groups significant at $p < .01$

Table 2 shows that younger age groups can indeed be qualified as digital natives in terms of the prominence that ICTs and the Internet have in their lives. The youngest Internet users (second-generation digital natives) lived in households with the widest variety of ICTs and they used the Internet as a first port of call for the widest range of activities in comparison to almost all other generations. They also multi-tasked significantly more and referred to the Internet more than others for information for school and work. For most indicators of digital nativeness there was a linear decline with age and a clear drop in the 44–54 or 55–64 year age groups.

Table 3 provides an overview of what different age groups used the Internet for. Not surprisingly the teenage group was least likely to manage their finances online or use e-government. Younger people, when they did use the Internet, were also less likely to use the Internet for civic participation and this corresponds to what we know about offline behaviour. Younger people were more likely to use the Internet for entertainment, social networking and diary functions. In terms of the three activity types most closely related to learning, young people were more likely to use the Internet for fact checking (definitions of words and checking facts) and training (looking for jobs, e-learning, online courses). For current affairs and interests the differences between age groups were not significant. The linear decline by age in relation to the types of activities people engage with was less clear than when we looked at other indicators of digital nativeness. Although entertainment and social networking activities dropped steeply for those who were neither first- nor second-generation digital natives (14–25-year-olds), for other activities related to applications for which some economical capital is necessary (shopping, investment and travel) first generation

Table 3. Percentage of Internet users who undertook different types of Internet use (in the last year) in different age groups

	Age in years						
	14–17	18–24	25–34	35–44	45–54	55–65	65+
Entertainment ** (%)	100	93	92	85	79	67	68
Training ** (%)	94	87	83	80	77	62	53
Fact checking ** (%)	92	84	86	84	82	76	69
Current affairs/interests (%)	85	90	92	93	91	86	81
Person-to-person networking ** (%)	84	84	87	83	73	74	71
Shopping ** (%)	81	94	94	95	93	92	85
Social networking ** (%)	70	64	49	47	37	35	32
Travel ** (%)	55	83	95	93	90	87	77
Diary functions ** (%)	50	40	32	27	26	22	18
E-government ** (%)	25	37	50	58	48	44	41
Finance ** (%)	16	47	68	71	60	58	45
Civic participation * (%)	3	7	11	5	11	13	12
n	85	211	318	343	295	172	153

Notes: base: all Internet users ($n = 1578$); * differences between age groups significant at $p < .05$; ** differences between age groups significant at $p < .01$

digital natives (18–25-year-olds) were, not surprisingly, more likely than second generation digital natives (14–17-year-olds) to participate.

Experience

Experience was also an important variable in relation to 'digital nativeness'. In general there was an increase in household media-richness ($r = .22$; $p < .01$), the importance of the Internet ($r = .29$; $p < .01$), multi-tasking ($r = .20$; $p < .01$) and Internet self-efficacy ($r = .38$; $p < .01$) with an increase of experience. Thus those who had experienced the Internet for longer periods of time were more digitally native. Nevertheless, it is interesting to note that the most recent users (less than six months of use) showed higher levels of self-efficacy (51% good or excellent skills), media richness (av = 2.78) and importance of the Internet (av = 2.10) than those who had used the Internet for six months to one year (28% good or excellent skills; av = 2.59 media-richness; av = 1.99 Internet as first port of call).

The difference was especially large for self-efficacy. We could call this the 'honeymoon' period in which the new user tries everything out and feels like the world is at their feet, after a few months (half a year) their enthusiasm dies down and they realise that there are many things they cannot do.

In contrast to what was found for generational groups (see Table 3), all differences between experience groups were significant (see Table 4). Almost always it was those with the most experience, that is having used the Internet for more than five years, who used the Internet the most, independent of the activity observed. There were a

Table 4. Percentage of Internet users who undertook different types of Internet use (in the last year) in groups with different years of Internet use experience

	Years of experience in using the Internet				
	< 6 months	6 months to 1 yr	1 yr to 2 yrs	2 yrs to 5 yrs	> 5 yrs
Current affairs/interests * (%)	81	76	90	87	95
Entertainment * (%)	79	67	76	84	89
Shopping * (%)	76	87	93	90	97
Travel * (%)	70	73	87	85	94
Fact checking * (%)	68	69	79	81	88
Person-to-person networking * (%)	64	55	71	78	90
Training * (%)	64	62	64	75	87
Finance * (%)	36	34	47	54	72
Social networking * (%)	30	27	30	40	63
E-government * (%)	27	24	33	41	62
Diary functions * (%)	17	12	19	25	41
Civic participation * (%)	4	5	5	5	15
n	85	98	171	568	635

Notes: base: all Internet users (n = 1,578); * differences between age groups significant at $p < .01$

few exceptions, for instance, entertainment, which is the activity novice users undertook more than the intermediate users. Current affairs and interests and person-to-person networking also showed a slight dip for those who had used the Internet between six months and one year in comparison to those who had used it less than that. For many other activities, including the three learning-related activities (i.e. fact checking, training and learning and current affairs and interests) use showed a large increase for those individuals who had used the Internet for more than one year.

Breadth of use

The sum of all the Internet uses discussed in the previous sections can be called the breadth of use, and the higher the number of different activities a person undertakes the more the Internet is integrated into the person's everyday life.

The increase in digital nativeness was exponential in relation to breadth of use. Not only were those with a narrow use less likely to multi-task (r = .40; $p < .01$), they were also less likely to use the Internet as a first port of call (r = .45; $p < .01$) and had far lower levels of Internet self-efficacy (r = .49; $p < .01$). In addition, they had a smaller variety of ICTs in their households (r = .37; $p < .01$).

To understand how this type of expertise, or embededness in the Internet, is related to specific uses of the Internet we grouped the number of different activities a person undertook based on quintiles of Internet users. That is, we constructed five almost equal-sized groups of Internet users with different levels of breadth of use.

Table 5. Percentage of Internet users who undertook different types of Internet use (in the last year) in groups with different breadths of activity

	Number of activities undertaken in total				
	1 or 2	3 to 6	7 or 8	9	10 to 12
Shopping * (%)	56	81	95	99	100
Travel * (%)	33	73	91	96	99
Current affairs/interests * (%)	21	75	96	99	100
Training * (%)	17	47	82	91	98
Entertainment * (%)	17	58	91	98	99
Person-to-person network * (%)	16	44	89	97	99
Fact checking * (%)	12	62	84	96	98
E-government * (%)	5	14	33	60	86
Civic participation * (%)	4	1	3	6	24
Social network * (%)	3	11	32	55	92
Finance * (%)	2	23	52	71	94
Diary * (%)	0	4	13	34	68
n	60	356	458	253	441

Notes: base: all Internet users (n = 1,578); * differences between age groups significant at $p < .01$

Similar to what we found for experience groups, all differences between breadth of use groups were significant (see Table 5). There was a pattern in the order in which people began to use the Internet for different purposes. The most popular activities for people who only used the Internet for one or two things tended to be shopping and travel, then, as the range of use increased, Internet users were more likely to use the Internet for current affairs, training, entertainment, person-to-person networking and fact checking. Using the Internet for social networking, finance and diary functions were activities that were more likely to be undertaken by those who use the Internet for 10–12 activities than by those who undertake less than 10 activities.

Generation, experience and breadth of use

Thus, the descriptives do not give straightforward answers to the question of what determines digital nativeness; age, experience and breadth of use all seem important. Only by looking at their independent effect can we sort out which factors really determine who shows the characteristics of a digital native. Below we examine the importance of these three variables alongside gender, whether or not there are children in the household and level of education, in explaining: (1) being surrounded by all kinds of different technologies; (2) using the Internet as a first port of call for information; (3) multi-tasking; (4) self-efficacy; and (5) using the Internet for the three types of learning activities that are the focus here (fact checking, training and learning and current affairs and interests).

Generation, experience and breadth of use were all significantly and independently related to the media-richness of the household (see Table 6a). Younger people, those who had used the Internet for longer and those who had integrated the Internet into

Table 6. Linear regression of media richness of the household and Internet prominence (first port of call)

	Media richness[a]			First port of call[b]		
	b	β	*p*	*b*	β	*p*
(Constant)	2.09		**	1.34		**
Generation	–0.01	–0.12	**	–0.02	–0.14	**
Experience	0.04	0.09	**	0.05	0.09	**
Breadth of use	0.21	0.31	**	0.27	0.38	**
Gender (female)	–0.15	–0.04	0.06	–0.19	–0.05	*
Children	0.90	0.26	**	0.05	0.01	0.54
Education	–0.12	–0.06	*	0.01	0.00	0.88
$R^{2=}$		0.24			0.23	

Notes: base: all Internet users (n = 1578); [a] number of ICTs in the household; [b] the number of activities for which a person would use the Internet first; * significant at $p < .05$; ** significant at $p < .01$

a wider variety of activities had more different ICTs in the household. In addition, the presence of children in the household and high levels of educational achievement were strongly related to the variety of technologies one had access to at home. Breadth of use and the presence of children in the household had a larger relative impact (based on standardised coefficients) on the media-richness of the household than the age of the person.

Generation, experience and breadth of use were all important predictors of using the Internet as a first port of call as a benchmark for digital natives (see Table 6b). In contrast to the media-richness of the household, children and the level of education were not significantly related to using the Internet as a first port of call. However, women were significantly less likely than men to use the Internet as the first port of call. The strongest predictor of using the Internet as the first port of call was the breadth of a person's Internet use.

Similar to what was shown for media-richness and using the Internet as a first port of call, generation, experience and breadth of use were also good predictors for digital nativeness when multi-tasking was taken as the ultimate indicator of this type of person (see Table 7a). Similar to Internet use as a first port of call, level of education and having children did not influence the extent to which a person multi-tasked.

The importance of self-efficacy in relation to positive learning outcomes has been clear in offline learning. Similarly, the extent to which people report that their ability to use the Internet is poor, fair, good or excellent is a good predictor of Internet use and positive attitudes towards using the Internet as a source for information (see also Eastin & LaRose, 2000). However, it is not clear whether Internet self-efficacy itself is best explained by generation, experience and/or breadth of use. Table 7b shows that generation, but also experience and breadth of use as well as level of education were important in relation to how confident people were in their own Internet skills.

Table 7. Linear regression of multitasking and self-efficacy

	Multitasking [a]			Self-efficacy [b]		
	b	β	*p*	*b*	β	*p*
(Constant)	0.37		**	2.08		**
Generation	–0.01	–0.20	**	–0.10	–0.14	**
Experience	0.03	0.13	**	0.17	0.24	**
Breadth of use	0.08	0.28	**	0.13	0.32	**
Gender (female)	–0.09	–0.07	**	–0.08	–0.05	0.05
Children	0.03	0.02	0.40	–0.06	–0.04	0.12
Education	0.04	0.05	0.07	0.16	0.16	**
$R^{2=}$		0.21			0.34	

Notes: base: all Internet users (n = 1578), [a] how often the respondent does other things while using the Internet; [b] how good the respondent thinks they are at using the Internet; * significant at $p < .05$; ** significant at $p < .01$

Different indicators predict the three types of learning activities (fact checking, training and learning and current affairs) (see Table 8). For fact checking, breadth of use was proportionately the most important variable, generation and level of education were also significant predictors. In other words those who used the Internet for more purposes, were younger and had a higher level of education were more likely to use the Internet for fact checking. Breadth of use was also very important for training and learning. In addition, this type of Internet activity was more likely to be undertaken by those with more education, those who were younger, those who considered themselves more expert at using technologies and women. For current affairs, breadth of use was again important, along with generation and gender. Men and older generations were more likely to use the Internet to keep up with current affairs.

Table 8. Linear regressions of formal and informal online learning opportunities

	Fact checking			Training and learning			Current affairs		
	b	β	*p.*	*b*	β	*p.*	*b*	β	*p.*
(Constant)	0.04		0.72	–0.97		**	0.02		0.94
Generation	–0.04	–0.06	*	–0.20	–0.16	**	0.05	0.05	*
Gender (female)	0.04	0.03	0.29	0.14	0.04	*	–0.18	–0.07	**
Experience	0.02	0.03	0.23	0.03	0.02	0.41	–0.02	–0.02	0.40
Breadth of use	0.16	0.40	**	0.29	0.36	**	0.32	0.48	**
Self-efficacy	0.03	0.04	0.21	0.15	0.08	**	0.06	0.04	0.14
Children	–0.02	–0.01	0.67	0.10	0.03	0.20	0.02	0.01	0.71
Education	0.05	0.05	*	0.31	0.16	**	0.05	0.03	0.26
$R^{2=}$		0.22			0.30			0.26	

Notes: base: all Internet users (n = 1578); The linear regressions were based on the factor scores for each of these activities; * significant at $p < .05$; ** significant at $p < .01$

Experience (years) with using the Internet was not significant for any of the learning activities nor was the presence of children in the household.

Discussion

In this paper we have examined the extent to which generation, experience in using the Internet and breadth of use are good indicators of whether someone is a digital native or not. For the purposes of this paper a digital native has been defined as someone who comes from a media-rich household, who uses the Internet as a first port of call for information, multi-tasks using ICTs and uses the Internet to carry out a range of activities particularly those with a focus on learning.

Contrary to the argument put forward by proponents of the digital native concept, generation alone does not adequately define if someone is a digital native or not. From the analysis above it is clear that there are a range of factors involved. It appears that younger people do have a greater range of ICTs in their household, tend to use the Internet as a first port of call, have higher levels of Internet self-efficacy, multi-task more and use the Internet for fact checking and formal learning activities. Nevertheless, generation was not the only significant variable in explaining these activities: gender, education, experience and breadth of use also play a part. Indeed, in all cases immersion in a digital environment (i.e. the breadth of activities that people carry out online) tends to be the most important variable in predicting if someone is a digital native in the way they interact with the technology.

In some respects these findings do support the arguments put forward by Prensky and others. A larger proportion of young people use the Internet, they are more likely to come from media-rich homes, are more confident about their skills and are more likely to engage in online learning activities. What implications this has for young people's brain structures remains an open question. Nevertheless, what is very clear is that it is not helpful to define digital natives and immigrants as two distinct, dichotomous generations. While there were differences in how generations engaged with the Internet, there were similarities across generations as well, mainly based on how much experience people have with using technologies. In addition, the findings presented here confirm that individuals' Internet use lies along a continuum of engagement instead of being a dichotomous divide between users and non-users (see also Warschauer, 2002; Van Dijk, 2005).

This conclusion supports other research that has demonstrated that there are significant differences within cohorts of young people in terms of their preferences, skills and use of new technologies (e.g. Kennedy *et al.*, 2008). As Facer and Furlong (2001) argue, young people are not, a 'homogeneous generation of digital children' (p. 467). This work adds to existing research by showing that a generational distinction between natives and immigrants, us and them, is not reflected in empirical data. Therefore, the distinction is not helpful and could even be harmful. For example, the inequalities in use and breadth of use within younger generations could be exacerbated as teachers assume a level of knowledge in school lessons that may not be accurate for all students (Facer & Furlong, 2001); and teachers and parents do not

help young people in this area as they feel powerless in trying to support them in their uses of the Internet and other new technologies (Cheong, 2008; Helsper, 2008b).

So, if generation is not the only defining characteristic of a digital native, what implications does this analysis have for education policy and practice? In terms of formal education there seem to be two key messages. Firstly, it seems that adults, specifically teachers, can 'speak the same language' as their students if they want to. Younger people are more likely to have a wider variety of ICTs at home, use the Internet as a first port of call for information, multi-task and use the Internet first for school/work information but many adults do as well. Tables 1–3 suggest that the biggest drop off in these activities in terms of generation appears after the age of 55—much later than supporters of the digital native concept would have us believe and older than many educators.

Of course, some supporters of the digital native or net generation concept would agree that older people can learn to use technologies. For, example Tapscott (1998) draws on the work of Piaget to explain that learning to use technology is an assimilative process for young people who have always experienced technology as a part of their everyday lives. However, for older people where new technologies have been introduced at some stage in their lifetime it is an accommodative (thus more difficult) process (Tapscott, 1998). Whether this is true or not cannot be gleaned from our data, but the findings do suggest that older generations have accommodated ICTs to a great extent and in quite a few instances to the same level as younger people.

Secondly, these data help to add to the debate in terms of what or how we teach young people in schools. While it is important to understand what young people are using new technologies for in debates about future developments in pedagogy and curriculum; we cannot assume that just because young people do more of something it is always a good thing. For example, the analysis here supports the view that young people multi-task more. However, we do not know if this is a positive or negative aspect of young people's use of new technology. Multi-tasking may have a negative impact on learning due to cognitive overload (Hembrooke & Gay, 2003). Similarly, while young people are more likely to use the Internet as a first port of call for information this does not mean they are in fact skilled in dealing with and critically assessing information (Livingstone, 2008). Finally, while not the focus of this paper, there may not be much demand from young people for school to change as technology may well play very different roles in a student's life in and out of school (Bennet *et al.*, 2008).

These data also have implications for supporting informal and family learning which are important policy areas in the UK (BECTA, 2008). It could be argued that there are potential learning benefits in many online activities from playing collaborative games to chatting in a forum. However, while in general in the policy literature access and use of the Internet is a 'good thing', there is very little debate about the kinds of learning activities we want people to carry out online or indeed if any activities are seen as more 'beneficial' for learning than others. Other studies with a broader focus on different digital cultures and home socialisation in relation to technologies argue that the impact of home interaction with the Internet on formal education cannot and

should not be ignored because they influence what young people are able and willing to learn in school (Helsper, 2009). Questions that educators need to ask themselves are, for example, 'are we only interested in supporting formal learning activities or are we satisfied if people just focus on playing online games, further developing skills they acquired in informal contexts?' In some ways this analysis helps to address this question. The analysis has shown that immersion in the technology (i.e. breadth of online activities) is an important factor (although not the only factor) in understanding whether people are confident in their ICT skills and whether they use the Internet for the three learning activities classified here. Thus, perhaps policy makers should be developing initiatives that encourage broad use of technologies as opposed to focusing on one or two narrow activities. We speculatively conclude that immersion in ICTs or, perhaps more accurately, the integration of ICTs in many aspects of a person's life, is likely to lead to the uptake of digital learning opportunities and that Internet users are unlikely to ignore these learning activities if they otherwise use technologies in a broad fashion.

In terms of family learning, there are also some interesting implications. Having children in the household is a significant variable in the media-richness of the household. Thus, it could be argued that older generations might acquire the technology because they think it will benefit their children (Venkatesh & Vitalari, 1987, 1992; Van Rompaey *et al.*, 2002). This obviously has positive implications for learning. However, interestingly, based on the analysis here, the presence of children in the household does not influence parents' use of the Internet for their own learning activities. Parents have an important role to play in supporting their own children's use of technology and our research shows know that generational gaps are far from insurmountable. Nevertheless, we still need to explore and better understand the link between children's use of technology, technology in the home and family learning.

Finally, our analysis has demonstrated the continuing importance of socio-demographic variables. Specifically, education and gender. The stronger a person's educational background the more likely they are to feel confident in their ICT skills and use the Internet for learning activities, specifically fact checking and training and learning. Our analysis has also shown that gender is important. It is important that these issues of social inclusion and exclusion are not ignored in debates around the idea of the digital native (Facer & Furlong, 2001; Cheong, 2008; Helsper, 2008a).

Conclusion

Although young people do use the Internet more, our analysis does not support the view that there are unbridgeable differences between those who can be classified as digital natives or digital immigrants based on when they were born.

This is important because the term digital native, net generation and other catchy terms are being used widely in public and political debate. The acceptance of these generalisations is especially problematic in a context where the Joint Information Systems Committee (JISC), BECTA and others are investing significantly in research programmes that aim to explore and better understand learners' experiences of using

technologies. More importantly, the frequent uncritical use of these and similar terms, even if the term is used without accepting the underlying assumptions, could have a negative impact upon the perceived possibilities of teacher–student interaction.

Proponents of a generational definition of concepts such as that of the digital native arguably support a view of society as a new era that is fundamentally different and signals a break with previous times (Stevenson, 2002), where technology is a key driver of this change (Webster, 2002). Yet these data indicate that the opposite is true—that contemporary society is a continuation of the past and technology, while important, is not the only determining factor in our lives. There can be a tendency within educational policy to see technology as the 'fix' or 'solution' to many of the challenges the sector faces (Robins & Webster, 1989) and there is a danger that the current popularity of statements about young 'techy' generations could increase the prominence of this deterministic view. To counter such claims, the publication and discussion of empirical work on the realities of how younger and older generations learn through, and engage with, technology is needed. This study and other research, such as that by Facer and Furlong (2001), Bennet *et al.* (2008) and Cheong (2008), are steps in the right direction but further research and greater awareness amongst parents and practitioners is necessary.

While survey data go some way to understanding these issues, more qualitative work could also be beneficial to explore the dynamics of family learning, what people actually do when they are online, how learning can take place and the importance of cognitive and neurological development. Reporting of use of the Internet is not the same as understanding the learning that may take place as a result of this use. In particular, we lack studies that discuss household member and peer interactions, for example in relation to proxy use, as regards the use of and learning from ICTs. Such research is vital in order to refine and advance existing theories of learning using new technologies.

Prensky, Oblinger and Oblinger and others are right—we need to understand learners in order to teach them well. We are not saying education should not change, but debates about change must be based on empirical evidence and not rhetoric.

Note

1. All searches performed March 2009 using the 'digital native' search term.

References

BECTA (2008) *Harnessing technology: next generation learning 2008–2014.* Available online at: http://publications.becta.org.uk/display.cfm?resID=37348 (accessed 17 December 2008).

Bennett, S., Maton, K. & Kervin, L. (2008) The 'digital natives' debate: a critical review of the evidence, *British Journal of Educational Technology,* 39(5), 775–786.

Cheong, P. H. (2008) The young and the techless? Investigating Internet use and problem-solving behaviors of young adults in Singapore, *New Media and Society,* 10(5), 771–791.

DiMaggio, P. & Hargittai, E. (2001) *From the digital divide to digital inequality: studying Internet use as penetration increases.* Working Paper Series (15) Princeton University, Center for Arts and Cultural Policy Studies. Available online at: http://www.princeton.edu/culturalpolicy/workpap/WP15%20-%20DiMaggio+Hargittai.pdf (accessed 31 March 2008).

Dutton, W. H. & Helsper, E. J. (2007) *The Internet in Britain: 2007.* Oxford: Oxford Internet Institute, University of Oxford. Available online at: http://www.oii.ox.ac.uk/microsites/oxis/ (accessed 31 March 2008).

Eastin, M. S. & LaRose, R. (2000) Internet self-efficacy and the psychology of the digital divide, *Journal of Computer-Mediated Communication,* 6. Available online at: http://www.ascusc.org/jcmc/vol6/issue1/eastin.html (accessed March 2009).

Facer, K. & Furlong, R. (2001) Beyond the myth of the 'Cyberkid': young people at the margins of the information revolution, *Journal of Youth Studies,* 4(4), 451–469.

Facer, K., Furlong, J., Furlong, R. & Sutherland, R. (2003) *Screenplay: children and computing in the home* (London, RoutledgeFalmer).

Gibbons, S. (2007) *Redefining the roles of information professionals in higher education to engage the net generation.* Paper presented at EDUCAUSE, Australasia. Available online at: http://www.caudit.edu.au/educauseaustralasia07/authors_papers/Gibbons2.pdf (accessed 31 March 2008).

Hargittai, E. & Hinnart, A. (2008) Digital inequality: differences in young adults use of the Internet, *Communication Research,* 35(5), 602–621.

Helsper, E. J. (2008a). *Digital inclusion: an analysis of social disadvantage and the information society* (London, Communities and Local Government).

Helsper, E. J. (2008b). *Digital natives and ostrich tactics? The possible implications of labelling young people as digital experts* (London, Futurelab).

Helsper, E. J. (2009). Digital literacies: different cultures different definitions, in: H. Drenoyianni (Ed.), *Proceedings international conference on digital literacy* (Oxford, Peter Lang).

Helsper, E. J., Dutton, W. H. & Gerber, M. (2009). *To be a network society: a cross-national perspective on the Internet in Britain. OII Research Report, No 7.* Available online at: http://www.oii.ox.ac.uk/microsites/oxis/publications (accessed 23 January 2009).

Hembrooke, H. & Gay, G. (2003) The laptop and the lecture: the effects of multitasking in learning environments, *Journal of Computing in Higher Education,* 15(1), 46–64.

Kennedy, G., Judd, T., Churchward, A., Gray, K. & Krause, K. (2008) First-year students' experiences with technology: are they really digital natives? *Australasian Journal of Educational Technology,* 24(1), 108–122.

Livingstone, S. (2008) Taking risky opportunities in youthful content creation: teenagers' use of social networking sites for intimacy, privacy and self-expression, *New Media & Society,* 10(3), 393–411.

Livingstone, S. & Bober, M. (2005). *UK children go online: final report.* Available online at: http://www.lse.ac.uk/collections/children-go-online/UKCGO_Final_report.pdf (accessed 31 March 2008).

Livingstone, S. & Helsper, E. (2007) Gradations in digital inclusion: children, young people and the digital divide, *New Media & Society,* 9, 671–696.

Oblinger, D. & Oblinger, J. (2005) *Educating the net generation.* Available online at: http://www.educause.edu/educatingthenetgen/ (accessed 31 March 2008).

Prensky, M. (2001a) Digital natives, digital immigrants. Part 1, *On the Horizon,* 9(5), 1–6.

Prensky, M. (2001b) Digital natives, digital immigrants. Part 2: do they really think differently? *On the Horizon,* 9(6), 1–6.

Rainie, L. (2006) *Life online: teens and technology and the world to come.* Available online at: http://www.pewInternet.org/ppt/Teens%20and%20technology.pdf (accessed 31 March 2008).

Robins, K. & Webster, F. (1989) *The technical fix: education, computers, and industry* (Basingstoke, Macmillan).

Stevenson, N. (2002) *Understanding media cultures: social theory and mass communication* (2nd edn) (London, Sage).

Tapscott, D. (1998) *Growing up digital: the rise of the net generation.* (New York, McGraw-Hill).

Underwood, J. (2007) Rethinking the digital divide: impacts on student tutor relationships, *European Journal of Education,* 42(2), 213–222.

Van Dijk, J. A. G. M. (2005) *The deepening divide: inequality in the information society* (Thousand Oaks, Sage).

Van Rompaey, V., Roe, K. & Struys, K. (2002) Children's influence on Internet access at home: adoption and use in the family context, *Information, Communication & Society,* 5(2), 189–206.

Venkatesh, A. & Vitalari, N. (1987) A post-adoption analysis of computing in the home, *Journal of Economic Psychology,* 8(2), 161–180.

Venkatesh, A. & Vitalari, N. (1992) An emerging distributed work arrangement: an investigation of computer-based supplemental work at home, *Management Science,* 38(12), 1687–1706.

Warschauer, M. (2002) Reconceptualizing the digital divide. *First Monday,* 7, 7.

Webster, F. (2002) *Theories of the information society* (2nd ed) (London, Routledge).