Developing digital fluency through ubiquitous mobile devices: Findings from a small-scale study

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ABSTRACT

As part of the Visual Learning Lab's initiative of promoting visual learning supported through technologies in Higher Education, this VLL funded study explored part-time mature doctoral students' use and perceptions of a mobile device in support of their research activities. The study was conducted by the Graduate School in collaboration with the School of Nursing at the University of Nottingham. Six students participated in the study for a period of six months. The methodology was qualitative and included semi-structured exit interviews. By re-analysing the original study (Gibbons, 2009), this paper raises a vital question about what constitutes a meaningful mobile learning experience which takes into account the different biographical and life stage factors. It challenges the ongoing debate on generational issues on uses of mobile or other digital technologies and leads to discussion of the concept of digital fluency with all learners.

1. Introduction

Based on a small-scale study, we argue in this paper for the need to recognise the learner's complex relationship with mobile devices and hence develop our understanding of the notion of digital fluency when conducting research into mobile learning. Our argument is that mobile learning can be relevant to all learners without generational barriers. It indicates the value of 'digital fluency' as a means to describe user interaction with technology in general.

Ubiquitous and networked mobile devices such as 3G mobile phones, PDAs and pocket PCs are increasingly used for educational purposes and in educational settings. Multi-functional applications, advanced hardware and network technology offer new possibilities for supporting new ways of learning, collaborating and communicating. Learning through mobile devices is often described as 'm-learning'. However, 'm-learning' is not just about using or learning to use a mobile tool. According to Sharples, Taylor, and Vavoula (2007), apart from taking account of user engagement with mobile technology, conceptualising 'm-learning' firstly starts from the assumption that learners are continually on the move, from one space to another, from topic to topic. Secondly, it embraces the considerable learning that takes place outside a formal learning environment, such as offices, classroom. Thirdly, it is an active process of building knowledge and skills through practice within a supportive group or community.

M-learning has been taken into account as an innovative practice and the benefits of mobile devices have been well documented in the literature. The most obvious benefits can be described as its ubiquity, flexibility, interactivity, multi-functionality and nonlinearity (Kress & Pachler, 2007). Numerous studies across disciplines have explored the impact of using mobile technologies on education. Rege and Keane (2003) list the key benefits of embracing mobile technology as a new tool in medical education as enhancing patient encounters and improving course evaluation management. On reporting the outcomes of using PDA phones on Geography Information Science (GIS) in three Dutch universities, Wentzel, Lammeren, Molendijk, Bruin, and Wagtendonk (2005) demonstrate that the mobile devices implemented have positive impacts on both students and teachers. Their study concludes that the mobility dimension changes the relevance of the educational materials, students' attention span, the focus of their education effort, and their attitude balance towards reading, experimenting, interacting and communicating.

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As well as recognising the significant contribution of mobile technologies in education, there is some concern that the transformation of communication and interaction does not live up to its promises and expectations when it comes to schools and universities (e.g., Norris, Soloway, & Sullivan, 2002; Tatar, Roschelle, Vahey, & Penuel, 2003). Other concerns highlighted by researchers are related to developmental issues such as the issue that SMS texting could be harmful to a young learner's grammatical development (e.g., Attewell, 2003); support-related issues such as the need for more comprehensive training and access to technical support for teaching staff (e.g., Perry, 2003); technical issues such as having problems with limited memory of the mobile device (e.g., Corlett, Sharples, Bull, & Chan, 2005); ownership issues such as limited or difficult access to the required hardware (e.g., Wager, 2005; Gomez, 2007) and security and privacy issues (e.g., Ugray, 2009).

It is apparent that defining usage patterns and new relationships amongst learners, individual devices, information and society as a whole has generated a great interest from educators, researchers and technology developers. We suggest that one key concept to be taken into account is 'digital fluency'. In her report on studying digital youth, Hsi (2007) argues that unlike the definitions of 'computer literacy' or 'technological fluency' that are typically "associated with mastering computer productivity skills, manipulation of electronic data and applications, and assessment of those skills for workforce preparation purposes" (2007: 1513), the meaning of 'digital fluency' extends the prior information technology fluency framework to frame fluency as "constructing new representational practices, design sensibilities, ownership, and strategic expertise gained, taking a practice-oriented perspective rather than a data, information, or knowledge-centred perspective" (2007: 1513). Resnick (2001) also differentiates between people who are fluent in the technology and those who just 'look up information on the web, use a word processor, and send e-email' (2001: 48). He uses the analogy of learning a foreign language to articulate the meaning of 'digital fluency'. According to him, in order to be truly fluent in a foreign language, one must be able to articulate a complex idea or tell an engaging story. Similarly, being digitally fluent involves not only knowledge of how to use digital technologies, but also knowing how to construct ideas of significance with digital technology. However, whilst digital technology is becoming easier and cheaper for people everywhere to gain access t0, the risk of a 'fluency gap' could remain unchanged as only a small number will be able to use the technology fluently (Resnick, 2001).

There are also generational issues relating to different perceptions and attitudes towards the use of mobile technologies by different age groups (e.g., Kineo & UFI/Learndirect, 2009; Sharples et al., 2007). More specifically in education, how mobile devices can be designed and used to engage young learners' attention and empower their learning have been the key foci of major research projects (e.g., Hsi, 2007; Lee, Luchini, Michael, Norris, & Soloway, 2004; Maag, 2006; Mitchell & Doherty, 2003; Rogers et al, 2002). However, research into mature learners' perceptions and experiences on accessing mobile technologies is limited. In addition, there is a general concern relating to conceptualising m-learning. Much of the research into the use of mobile technologies for learning is driven by the technical capabilities of new devices. Although research shows that the new capabilities inspire new practices which can lead to valuable outcomes, application of theory to the use of these technologies for educational purposes is lacking (Naismith, Lonsdale, Vavoula, & Sharples, 2004). More comprehensive work into this area is needed to inform design and implemental strategies for m-learning. This paper starts to address this gap in research based on one initial study described in more detail in the following section. The notion of digital fluency is elaborated from the data to form the main argument presented in this paper.

2. The study

This paper reports on a small-scale learning project conducted in 2007/8, which was funded by the University of Nottingham's Visual Learning Lab (VLL) Centre for Excellence in Teaching and Learning (CETL). The VLL is one of 74 Higher Education Council for England (HEFCE) funded Centres for Excellence in Teaching and Learning (CETL). The overall aim of the VLL is to promote visual learning supported through technologies in Higher Education. This paper further builds on an initial analysis of findings using the original project data and relevant literature in order to discuss the perceptions and uses of a mobile device by a group of mature part-time learners. Note that technical evaluation of the device itself was not the main aim of either this paper or the original study.

2.1. Context of the study

The main aim of the original study (Gibbons, 2009) was to give immediate access to mobile visual technologies, in this case a Personal Digital Assistant (PDA) phone for postgraduate research students and at the same time explore the presumed benefits of mobile learning for this or other postgraduate groups. Using Sharples et al.'s (2007) concept of m-learning, we describe this study as a small-scale m-learning project. The background and characteristics of the participants, their experience of using the mobile device and the subsequent impact on their learning and professional practice will be discussed throughout the paper. This development study was undertaken, with the agreement of the School of Nursing at the University of Nottingham, by a Graduate School member (one of the authors, CG) who provides research training and development activities for researchers and research students. The context of the study can therefore be described as educational development; providing a step change in available technology for this group of students and the Graduate School teaching and learning practitioners. This particular cohort was chosen for strategic development reasons with an anticipated outcome of general upskilling in technology for those involved. The major research purpose was to explore whether the mobile device would have time management and learning benefits for doctoral students. The details provided in Section 2.1–2.3 have been described previously in Gibbons (2009).

2.2. Participants

Six doctoral research students, 3 female and 3 male, from the School of Nursing participated in the study for a period of six months. All of them were full-time nursing lecturers who were registered part-time for doctoral studies. They were all supervised centrally for their doctorates, but worked at one of the many satellite locations of the School or at another regional university. The main characteristics of the participants can be summarised as follows:

- Mature learners
- Professionals in the subject discipline of nursing
- Off-campus part-time doctoral students
- Have intensive work demands and personal/family commitments

2.3. The equipment

Each participant was given an HTC TyTN Mobile Pocket PC smartphone with charger. In this paper, we refer to it as a PDA phone. The decision was made based on two main criteria: firstly, the device must support Microsoft functions; and secondly, it has to be PC based as the university Information System (IS) did not support AppleMac or Blackberry at that time. The chosen HTC phone is an Internet-enabled Windows PDA phone with camera and video capability. It has a touchscreen with a left-side slide-out keyboard. In addition to its camera phone function, participants had also access to Windows Mobile versions of Microsoft Word, Excel, Outlook, Internet Explorer, portable Media Player, e-mail, and instant messaging. It was suggested that participants transfer their own mobile phone SIM card to the PDA phone, thereby encouraging them to use a range of functions and not have the inconvenience of having different numbers. The connection types of each individual were therefore different. No concerns were expressed throughout the study over the phone SIM card. Although the participants needed to pay for their own phone calls, the connectivity to the University's WiFi system for the download and storage of material is free and does not involve any costs for them. The device also allows direct communication for the user via email and Blackboard WebCT discussion groups which it was anticipated would aid data collection and monitoring of the study. The participants were encouraged and supported by staff from the Graduate School to use the PDA phone for their professional, teaching and research activities through a web-based Blackboard learning discussion forum, and in an online asynchronous conference which was called *virtual research café*.

2.4. Methodology

A project working group (which included one of the study participants) was convened to develop appropriate supportive activities as the study progressed, thus the approach was driven by the immediate expressed needs of the cohort and the teaching and learning practitioners involved. The epistemological precepts which guided the study development were qualitative (Gibbons, 2009) and the methodology can be best described as phenomenological interpretivism (Denzin & Lincoln, 2000; Gubrium & Holstein, 2000). The subjective experiences and meanings given by the participants are therefore understood to give valued insight into social phenomena from which the participants (including any researchers) cannot be separated. In addition to other data collected throughout the study (e.g., the bi-monthly working group meeting notes and small online questionnaire), semi-structured exit interviews, with qualitatively typical 'What' and 'How' questions were conducted by one of the authors (CG). The central question for participants at that point was *How does having this device change your learning?* The interviews also included exploration of aspects such as the types of learning materials participants have accessed, the volume of material accessed, perceived effectiveness of the learning material, uptake of different types of material, time management benefits and unforeseen uses of technology. Technical issues were also covered, especially where they impacted on use of the technology for research purposes. Initially, the VLL was interested in looking at the interplay of audio-visual data use and storage, in relation to patterns of usage as individual and group users of a potentially highly visual portable and flexible mobile device. After the first paper (see Gibbons, 2009) had been developed focusing on the implications of mobile learning for postgraduate research training, we were keen to expand the study in order to explore more explicitly how mobile device uses by doctoral students can be explored further in personally and professionally meaningful ways.

The audio interview from the original study was transcribed verbatim by a third party and re-analysed by one of the authors (RLW), in order to assess whether the mobile device had accommodated the needs of mature learners for their professional and learning development and with a focus on examining impact on future practice. The re-analysis only made use of the interview data and excluded the observation notes. This decision was based on the phenomenological core concept of 'bracketing' which minimises the preconceived views and illustrates the immediate experience of the studied phenomenon through a reflective turn (Moustakas, 1994). Considering the paper was qualitative in nature and the responses received ($n = 6$) was insignificant, the questionnaire data was also not used in the re-analysis. Thematic analysis was guided by grounded theory which aims to enable findings to emerge from the data rather than from preconceived ideas (Glaser & Strauss, 1967; Strauss & Corbin, 1990). This approach was agreed to be sufficiently in keeping with the epistemological precepts of the original study. The following procedures suggested by Strauss and Corbin (1990) and Charmaz (2000) were followed:

- Open coding, where data was broken open to identify relevant categories,
- Axial coding, where categories were refined, developed and related, and
- Selective coding, where the 'core category', or central category that ties all other categories in the theory together, were identified and related to other categories.

As a teaching and learning project, Ethics Committee approval was not required by the School of Nursing. However, in keeping with ethical principles of informed consent (Plummer, 2001), all participants were given access to the study briefing documents, and written participant agreements were drawn up. Additional written consent was given by participants for data to be released for use by researchers beyond the Graduate School, including the authors of this paper.

3. Findings - learners' evaluation and experience of using the PDA phone

A number of general themes and issues emerging from the further analysis of the study data have been identified and they share great similarities with the findings from the original study (Gibbons, 2009), in particular the findings on user evaluation of the device itself. A conscious effort was made to ensure that the themes developed from the re-analysis best reflected the intended meaning of the participants.

The findings show that the participants used the PDA phone in a wide range of ways, and since it was a small-scale study, these differences may not fall into distinct patterns. The primary purpose of the study was to improve doctoral research students' learning by using the PDA phone as a learning tool. While this study was designed to discuss the perceptions and uses of a mobile device but not to provide evaluation results of the device itself, it did show that the participants thought the technology to be useful and to a certain extent, inspirational. Table 1 below summarises the mature learners' critical opinions towards the PDA phone's main functionalities (see Table 1).

Further analyses of the data drew attention to five major themes which are discussed in more detail in the following paragraphs. Note that themes 3.1–3.4 were identified previously (see Gibbons, 2009), but have developed in more depth. Theme 3.5 is a new theme which has emerged from the re-analysis.

3.1. PDA phone as a storage tool

The study found that rather than being a communication tool, the PDA phone has been used mostly as storage tool to review files and store data. Use of the mobile device during down time, such as skim reading meeting agendas while on the train for travelling, was mentioned as one of the main benefits of having the portable device (e.g., "*the other thing is the agendas and minutes and instead of having a paper base you can just scroll through the minutes just to remind yourself…*"). Another advantage was that the device allows file transferring and synchronisation between different computer platforms, such as work and home PCs. Due to the nature of their work, this was particularly useful for the participants who carry out work and research in different locations. (e.g., "*It was mainly for transferring files…so it was for mobile use. Occasionally, I would download a presentation, because I teach at Derby, Nottingham and Lincoln. So in the interim I could check, or even alter a presentation and then email it to my university server.*").

3.2. Visual and audio usages

Although all of the participants actively engaged with ways of incorporating visual technologies into their personal and professional activities, the visual functionality of the PDA phone did not attract great attention from them. Only one participant mentioned that he used a few times the built-in camera as a means to record visual information in situ. The low usage, according to the participants was mainly due to the poor quality of the video. On the contrary, the audio voice recorder was used rather frequently by the participants to record thoughts and ideas related to their work (e.g., "*… for me, it's [used] when I'm thinking about something and I would have it at the side of my bed at night because my mind is quite active*"). It seemed that the portability and the easy to use audio functionality of the device allowed participants to continue developing work related activities beyond normal working hours. Some participants expressed that it particularly suits their 24/7 life style and working pattern. In terms of using the device as an organisational tool, interestingly, views were polarised with half the participants favouring the e-calendar function provided by the device, with the rest preferring the traditional paper-based diary. Previous experience of online or electronic diary management was not an indicator of which method a participant would favour. This is discussed further in Section 3.4.

3.3. Technical and physical issues of the device

The problems participants reported were mostly technical in nature, for example having problems with downloading and transferring files. The PDA phone promised a wide range of functionalities, but the participants felt that the device did not live up to their expectations. The hardware limitations of the device and software issues led to a few participants looking for other alternatives during the trial period. For example, due to the poor quality of the built-in camera, a few participants have switched back to use their personal digital camera. Usability issues were also encountered. The participants found the device was rather large and heavy for comfortable use compared with their slimline designed mobile phones. There were also some personal learning issues with regards to using the device. One participant reported that she was frightened of 'playing' with the device as she felt that it might wipe something out or lose all her files. A few participants also admitted that they felt impatient towards 'trying out' the device as it takes time and effort to fully understand its functionalities (e.g., "*… I was using it more as a method of transferring files and transporting files rather than using it as a research tool. One of the problems was it was very time consuming to implement all the stages to get through to actually access what you wanted*").

3.4. Internet connectivity

Apart from the issues with the physical device itself, such as the small display screen and the keyboard layout, the main reported limitation was the failure of wireless connectivity in half of the devices. The failure of accessing WiFi due to unsolved technical issues led to

Table 1
Mature learners' critical opinions towards the PDA phone's main functionalities.

Functionalities of the HTC TyTN PDA Phone	Participants' critical opinions
Portable	The size and the weight of the PDA phone needs to be reduced
Visual and kinaesthetic	Need a good quality video camera for research interview purposes
Internet-enabled	Need consistent and fast WiFi Internet connection
Rapid response	Applications need to be able to be quickly accessed and operated
Enabling multitasking	Need to be more functional and the applications/functionalities need to be relevant to users' needs
Social and collaborative	Mainly on internet access and checking/composing email. No great expectation on the social aspect from the participants
Physical appearance	The focus of interest was not for the appearance of the device but for its usability
Entertainment (e.g. the *bubble breaker* game)	Seen it as a bonus but not much uses by the participants

a great deal of disappointment. Interestingly, for all the participants, the WiFi Internet features were consistently rated by the participants to be actually or potentially the most useful, especially at times when laptop or fixed station computers were unavailable. One participant stated: "*Sometimes we'd be in ethics committees and students had put through project proposals and because we're in one with the complimentary medicines team we'd want to know if it was something in their area because it's so alien … Because you are sat in a meeting you can't go to your computer so it would have been useful if I could have got hold of that…*". It seems that the Internet connectivity issue had prevented some participants from fully engaging with the device; hence potential usage of other phone features, such as the e-calendar might have been diminished.

3.5. Learner self-reflection upon their engagement and practice

Although the study found that the whole learning experience was quite profound for some study participants, the use of the PDA phone did not have a great impact on their current study as doctoral students. In this regard, the findings share some similarities with a study conducted by researchers at the University of Birmingham (Corlett, Sharples, Chan, & Bull, 2004; Holme & Sharples, 2002; Sharples, Chan, Rudman, & Bull, 2003). Their study shows that there was no particular function and application of the mobile device that has significantly changed learners' learning behaviours. However, by examining the data from a different angle, we found that the use of the device led to a subtle behaviour change in one individual. In this case, changes happened in that participant's work environment where everyone was required to use the similar mobile devices for work and communication. Due to the experience gained from participating in our study, in particular the experience of experimenting with the use of Outlook Calendar via the PDA phone, this female participant felt she was more skilful and therefore more confident than her other colleagues. She reported: "*…we [the School] have never used Outlook Calendar before…so while people [my colleagues] were struggling to come to terms with Outlook Calendar…I cannot do without it*". Through exploring and engaging with the device, all participants in our study admitted that they became more aware of key issues in mobile learning such as the small visual display and potentially instable Internet connection. However, using the mobile device also raised their awareness of opportunities and affordances of learning technologies. For example, one male participant mentioned that: "*[The use of the device] got me thinking what I actually needed and the sheer fact that a laptop is too large and cumbersome to carry around with you. I wanted something that I could boot up quite instantly and get on the Wi-fi; go transfer files and this is ideal*".

Another female participant reflected in slightly different ways on her mobile device uses. In her case, while the School IT technicians were trying to solve the technical problems she had encountered during the six months' project period, she had gradually developed a close working relationship with the technicians and enjoyed exploring the new learning experience with them. She realised that what she had learnt was far more than simply having a gadget. For her, the benefit of using the PDA was beyond the device itself as she stated: "*People sometimes think that gadgetry is the 'be all' and 'end all' and for me, it is not. It enables and strengthens communication but we cannot survive without human contact. So this is another device that promotes a channel of communication*". During the exit interviews, the participants also generated some interesting ideas about how technologies can be used in their own everyday practice. For instance, when asked whether they could continue using the visual aspects of the device, one participant stated: "*In fact what it has taught me is that there's room for manoeuvre and perhaps you can engage with some podcast activity or perhaps you can get more flexibility in your approaches to your teaching… it's made me think about my style in terms of my approach towards my professional practice as a teacher in that there are a lot more opportunities out there than I actually realised a year ago*". Another participant remarked: "*…you could show somebody a brief clip and maybe then have a discussion about what you have seen on there…so probably in small groups. Depending on what size your tutorial groups were you might be able to show it to them. I think there is a lot of flexibility with these new devices*". This finding in particular was confirmed in the re-analysis of the data and indicates the changed perceptions of the role of mobile technologies in their professional practice. This emerging theme forms the key argument of our paper and will be analysed and discussed further in the next section.

4. Discussion

Barker, Krull, and Mallinson (2005) acknowledge that the technical capability of mobile devices is a crucial factor in developing and sustaining feasible m-learning. The findings of this study support this argument. Although the study focused on the device as a tool for learning and communicating about research, the technical problems with the device were repeatedly cited as a major concern for all participants. This indicates that the stability and reliability of the technology as well as the suitability and usability of the functional design should be the primary consideration of all technology-enhanced teaching and learning contexts. Based on the findings, we divide our discussion into four areas.

4.1. Developing m-learner's self-reflection

Bruce and Hogan (1998) argue that technologies should be viewed as ideological tools which embody social values. They conclude that it is less useful to focus on the technical attributes per se, instead they suggest that there is a need to understand the ways in which ideology is embedded within technology. In this study, due to the technical issues, the participants did not fully benefit from what the PDA phone promises to offer. It seems that the device gained little popularity amongst the participants and there was limited factual evidence showing changes to their learning or personal behaviours. However, to some extent, especially via the exit interviews, when asked what they had learnt from participating in this trial, all participants provided a reflective account of how this or other similar devices can be used accordingly in the future and how their teaching and research practices might be enhanced through its regular use. By analysing the interview data, we found that the participants had related the problems they experienced with the technology to their identities and practices as learners. One participant admitted that she did not use the visual functionalities the PDA phone offers as she has not yet reached the need at that stage of her research work. However, she later mentioned that: "*If I'd been data collecting then I think I would have used it [the PDA] in other ways*". Another noted: "*The camera facility and the recording facility could be used in teaching sessions I suppose but there are loads of issues around getting people's consent. I think that could be potential, but again, I think you need to be quite sure why you are doing this and what you are doing it for. So I think it is important to plan it first*". This participant was not only reflecting on the possible uses of the camera but

also the ethical concerns related to the uses of such visual function in teaching and research. This unexpected finding indicates that it was not the mobile device alone but the process of self-reflection from one's professional practice that led to conceptual changes. Self-reflection plays a essential part in adult learning and the argument on 'learning from one's professional practice' is well supported by many adult learning theories, such as situated learning (Lave & Wenger, 1991), reflective practice (Moon, 1999) and workplace learning (Eraut, 2004).

The methodological approach in this project belongs to a paradigm that places a high value on participant identities and purpose. Furthermore the process of iterative reflection used in the regular project meetings and the exit interviews resulted in the learning. In short, it was the reflexive involvement in a learning project that made the difference. From the students' point of view, the outcome of participating in this project was not simply to use a new tool, but to develop their thinking and reflection about this particular tool and its possible uses. It is only in this sense that the tool used contributes to the development of learner identities. In our case, we suggest that learner reflection on m-learning always involves processes which question and envelop uses of technologies as tools for particular purposes and motives as well as supporting or challenging particular identities as learners. In order to get the project participants to reflect on the uses of mobile technologies they had to be exposed to the technology over a slightly longer period of time, so that they could get to understand the affordances and limitations of using such a mobile device as fully as possible. In this regard, this study raises important questions about ways to encourage learner reflection about technology uses, which allow learners to develop and adopt their learner identities supported by technology uses. In other words, reflection is part of one's self-development process of extending 'information technology fluency' to 'frame fluency' (Hsi, 2007) which means that users not only learn how to use the technology itself but also know how to construct new ideas and manipulate it to suit their personal and professional demand.

4.2. Appropriation of m-learning

During the interviews, participants expressed their impatience with learning how to use the device especially when they encountered technical and functional problems. One reason might be that the participants saw the value of the PDA phone but were reluctant to invest time and effort to discover the potential of a device which they had to return at the end of the study. According to Perry (2003), ownership is a prerequisite for engagement, where learners have the freedom to go beyond the boundaries and play with it and therefore discover its potentials. This concept also closely relates to Waycott (2004)'s work on appropriation as she suggests that appropriation should be dealt with as the way of how to integrate new technology into the users' activities. Waycott's study reveals a two way process, firstly, users adapt their mobile device use to their everyday practices, prior expectations and preferences in order to carry out their activities and secondly, the devices in turn also change the user's activities and consequently, users generate different levels of expectations and preferences. The findings show that the use of mobile technology did not transport the participants into a new world; rather mobile device use affects the world in which they are situated. We argue that the learners' self-reflection on using the device can be seen as the first step towards changing learning behaviours and activities. Embedded use of mobile devices adds value - hence we suggest that addressing questions on how to ensure technologies are blended to users' everyday life and how to secure the ownership and appropriation of technology by users are the key.

From an operational perspective, the initial implementation of mobile technology could be logistically challenging and requires careful planning and commitment from all partners. When this is in place, promising innovative practice is likely to ensure. However, a large scale project can require a great deal of infrastructure and investment - both financial and pedagogic. One may argue that small-scale use of devices in practice or *in vivo* affords participants liberty in the use of the device. Moreover it is this liberty and the design flexibility of an epistemologically sound qualitative learning project (as compared with empirical experimentation) that is likely to create conditions for innovative practice. Regardless of the epistemological stance of research, the need for necessary technical and training support for the transition of learners, in this context, mature learners, from reluctant or less skilled use to active engagement with the technology should be taken into account from the start.

4.3. Generational difference and digital fluency

What mobile technologies can offer seems well matched to the expectations of the so-called 'net generation' (Oblinger & Oblinger, 2005), who were born from the 1980s onwards and have grown up with exposure to the Internet and mobile devices. According to Oblinger and Oblinger (2005), the 'net generation' are 'digital natives' (Prensky, 2001) who think and process information fundamentally differently from their predecessors, the 'digital immigrants' (Prensky, 2001), whose interaction with these digital tools is not innate. It is apparent that the participants from this study do not fall into the 'net generation' category. This group of mature learners might not have the intrinsic skills when using a new mobile device and is likely to be somewhat reluctant to discover the potential of the learning tool. However, the findings illustrate nevertheless that mobile learning is relevant for all learners even though they might be 'digital immigrants'. The critical opinions from the participants (see Table 1) are not that different from the pre-defined 'expectations of the net generation' noted in Oblinger's paper and they certainly challenge those assertions. The characteristics of m-learning, such as its portability, accessibility and flexibility are not only popular among the 'digital natives', but they also reflect the demands and expectations that mature learners have of mobile technologies. The following quotation illustrates this argument: "*I work full time and a lot of my thinking time is fragmentary; it is not that I have got a whole day to just think about research because work often spills into that time, annoyingly. So I wanted to have the opportunity, when I got the moment, to get some research work done*".

Mature learners might be more critical of new technology, but it does not mean that they have different expectations and demands on technologies. Indeed, most members of the group referred to themselves as users of highly complex technical equipment upon which lives depended in their professional lives. The female participant specifically invoked this professional identity to motivate themselves when challenged by their seeming inability to make the PDA function as expected (e.g., "*I was spending time getting used to the new activities that I wasn't familiar with and I did find myself being a little bit in awe and I thought: 'come on get real here! At the age of twenty-one I ran a forty-two bed surgical ward with poorly patients so I shouldn't be frightened of this! I am not going to kill anybody!' It was actually making myself face up to some of those limitations and then coming back to the fact that I am normally fascinated by gadgetry and I don't usually do fear with gadgets and devices*"). These learners had high expectations of the devices and themselves. This demonstrates the limited value of the 'digital

immigrants' and 'digital natives' debates. The ubiquitous nature of mobile technologies has actually led some to suggest that mobile learning is particularly suited to more mature and independent learners (Kineo & UFI/Learndirect, 2009).

Interestingly, Oblinger and Oblinger (2005) also point out that the differentiating factor may not be so much one person's generation versus another; the difference may be in experience. For example, they considered that individuals who are heavy users of IT tend to have characteristics similar to the Net Generation. Salajan, Schönwetter, and Cleghorn (2009)'s survey study seems to favour this particular observation by suggesting that a definitive distinction cannot be confidently drawn between students (digital natives) and faculty members (digital immigrants). They confirm that although students seem to be more proficient in the use of digital technologies then their professors, when it comes to the actual use of a specific piece of technology or programme, this division is much more blurred. Based on our findings, we argue that the perception and use of a mobile device is mainly influenced by learners' personal skills, interests and knowledge of technology as a whole independent of age or generational factors. Sharples (2003) describes the requirements for mobile devices as personal learning tools, including that they are truly portable, adapt to an individual's abilities, available anywhere and intuitive to use. We suggest that these qualities are applicable to all users across different age groups.

Our findings question the usefulness of dichotomous representations of learners as 'digital natives' and 'digital immigrants'. Instead, we suggest that 'digital fluency' might be a more valuable concept to develop. We support the claims made by Bennet, Maton, and Kervin (2008) who write that 'young people's relationships with technology is much more complex than the digital native characterisation suggests' (Bennet et al., 2008: 783) by suggesting – based on data collected as part of our study – that equally, mature learners' relationship with technology is highly complex. We found that although the participants share some similarities in the evaluation results, they all have different preferences on the PDA phone's functionalities. For instance, some were much keener to use the electronic diary than others. Alongside Hsi's (2007) interpretation of a practice-oriented perspective on digital fluency, we see 'digital fluency' as a developmental process - through engaging with the mobile devices, users developed different levels of expertise and ability depending on their interests, needs and individual technical limitations of the mobile devices. However, we aware that the fluency in technology might not be exactly like fluency in speaking a foreign language as Resnick (2001) argues – rather it is also highly contextualised. In the profession of nursing, for example, everyday hospital ward practice increasingly involves extensive use of technology, yet the change of context with this study left some of the participants feeling deskilled. They all reached a point in the process where they actively reminded themselves that they have these skills, and had the confidence to deploy technologies in new contexts. Learning, for most of the participants, was about overcoming the initial novelty and was around the incorporation of technology into current behaviours: handling new tools with greater confidence; being exposed to new ways of incorporating visual technologies into working lives and actively engaging in this. In this sense, the findings of our study illustrate that Bennet et al's (2008) argument about young people's complex relationship with technologies also applies to the debates concerning 'digital immigrants'. The concept of 'digital fluency' seems to be a particularly useful construct for understanding appropriation of mobile devices by learners of all ages. This overcomes the dichotomous description of 'digital natives' and 'digital immigrants' and it allows us to consider that learning about technology should always include learning *with* technology.

4.4. Creating a rich and meaningful mobile learning experience

Learning is deeply personal and contextual and it needs to be facilitated by relevant, reliable, and engaging activities and tools. Mobile learning can be seen as a set of processes involving both technological and social-cultural elements by which individuals are enabled to engage actively with their social surroundings via portable devices, in order to acquire new knowledge, understanding and skills. This study reinforces that simply giving out a 'fancy' device does not guarantee better learning. This finding is not new, but it raises the critical questions of: *how do mobile devices allow a learner to conduct tasks in the way they prefer?* and *what makes a rich and meaningful mobile learning experience?* If mobile technologies are continuously used as a tool to enhance personal learning, they need to start to reach beyond concepts of 'anytime, anywhere' and multi-functionality, by looking more at specific learning contexts and engaging learning with individual needs. In other words, the actual needs of the learners need to be specifically defined and the associated support, activities and resources need to be effectively deployed. However this does not necessarily mean *pre*defined if the methodological and study design allows for effective opportunities for definition and redefinition, such as in the qualitative design of this study.

It is notable that the six participants in this study have less learning flexibility than normal full-time students due to their work and family commitments. This made it particularly important for the technology to provide them with 'immediate' learning moments. The technology and the associated applications should be designed with a component of flexibility and rapidity so that the doctoral students can send information and obtain feedback easily and quickly at different times of the day and in various locations. This could be, for example, a mobile device designed to allow nursing students to capture and record 'critical incidents' (Flanagan, 1954) while working or conducting research activities at a hospital, and to immediately share their thoughts and obtain feedback from others including their peers and supervisors. Furthermore, applications and functionalities need to be usable without too much incremental effort as Wager (2005) points out in his paper: '*What is the point of automation if it takes more work to do the job with the software than without it?*' Fundamentally though, the starting point of a meaningful experience with technology is probably best expressed as in the repeatedly stated words of the participants, and one very frustrated male participant in particular; '*I just need it to work!*'.

Loi and Dillon (2006) propose that 'designed interventions' should be used in adaptive educational environments. They describe them as technologically and pedagogically mediated interventions that facilitate particular educational outcomes. These principles may also be applied to mobile learning as the digital artefact is increasingly embedded in the 'ecology' of our everyday life: it is possible to achieve a rich and meaningful mobile learning experience through good use of technology and appropriate design of pedagogical activities. From a learning-oriented perspective, it is essential that the functionality of the device needs to demonstrate the relevance of learning, adhere to general educational principles such as designing pedagogically sound and learner-focused content to promote autonomous learning and to make a learning experience more meaningful and memorable. This study indicates that mature mobile users are primarily interested in consistent and practical tools that usefully support their learning needs. In terms of 'usefulness', according to our participants' point of view, mobile technologies are meant to save time, to be ready to use when needed and to improve learning quality. These qualities are not new but simply remind us what technologies are supposed to be. Correct functioning and embedding is more likely to raise acceptance and stimulate use of the technology. This study reinforces that technology should not be used in isolation; its usage should be blended with other

appropriately designed activities, or the lived context and practice of the participants. As mobile learning shares the same value of the 'anytime, anywhere' e-learning landscape, various e-learning platforms and web applications should therefore be integrated into m-learning in order to enable a mutual synergy. The integration of the asynchronous online learning conference - *virtual research café* in this study (modelled on development activities in the school that would be familiar to the project participants) was an attempt to provide such a platform for sharing and discussion, and hence to encourage active thinking about their research studies. The piloting result has indicated interest and support despite the fact that the active engagement was not great. During the interviews, participants' reported that the idea of *research café* was novel and helpful. The low engagement was due to 'lack of time' and 'a curiosity to see what it involved before becoming involved themselves' (Gibbons, 2009). Although the enhancement of collaboration was not the primary aim of this study, the importance of developing awareness of the learner about the learning community they engage with should not be ignored. The Graduate School is now considering developing this online platform as a model to engage and support all part-time and distance-based doctoral students across disciplines in their learning and research activities.

5. Conclusion and future research

We wish to conclude our paper with some general comments on the digital fluency concept. We suggest that the notion of digital fluency is more helpful than dichotomous claims made about Net Generation and New Millennium Learners. This conceptualisation also demands that we recognise that learning (with and without technologies) always takes place in complex 'live' contexts (which may be even more complex for mature learners than for younger learners). These multiple and variable contexts have significant impact on learners' appropriation of new technologies and related uses. This also suggests that there is a need for researchers into m-learning (and related technology uses) to develop a better understanding that – in order to recognise this complexity and impact of live worlds on technology facilitated learning – research needs to be undertaken both in the field and supported by in situ-experimentation or interventions.

We also suggest that technology facilitated learning can be enhanced when research projects are based on methods and epistemologies that value participation and reflexivity. Finally, we maintain (in agreement with Hsi's (2007) work) that digital fluency could become a vital concept to explore technology-enhanced learning and m-learning research. We are aware that the claims made here are based on limited data. However, these claims refer to insights drawn from human feeling as a valued and indeed necessary part of successful technological communication and phenomenological research in general (Howard, 2000).

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