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Lawrence A. Tomei
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Anywhere, Anytime Learning Using Highly Mobile Devices

Mark van 't Hooft

Kent State University, USA

Graham Brown-Martin

Handheld Learning, London, UK

Karen Swan

Kent State University, USA

INTRODUCTION

In a world that is increasingly mobile and connected, the nature of information resources is changing. The new information is networked, unlimited, fluid, multimodal, and overwhelming in quantity. Digital technologies, such as mobile phones, wireless handheld devices, and the Internet, provide access to a wide range of resources and tools, anywhere and anytime. This type of access and connectivity has also had an impact on how we collaborate on projects and share media and therefore, greatly increases opportunities to learn inside *and* outside institutionalized school systems. Learners now have the tools to take learning beyond classrooms and the school day.

The development of handheld devices can be traced back to Alan Kay's vision of the Dynabook. As early as the 1970s, Kay envisioned a mobile, kid-friendly, notebook-sized computer with artificial-intelligence capabilities that would support children's learning inside and outside of school. Similar ideas soon followed in the form of devices such as the Psion I (1984), the GRiDPaD (1988), Amstrad's PenPad, and Tandy's Zoomer (1993), the Apple Newton (1993-1995), and the eMate (1997-1998). During the 1990s and early 2000s, Palm developed a series of handheld devices that defined the handheld market in North America, while Microsoft developed several versions of its Windows Mobile software that could be found on mobile devices made by such companies as HP, Dell, and more recently, Fujitsu Siemens (Bayus, Jain, & Rao, 1997; HPC Factor, 2004; Williams, 2004).

There are also many devices whose primary function is entertainment or communication, including media players such as Apple iPods, portable gaming devices

like the Sony PSP and the Nintendo DS, and, of course, mobile phones. These types of devices are becoming increasingly popular and multifunctional, with iPods being able to store and play music, pictures, and video; portable gaming devices sporting wireless capabilities for interaction between devices (and in the case of the PSP, Internet access); and mobile phones being used to shoot pictures and video, upload content to the Web or e-mail it elsewhere, do text messaging, and make phone calls. Whatever the device, convergence seems to be increasingly important, and growing numbers of young people are using these mobile, digital, and connected tools daily, whenever and wherever they need them, and this includes schools.

BACKGROUND

Mobile computing enthusiasts have advocated the use of highly mobile devices for teaching and learning to get closer to a ubiquitous computing environment, defined in 1991 by Mark Weiser as a setting in which "a new way of thinking about computers in the world ... allows the computers themselves to vanish into the background" and become indistinguishable from everyday life (p. 94). Weiser emphasized that ubiquitous computing does not just mean portability, mobility, and instant connectivity, but also the existence of an environment in which people use many computing devices of varying sizes that interact with each other, combined with a change in human psychology, to the point where users have learned to use the technology well enough that they are no longer consciously aware of its presence and do not have to be. This version of ubiquitous computing has recently been revisited by

scholars such as Yvonne Rogers (2006), who proposes a modified version in which

UbiComp technologies are designed not to do things for people but to engage them more actively in what they currently do (p. 418);

and Bell and Dourish (2007), who argue that ubiquitous computing is characterized by power-geometries (the ways in which spatial arrangements, access, and mobility reflect hierarchies of power and control); heterogeneity (as opposed to standardization and consistency in technology, use, and regulation); and management of ubiquitous computing that is messy.

Weiser's somewhat revised vision of ubiquitous computing fits well with current visions of technology integration in education and its potential impact on teaching and learning. Academic research has shown that computer use and student learning gains are "closely associated with having computers accessible to all students in teachers' own classrooms" (Becker, Ravitz, & Wong, 1999; see also Shin, Norris, & Soloway, 2007). Highly mobile devices provide a solution because of their small size and comparatively low cost in acquisition and ownership (Norris & Soloway, 2004; Sharples, 2000a), and they supplement the existing technology infrastructure. Some scholars have defined the resulting learning environment as "handheld-centric," "providing all students with access to valuable resources on a shared but timely basis," where each tool has been earmarked for its intended use (Norris & Soloway, 2004; Tatar, Roschelle, Vahey, & Penuel, 2003). Another group of scholars is looking at learning with highly mobile devices from a broader perspective. They have coined the term m-learning, "the processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies" (Sharples, Taylor, & Vavoula, 2007).

Highly mobile devices are also altering the nature of technology integration in teaching and learning, and can act as catalysts for radical changes in pedagogical practices (Fung, Hennessy, & O'Shea, 1998). Their fundamental difference from more traditional desktop computing environments lies in the fact that users "interacting with a mobile system interact with other users [and] interact with more than one computer or device at the same time" (Roth, 2002, p. 282; see also Cole & Stanton, 2003). Consequently, highly mobile devices lend themselves well for both individual and

collaborative learning, if used appropriately. Roschelle and Pea (2002), for example, highlight three ways mobile devices have been used to enhance collaborative learning—classroom response systems, participatory simulations, and collaborative data gathering—and suggest there are many more uses (see also Roschelle, 2003).

Moreover, because of their small size, portability, and connectivity, highly mobile devices do not constrain users like desktops and laptops do. As such, they encourage learners to use technology across the curriculum and in everyday activities, and embrace it as a lifelong-learning tool to be used anywhere and anytime (Inkpen, 2001; Sharples, 2000b), eventually leading to the type of ubiquitous computing that Weiser envisioned and Rogers, and Bell and Dourish advocate.

TEACHING AND LEARNING WITH MOBILE DEVICES

Highly mobile devices possess certain characteristics that allow for frequent and immediate access to a variety of tools and information sources for teachers and students, and their use in classrooms and other learning environments is bringing about many changes. However, it is important to understand that simply putting more digital tools in schools is not the solution to making technology use for teaching and learning meaningful and effective. Rather, teaching, learning, and technology need to be reconceptualized before the full educational possibilities inherent in small, versatile, and mobile digital technologies can be realized.

In *The Educators Manifesto* (1999), McClintock proposes that digital technologies change what is pedagogically possible. To take advantage of these possibilities, teaching must be continuously redefined within the changing context that new tools such as handheld computers create. Teaching should be reconceptualized as "conducting learning," thereby putting more responsibility for learning on the learner. Second, teaching must no longer be thought of as restricted by the spatial and temporal boundaries that current educational systems impose. Third, the content and focus of teaching must be redefined to meet the needs of the 21st century world (Swan, Kratcoski, & van 't Hooft, 2007).

If teaching is to be reconceptualized to take full advantage of mobile tools, so should learning. As digital

tools are becoming increasingly mobile, connected, and personal, they have the potential to make learning student-centered, and can support both individual and social construction of knowledge. In particular, students need to be given more responsibility for their own learning. Four areas in which learning should be redefined as more student-centered are engagement and motivation, individualization and choice, collaboration and peer learning, and learning for all students (Swan et al., 2006).

Mobile technology has the potential to have a substantial and positive impact on teaching and learning. Merely introducing the tools in the classroom will not suffice; it is even more important that educators think about how teaching and learning need to change in order to take full advantage of the good things that digital technology has to offer for students and teachers alike.

The first step in rethinking teaching and learning within a context that includes the latest digital tools is simple, yet radical. Educators need to embrace the technology and learn about the ways in which younger generations are using it. Current students live in a world that is connected 24/7 and high tech, with an overwhelming amount of communication devices and information channels. Within this context, digital tools are increasingly personal, mobile, networked, social, accessible, flexible, multimodal, and contextual (see e.g. Roush 2005, Thornburg, 2006; van 't Hooft & Vahey, 2007).

Second, we need to rethink the role of technology in schools and the fundamental impact this changing role is going to have on teaching and learning. Too often, we look at technology as being integrated in the existing curriculum, which entails doing the same things we were doing, and using technology as an add-on. Indeed, we probably need to stop thinking about technology *integration* altogether, but instead see technology as an agent of *transformation* that will enable us to do new things in new ways. As stated above, for example, mobile technology has the potential to break through the temporal barriers of the school day and the brick and mortar of school walls, making learning an authentic and relevant aspect of everyday life, and not just schooling (Alexander, 2004; Breck, 2006).

Third, fundamental changes in teaching and learning as brought about by pervasive digital tools require that teachers carefully reexamine how they view and use technology, and how this impacts their teaching

philosophy, curriculum, and practices. This type of examination is not going to take place overnight. It takes time and effort. It takes motivation and engagement, individualization and choice, collaboration, and a group effort by all. In the end, it may, and probably will, require fundamental changes in the ways in which we teach our children.

Fourth, there are always the technical and logistic issues to be overcome. These include more traditional issues related to networking, compatibility, security, maintenance, and training, as well as new problems created by new technologies, such as copyright infringement, violation of privacy, and cyberbullying.

Fifth, while highly mobile devices provide affordances that many other technologies cannot, there are always limitations on their use. Therefore, it is essential that teachers (and) students consider when it is appropriate to use a mobile tool for purposes of learning and when it is not. Whatever the choice of tool, it should not get in the way of learning. For example, it would be unwise to try to do extended video editing or high-end graphics design on a mobile device.

Finally, we cannot overlook the most important partner in all of this, the students. Current generations of students prefer quick and easy access; communication and networking; digital, hyperlinked, and multimedia content; and just-in-time learning that is relevant and useful. In addition, in a digital and connected world, *learners* are mobile; active, communicative, and resourceful; and construct context through interaction (Alexander, 2004; Roush, 2005; Sharples, 2005). How will they be affected by fundamental changes in teaching and technology use for formal *and* informal learning?

FUTURE TRENDS

Various pilot and research projects have attempted and are attempting to bring about changes in teaching and learning by introducing highly mobile devices. In *classroom settings*, a large-scale implementation of handheld computers has investigated what happens to teaching and learning when many devices are introduced in formal educational settings (Vahey & Crawford, 2002). Other examples include Room-Quake, which used handheld devices and a variety of artifacts to simulate earthquakes; and the application of handheld computers in combination with scientific

probes. In *informal environments*, we have seen mixed reality games that combine the real world with virtual environments (often through the use of digital overlays or location-based resources) to enable users to experience and reflect on both. Examples of such projects include Environmental Detectives (explore imaginary scientific problems or environmental disasters using Pocket PCs and GPS in a real setting), Frequency 1550 (using cell phones and GPS to learn collaboratively about the history of Amsterdam), and MobiMissions (a game in which players create missions for others and can choose which missions to take on). Most of the initiatives listed here are described in greater detail by Rogers and Price (2007).

However, as admirable as these projects are, the real work needs to be done in bridging the gap between learning in formal and informal settings. This could consist of the use of highly mobile devices to augment field trip experience and, at the same time, provide students with resources for learning, upon return to the classroom, in the form of digital data collected during the field trip. An early example of such a project is Ambient Wood, an attempt to digitally augment a woodland habitat. A more recent example is MyArtSpace, in which students choose which data to collect and store during a museum visit, for later use in the classroom (Vavoula, Sharples, Lonsdale, Rudman, & Meek, 2007), but these types of examples are still few and far between.

Research can be helpful here. Future inquiries in the area of wireless mobile learning devices should be focused on how this technology is changing interactions between learners, digital content, and technology, and how education will need to adapt to a world that is increasingly mobile and connected (van 't Hooft & Swan, 2007). Other questions of interest include: How can we create the best possible tools for learning without the technology getting in the way? How can mobile technologies best accommodate and support active and collaborative learning? How does context affect learning, especially when it constantly changes?

Finally, the current dearth of large-scale implementations of highly mobile devices can be blamed on a variety of reasons. For one, educational institutions usually do not have the resources to provide every student with a digital tool. Second, they haven't figured out yet how to take advantage of the mobile devices that many students already own or have access to. In fact, in many instances, it is not only inability, but also unwillingness on the part of the "traditional" education sectors to

perceive these same devices that are an integral part of the everyday life of a young learner as a viable platform. As a result, schools are banning devices such as mobile phones, when they could be used as mixed-media creators and communicators, and are instead trying to hold on to a computing model based on desktops and laptops that is slowly coming to its demise. Ultimately, the plethora of mobile devices and the manner in which they are embedded in the lives of young learners will raise the question, "Who supplies education?"

CONCLUSION

Younger generations are not fazed by constant change. They are growing up in societies that are in constant flux, where access to information is overwhelming, and technology is mobile, connected, and constant; they do not know a world without it. They know how to use the hardware and software, and are not afraid to learn to use new tools. However, they need guidance in learning how to use digital tools in ways that are meaningful, productive, responsible, and safe. In order for this to happen, teaching and learning in educational institutions will have to change to accommodate the use of highly mobile devices anytime and anywhere. Only then will students gain the knowledge, skills, and attitudes that are needed to be successful in the 21st century world.

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KEY TERMS

Bluetooth: An industrial specification for wireless personal area networks (PANs). Bluetooth allows devices to connect and exchange information over a secure, globally unlicensed short-range radio frequency.

GPS: Global positioning system. It consists of a receiver that uses three or more GPS satellites to calculate its location.

Highly Mobile Devices: Digital devices that have high mobility, a small footprint, computational and display capabilities to view, collect, or otherwise use representations and/or large amounts of data; and the ability to support collaboration and/or data sharing. Devices include PDAs, mobile phones, some tablet computers, networked graphing calculators, UMPCs, the new generation of handheld gaming systems, iPods, motes, and data loggers.

Informal Learning: Learning in which both goals and processes of learning are defined by the learner, and where the learning is situated rather than preestablished.

M-Learning: "The processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies" (Sharples, Taylor, & Vavoula, 2007).

Mobile Phone: A portable electronic device for personal telecommunications over long distances, often supplemented by features such as instant messaging, Internet and e-mail access, global positioning (GPS), and a digital camera. Most mobile phones connect to a cellular network.

PDA: Personal digital assistant. A handheld computing device that is characterized by a touch screen, a memory card slot and Infrared, Wi-Fi, and/or Bluetooth for connectivity. Data can be synchronized between PDAs and desktop or laptop computers.

UMPC: Ultra mobile personal computer. A small form-factor tablet PC (larger than a PDA but smaller than a tablet PC) that features a touch screen no larger than 7 inches, flexible navigation and input options, and WiFi connectivity.

WiFi: Short for "wireless fidelity" and a popular term for a high-frequency wireless local area network (WLAN), using the 802.11 protocol.