Anywhere Anytime Learning with Wireless Mobile Devices

Mark van 't Hooft
Kent State University, USA

Graham Brown-Martin
Handheld Learning Ltd, UK

INTRODUCTION

We are increasingly mobile and connected. It is easier now than ever to access people or content using one of the many available wireless mobile devices. For example, global smartphone sales topped $69 million in 2006, with projected sales of $190 million by 2011. The number of cellular subscribers worldwide is expected to grow from 2 billion in 2005 to 3.2 billion by 2010. Europe and North America are reaching near-saturation points, and China had the highest number of subscribers with 400 million at the end of 2005. In addition, the global market for mobile-phone content, including music, gaming, and video, is expected to expand to more than $43 billion by 2010 (Computer Industry Almanac, 2005, 2006).

The evolution from mainframes to wired desktops and now wireless mobile devices has caused fundamental changes in the ways in which we communicate with others or access, process, create, and share information (e.g., Castells, Fernandez-Ardevol, & Sey, 2007; Ito, Okabe, & Matsuda, 2005; Roush, 2005). Just like the introduction of the mechanical clock altered our perceptions of time and the invention of the magnetic compass changed our view of physical space, continuous and wireless access to digital resources is redefining the ways in which we perceive and use our dimensions of social time and space.

BACKGROUND: A BRIEF HISTORY OF HIGHLY MOBILE DEVICES

The development of handheld computers (excluding calculators) can be traced back to the Dynabook concept in the 1970s, followed by attempts such as the Psion I (1984), GRiDPaD (1988), Amstrad's PenPad and Tandy's Zoomer (1993), the Apple Newton (1993-1995), and the eMate (1997-1998). US Robotics introduced the Palm Pilot in 1996, the first personal digital assistant (PDA) to feature a graphical user interface, text input using handwriting recognition software, and data exchange with a desktop computer. This device became the forerunner of several generations of devices powered by the Palm OS (Williams, 2004), manufactured by Palm, Handspring, and Sony. At the same time, Microsoft pursued the development of a Windows-based portable device. This resulted in the release of Windows CE 2.0 in 1997, followed by the Handheld PC Professional and Windows Mobile 2003 and version 5 Operating Systems (HPC Factor, 2004). Windows-based handhelds and ultra mobile personal computers (UMPCs) have been produced by companies like HP, Compaq, Dell, and more recently Fujitsu Siemens.

The development of mobile and smart phones has followed a similar path, starting with mobile rigs in taxicabs and police cars and early attempts by Ericsson and Motorola. However, the form factor did not proliferate until the development of first-generation cellular (1G) in the early 1980s, soon followed by second (2G) (1990s), and third (3G) (2000s) generation mobile phone systems such as global system for mobile communications (GSM) and universal mobile telecommunications service (UMTS). Today, a wide variety of mobile phones and services is available. Besides voice calls, mobile phones can be used for text messaging, Internet browsing, e-mail, photo and video creation, and watching TV. In addition, cell phones are increasingly used to create and share Web-based content (Hamill & Lasen, 2005).

A third and increasingly popular mobile tool is the portable game console. While many mobile devices such as handhelds and mobile phones can be used for games, it is not their primary function. Currently available systems such as the Nintendo DS and Sony

PSP have wireless capabilities and can therefore be networked locally for peer-to-peer gaming or used to access the Internet (Parika & Suominen, 2006).

Finally, the development of a range of wireless protocols has played a critical role in the technological advancement and widespread popularity of mobile devices. Currently available and common wireless technologies are described in Table 1.

GSM and UMTS are primarily used for voice calls and text messaging. Infrared (IR) and Bluetooth are most commonly used to create short-range, low-bandwidth networks such as a personal area network (PAN) to transfer data between devices that are in proximity to each other. In contrast, 802.11 wireless protocols are used to create larger networks (wireless wide area network [WWAN] and wireless local area network [WLAN]) and access the Internet.

M-LEARNING

As stated, mobile devices and wireless networks are redefining the ways in which we live and work, providing ubiquitous access to digital tools and 24/7 access to resources in popular and widely-used portable form factors. New technologies are opening up new opportunities for learning by allowing learners to be mobile, connected, and digitally equipped, no longer tethered to a fixed location by network and power cables. "M-learning" (short for mobile learning) has been defined in many different ways. According to Sharples (2007), current descriptions fall into four broad categories that focus on the:

- ***Technology*****,** that is, learning with a wireless mobile device with the emphasis being on the device.
- ***Formal educational system*** and how mobile technologies fit into and can augment institutionalized learning.
- ***Learner*** and more specifically the mobility of the learner rather than the devices. This has also been described as learning across contexts.
- ***Societal context*** and how it enables, promotes, and supports learning on the go.

While there are differences between categories, m-learning sets itself apart from other forms of learning in a variety of ways. Its unique characteristics include mobility in space and time, active, communicative, and resourceful learners, and the importance of context (Alexander, 2004; Roush, 2005; Sharples, Taylor, & Vavoula, 2007; van 't Hooft & Swan, 2007).

Mobility in Space and Time

Mobility diminishes boundaries imposed by the brick and mortar of the school building and the schedule imposed by the school day. On one hand, wireless mobile devices, wireless networks, and online spaces make it possible to extend teaching and learning beyond school walls and the school day. On the other, they can bring the larger world into the classroom. As a result, m-learning provides opportunities to bridge formal (e.g., school or museum) and informal (e.g., home, nature, or neighborhood) learning settings, engage learners in authentic learning tasks, and promote life-

Table 1. Common wireless technologies (Adapted from Cherry, 2003)*

Technology	Year introduced in mobile devices	Max Data Rate (Mb/s)	Range (meters)	Frequency Band
GSM	1991	0.26	100-35,000	400, 450, 850, 1,800, and 1,900 Mhz
UMTS	2001	14	50-6,000	850, 1700, 1885-2025, 2110-2200 Mhz
IrDA	1995	4	1-2	Infrared
Bluetooth	2000	1-2	100	2.4 Ghz
IEEE 802.11a	1999	25-54	25-75	2.4 Ghz
IEEE 802.11b	1999	6.5-11	35-100	5 Ghz
IEEE 802.11g	2003	25-54	25-75	2.4 Ghz
IEEE 802.11n	2007 (unapproved)	200-540	50-125	2.4 or 5 Ghz