

Ubiquitous Learning and Handhelds

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THE ORIGIN OF UBIQUITOUS COMPUTING

The concept of ubiquitous computing or Ubicomp was first articulated by Mark Weiser in 1988 at the Computer Science Lab at Xerox PARC (Palo Alto Research Centre). He asserted that the most profound technologies associated with ubiquitous computing are those that disappear as they weave themselves into the framework of our everyday lives. He described Ubicomp as the third wave of computing. The first wave of computing, from 1940 to about 1980, saw the use of one mainframe computer by many people. The second wave saw a one-to-one computer to human ratio where individuals were connected to desktops or laptops. We are now in the third wave of computing where many computers dispersed throughout the physical environment, service one person, and as these technologies recede into the background of people's lives, they are increasingly being used unconsciously for task completion (Weiser, 1991, 1996). In this regard, ubiquitous computing is viewed as the age of "calm technology" (Weiser and Brown, 1996). In a similar analogy, O'Malley & Fraser (2006) describe technology associated with ubiquitous computing as "tangible" in which "the technology is so embedded in the world that it 'disappears'" (p.2).

UBIQUITOUS LEARNING

When computing becomes ubiquitous, it has the capacity to support learning whenever and wherever it might take place, i.e. ubiquitous learning (u-learning). If ubiquitous learning is to occur, the technology cannot disrupt the learning process. 'Calm' or invisible technology does not occupy the learners' attention

all the time but is able to be moved seamlessly and effortlessly between the learners' central and peripheral attention. Hence, u-learning is not constrained by physical space, plans or timetables but is pervasive and occurs anywhere at anytime. This flexibility and interactivity in learning has additional advantages. Price, Rogers, Scaife, Stanton and Neale (2003) state that tangible-mediated learning could allow learners to combine and re-combine familiar knowledge in new, unfamiliar ways - promoting creativity and higher order thinking.

In education, handheld mobile technologies offer the potential for u-learning through new ways of accessing information and thinking both individually and within networked communities, where collaborating with others supports developing new understandings and arguing for new solutions. Available technologies include mobile phones, laptops, tablet PCs, personal digital assistants (PDAs), MP3 players, iPods and games consoles. These technologies enable learning to be increasingly more mobile with the potential that young people's thinking can be shaped by connectivity through these devices (Aleven, Stahl, Schworm, Fischer & Wallace, 2003; Hargreaves, 2003; Becta, 2003). Consequently, the need to think in new ways and engage with others in that thinking is increasing all the time both to respond to the new potential and to increase the potential of the technologies to benefit the interactions between teachers and students.

At a broad level, u-learning (ubiquitous learning) is e-learning (electronic learning) usually associated with m-learning (mobile learning). At the level of the learners, there are more specific requirements placed on technologies if they are to be used for u-learning (Ogata & Yano, 2003, pp. 29, referencing the work of Chen, 2002 and Curtis, Luchini, Bobrowsky, Quintana & Soloway, 2002). These are:

- Permanency where learners never lose their work unless it is deleted on purpose.
 - Accessibility where learners are able to access their files, documents and data from anywhere.
 - Immediacy where learners are able to obtain information immediately.
 - Interactivity where learners are able to interact with teachers, peers or experts through synchronous or asynchronous communication. This enables knowledge development and generation to occur more quickly and readily. It is also the crucial requirement of u-learning because it makes explicit the mutual engagement of multiple learners.
 - Situating of instructional activities where learning is embedded in the learners' daily lives.
 - Adaptability where learners can get the right information at the right place in the right way.
- connectivity to learning communities online, or networks of connected handhelds and to data collection devices in shared learning environments and
 - affordability, bridging the gap between students' socio-economic backgrounds and creating a more equitable social fabric.

These characteristics are characteristics enabled by the educational affordances that handheld computers can offer, as described in the next section.

HANDHELD COMPUTERS FOR UBIQUITOUS LEARNING

Handheld computers are mobile devices that are also known as personal digital assistants (PDA), or by reference to various 'brand' or model names: pocket PC, Palm, Palm Pilot and IPAQ. Physically they have the potential to be ubiquitous due to their small size and light weight. Educationally, they are able to offer affordances that include (Kimber & Wyatt-Smith, 2006; Perry, 2003, 2006; Sharples, 2003, 2006; Waycott, Jones, & Scanlon, 2005):

- personalised learning that fits an individual's learning path and their social networks
- portability and access to the Internet allowing for learning and data collection anywhere and anytime
- social interactivity where students collaborate and exchange data in both online and offline environments
- context sensitivity where real-time or simulated data can be collected in real-time working environments

These affordances make handheld computers powerful tools for online and distance education. They have the capacity to extend the learning experiences of learners beyond the classroom and expand learning opportunities in a seamless (ubiquitous) manner in schools, homes and the wider community. The personalization of the handheld means that the learner is an active participant in the construction of his/her own knowledge (Piaget, 1955, 1972) and that existing knowledge and a socially interactive environment are built into the learning experience as factors that affect the construction of knowledge (Vygotsky 1962, 1978). This socio-cognitive theory of learning with technology has been discussed by Ng & Gunstone (2002). Personalisation of the handheld also contributes to the creation of situated learning (Lave & Wenger, 1991) focusing on learning by doing and learning in context (Keamy & Nicholas, 2007). In order to understand how handheld computers can be u-learning devices, it is necessary to look at what these devices are capable of doing and how those capacities contribute to learning.

CAPACITIES OF HANDHELD COMPUTERS

Handheld devices are not as powerful as laptops or tablet PCs but the technology is evolving quickly as more software applications are produced. For instance the *Handango* website listed 358 applications for pocket PCs using the Microsoft platform in June, 2007 while at the same time 2,262 were listed for the Palm platform. For the moment, the affordability of the devices means that the technology is within the reach of a wider range of students than other similar technologies such as the tablet PC.

Different models of handheld computers come with different functionalities. A basic model of a pocket PC will have Word Mobile and Excel Mobile, Bluetooth capability, calendar, calculator, notepad, voice recording and presentation (but not editing) software for

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