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# A Diachronic Overview of Technology Contributing to Mobile Learning: A Shift Towards Student-Centred Pedagogies

*Helen Crompton*

## Abstract

This chapter provides a brief historical overview of the technology contributing to mobile learning (mLearning) and the concomitant progression towards student-centred pedagogies. To begin, mLearning is defined. The theoretical, pedagogical and conceptual underpinnings of it are then explained, with a focus on the technologies and the pedagogies of each decade, from the 1970s and Kay's futuristic vision of a mobile learning device, to today's mobile learning technologies that have surpassed Kay's vision.

## Introduction

Mobile learning (mLearning) is a relatively new field of learning. It is embryonic in nature, still changing form and growing. It is pushing the boundaries of traditional pedagogies and challenging epistemic beliefs. Although it may seem that mLearning has appeared from nowhere, its foundations have developed over many years. Other technological innovations such as Gutenberg's printing press and the Industrial Revolution were significant building blocks in this movement. However, to pinpoint the specific time when mLearning was conceptualised, we need to look back to the 1970s. Understanding the theoretical, conceptual and pedagogical underpinnings of mLearning from its early years through to the present day will help readers appreciate how this technological epoch has transformed the didactic world.

This chapter provides an overview of mLearning, studying each decade in regard to the technological innovations and the pedagogical change during that period. Revealed through this discussion is how the development of technological devices parallels pedagogical progression towards student-centred learning.

## Defining Mobile Learning

Before studying the conception of mLearning, it is essential for one to know what the term means in order to understand what the field encompasses. Many scholars and practitioners have tried to define mLearning, but as the field is still changing, and will be for many more years, many different definitions have been provided to recognise those changes. For example, mLearning:

- is using the Palm (an early brand of mobile technology) as a learning device (Quinn, 2000; Soloway et al., 2001).
- is any sort of learning that happens when the learner is not at a fixed, pre-determined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies (O'Malley et al., 2003).
- is a form of eLearning that specifically employs wireless communication devices to deliver content and learning support (Brown, 2005).
- is any educational provision where the sole or dominant technologies are hand-held or palm-top devices (Traxler, 2005).

From this list, it is clear which technologies were used during specific periods of time, and that even Traxler's 2005 definition is already dated with some of today's mobile technologies (such as the iPad) not fitting this definition. The definitions used as examples do have many common elements. Nonetheless, to determine what should be included in the definition of mLearning has been an ongoing debate (e.g., Laouris & Eteokleous, 2005; Sharples, Taylor, & Vavoula, 2007; Traxler, 2009). This debate will not end soon, and further research is needed to understand what mLearning encompasses (Goh & Kinshuk, 2006).

However, from a review of the literature, four central constructs of mLearning have emerged: pedagogy, technological devices, context and social interactions (Crompton, in press). Given these four constructs, mLearning might therefore be defined as: learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton, in press). Over the next few pages, this definition and the four constructs of mLearning will be used in considering the technologies and the pedagogies of each decade. First the technology will be described, then the pedagogy, before the two are discussed together.

## Evolution by Decade

### 1970s

Many groundbreaking developments in the field of technology took place in the 1970s, and the concept of mLearning was also conceived. During this decade, the first mobile phone was developed, as was the first microcomputer, VHS video-cassette recorder and floppy disc. That phone — the DynaTAC 8000X, developed by Motorola in 1973 — was the first mobile telephone a user could carry without also needing to carry a large, heavy briefcase battery. In this period, technology also merged with telecommunications, with the first public analogue software switchboards appearing in the mid-1970s.

This was also the decade in which Alan Kay had a vision for a new type of computing that was much smaller and personalised. Kay's vision was directly inspired by Moore's Law, which states that due to advancements in the miniaturisation of microchip manufacturing, the computing power of these tiny chips would double roughly every 18 months (Maxwell, 2006). With Moore's Law, Kay determined that the work that was typically accomplished on large machines would soon be possible on small and even portable devices. Kay's small portable computer ideas led to the conceptualisation of the Dynabook. Kay's Dynabook was small and light enough to be easily transported, with the ability to conduct multiple tasks and "enough power to outrace your senses" (Kay & Goldberg, 2001). This revolutionary device had a number of particular attributes (Kay & Goldberg, 2001, p. 167):

"Imagine having your own self-contained knowledge manipulator in a portable package the size and shape of an ordinary notebook. Suppose it had enough power to outrace your senses of sight and hearing, enough capacity to store for later retrieval thousands of page-equivalents of reference materials, poems, letters, recipes, records, drawings, animations, musical scores, waveforms, dynamic simulations, and anything else you would like to remember and change."

Kay's Dynabook was never actually created, but Kay and Goldberg's research led to prototype desk computers which they called interim Dynabooks (Kay & Goldberg, 2001, p. 168). Kay and Goldberg also developed a programming language called SmallTalk. This object-oriented software language resulted in the later invention of the graphical user interface (GUI) used on computers, portable media players and other hand-held devices. The GUI was a significant technological invention: the pictorial icons of the GUI enabled novice computer users to easily access and run the programmes without having to use command strings.

Kay's Dynabook was largely influenced by the work of Seymour Papert. At that time, Papert was conducting research on school children as they worked with Logo language on computers. As the students used Turtle Geometry via a computational medium (Logo), they were able to manipulate geometric constructs concretely, thus bridging the divide between the concrete and formal cognitive stages described by French psychologist Jean Piaget (Papert, 1980a, 1980b). Kay held an educational vision for young children where the Dynabook could provide cognitive scaffolding for exploring the story text, as Turtle Geometry had for mathematics.

Student exploration was a key idea in education during the 1970s. The term "discovery learning" was coined, based on the idea that students are more likely to remember facts that they deduce themselves. This built on Bruner's (1966) belief that students use past knowledge during the active learning process. This moved away from the behaviourist stimulus-response approach to a focus on students acquiring, retaining and recalling knowledge. However, during the 1970s, information and communication technologies (ICT) were scarcely seen in schools. The few students using technology in schools were typically using behaviourist computer-assisted learning programmes (Lee, 2000).

## 1980s

This decade heralded the arrival of hand-held computers, which were marketed and used within the business setting. For example, in 1980, the TRS-80 Pocket Computer from Radio Shack boasted a 24 × 1 text LCD display with 1.5 kB RAM. In 1983, Commodore Business Machines developed the HHC-4 (Hand-Held Computer), featuring a 24-character LCD screen with 4 kB RAM which was expandable to 16 kB. As this decade progressed, so did the hand-held technologies. In 1989, Atari Computer featured the Portfolio portable computer. This device, the size of a video-cassette, included a keyboard with an eight-line, 40-character wide LCD display. The Portfolio boasted 128 kB RAM and allowed the user to store information externally on memory cards. The device included a word processor, spreadsheet, calendar, calculator and address book.

These hand-held computers were becoming increasingly more personalised, and were typically marketed for the individual rather than for shared use. Telephones were becoming more personalised, which resulted in a boom in personal mobile phone sales. Mobile phones became more portable, smaller and customisable to the individual (Goggin, 2006). Computers were also becoming more personalised with the first commercial laptop computer introduced to the market in the early 1980s. These computers often replaced the static tethered home computers. Towards the end of the 1980s, some schools and higher education establishments began to make the connection between technology and the student-centred personalised learning they sought to achieve, and allowed students to bring laptops into lecture halls for note-taking purposes.

Building from the discovery-learning approach of the 1970s, the 1980s moved into constructivist and constructionist learning. In keeping with Bruner's (1966) educational philosophies, constructivism is student-centred, "proposing that learning environments should support multiple perspectives or interpretations of reality, knowledge construction, context-rich, and experience-based activities" (Jonassen, 1991). Constructivists posited that students not only bring and use their prior knowledge, but also build on that knowledge using authentic tasks. "The computer was no longer a conduit for the presentation of information: it was a tool for the active manipulation of that information" (Naismith, Lonsdale, Vavoula, & Sharples, 2004, p.12).

Papert (1980b) proffered that an additional component be added to constructivist learning: students not only learn by building from their prior knowledge conducting authentic tasks, but also that they use that knowledge to produce new ideas. Papert added that students will be most likely to do this when they are able to create some type of external artifact. For example, students could use technology to teach Karel the Robot to perform tasks in Microworlds, or use Logo to teach the computer to draw a picture. This connects with Taylor's (1980) tutor, tool, tutee computer analogy, as students would take the role of the tutee.

A key feature of constructionist learning is not just that the students are creating external artifacts, but that those artifacts are to be shared with others. The student-centred learning of the 1970s was focused on connecting learning with the knowledge and experiences of the students. The 1980s added to this student-centred approach by having the students actively involved in learning using

authentic tasks and in creating artifacts to interact with the environment and society in sharing those artifacts.

During the 1980s, schools were beginning to get more computers for the students to use. Computer-Assisted Instruction (CAI) was gaining in popularity. CAI involved students interacting with computer programmes to solve problems and work through tutorials. The most common CAI programmes were drill-and-practice programmes. The affordances of technology in education were beginning to be recognised by many. Computers were described as infinitely patient tutors, tough examiners and tutors who allowed students to work at their own pace (Kulik, Kulik, & Cohen, 1980). CAI connected with the constructivist methodology, as the students were involved in the learning process through interaction (Chambers & Sprecher, 1980) and the immediate feedback from the computers often led to an increase in student motivation (Feurzeig, Horwitz, & Nickerson, 1981). A move towards more personalised learning was highly valued.

## **1990s**

This decade heralded the use of many new technologies. The first Web browser was developed, as well as the first digital camera and graphing calculator. Multimedia computers were available for student use in many schools. The desire to personalise devices and learning was duly noted by commercial vendors. Portable digital devices were developing rapidly and PalmPilots, a form of personal digital assistants (PDAs), were the first multipurpose hand-held devices that could be used in an educational setting. These hand-held devices included calculators, memos, contacts, notepad and photos.

As the hand-held technologies developed, Sharples made an attempt to actualise Kay's Dynabook. The Handheld Learning Resource project (HandLeR) developed a prototype personal hand-held computer to demonstrate the concept and feasibility of such a mobile device for experiential learning (Chan & Sharples, 2002). As Sharples (2000) wrote, this mentor system:

“would suggest ways of studying and set up systems for organising resources and remembering ideas and events; it can provide long-term guidance on developing skills, particularly where the mentor could have direct access to the technology needed for performing the skill (such as the Worldwide Web, or a digital camera); it can act as a learning assistant in performing tasks or solving problems, but suggesting new strategies and solutions.... A computer-based mentor need not reside in a single piece of hardware; it might migrate across different physical devices, but retaining the persona and knowledge of the learner.”

Sharples' (2000) vision was similar to what mobile technologies are available today. With the pedagogical drive towards student-centred learning, there was a call for designers of educational technologies to consider how technologies could be used to meet these pedagogical efforts. Soloway, Guzdial, and Hay (1994) posited three key questions for designers: “Why support learners and learning? How might the interface support learners and learning? What are the issues involved in providing such support?” These were essential questions that needed to be asked during a time of ICT adoption in schools.

Continuing the theme of social sharing of artifacts within the 1980s constructionist era, the 1990s developed socio-constructivist learning with proponents who posited that intellectual advancement develops through scholarly interactions with others. This pedagogical philosophy particularly benefited from the social adoption of the World Wide Web during the 1990s. Early websites were static in nature and offered little interaction from the users, but they did offer a method of uploading artifacts to be viewed by the worldwide audience. The nature of distance learning changed as technology enabled lecturers to teach groups as well as individuals through the World Wide Web, changing the name to electronic learning (eLearning).

The pedagogy in the 1990s also shifted towards problem-based learning, which involved students working on authentic problems within applicable environments. This caused many field-based experiences to ignore technologies as they were too cumbersome to carry around to different locations. Thus, mobility became a desirable technological attribute.

## **2000s to Present Day**

During the past decade or so, the changes in educational technologies have risen exponentially and the majority of these advancements correlate to the demand for student-centred learning. The call for personalised learning has increased with mounting pressure from educators and from society, which has grown accustomed to a personalised existence. The mobile phone that was once a symbol of status became an everyday tool for the masses. The phones became smaller and more affordable, and now provide many of the same capabilities of microcomputers.

As the 2000s progressed, the read-only Internet changed to the dynamic interactive “read-write web” (Richardson, 2005), allowing users to create and interact with content. Great banks of digital artifacts were made available through the Internet as libraries and museums digitised their collections (Benedek, 2007). Web 2.0 tools included methods to use social theories of learning with networks such as Facebook and Ning to communicate personally and professionally, as well as virtual learning environments (VLEs) such as Blackboard and Moodle to allow students and educators to mediate Web-based artifacts and communication.

As society grew accustomed to the smartphone capabilities and Internet access, the demand also grew for a variety of features for different tasks. Although smartphones were portable and provided an easy way to access the Internet, students found the screen size made it hard to read large amounts of text because of the constant need to scroll or make the text larger (Crompton & Keane, 2012). Tablets were introduced to provide both the portability and large screen. The early tablets were laptops with the ability to swivel the screen to sit neatly on top of the case with touch-screen capabilities, such as the Microsoft Tablet PC which was available to the public in 2001. Ultra Mobile PCs (UMPCs), such as the Wibrain B1, were developed and quietly introduced to the public in 2006. These UMPC were lighter and more portable than the original tablets, but still retained a larger screen. However, these mobile devices were quickly replaced by today’s tablets, such as the iPad and Motorola Zoom, which are thinner, lighter and again more mobile.

These mobile devices are extending the boundaries of traditional pedagogies towards student-centred educational practices. Students using various technologies

can have the choice of what they learn and how fast they go through the material. Today, students also have the choice of when and where they choose to learn. In the past, technology was seen as an expensive option for educational establishments. However, with the ubiquitous use of mobile technologies in today's society, many establishments are choosing to adopt Bring Your Own Technology (BYOT) initiatives. The BYOT approach allows students to learn with whichever mobile device best meets their needs, with little to no cost to the educational establishment. Both the device and the pedagogy are geared towards student-centred learning.

## Conclusion

This chapter provides a brief historical overview of technology and mLearning and the concomitant progression towards student-centred pedagogies, from Kay's 1972 vision of students working with the Dynabook in 1972 to present-day technologies that have even surpassed Kay's futuristic ideas. Nonetheless, during those early years, Kay worked with a group from Xerox to create the Dynabook as a business computer called the Star (Sharples, 1998). The business community could not see any use for this strange machine and the concept was unsuccessful. Society was not prepared for such a tool.

It would appear that the technologies used in schools have been well aligned to the pedagogical theories of that time towards student-centred learning. There has been rapid progress in technological affordances over the past few decades, and it will be interesting as to what the future may bring.

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