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Mobile Learning: Cell Phones and PDAs for Education

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Abstract

We introduce m-learning – learning with mobile devices, such as cell phones and pocket computers. We review the hardware and research on m-learning, and discuss our future work with mobile foreign-language study.

1: Introduction

Web-based learning, embraced by many educators, extends study beyond physical classrooms. M-learning - learning with mobile devices - promises continued extension towards "anywhere, anytime" learning. This paper introduces m-learning, summarizing the limits of current mobile hardware, examining its use in education around the world, and proposing a roadmap for creating and evaluating materials for m-learning foreign languages.

2: Background: Mobile Devices

This section analyzes two mobile devices: PDAs and cell phones.

PDAs (Personal Digital Assistants) are pocket-sized computers. PDAs are extensible, with optional hardware (e.g., keyboards and wireless networks) and software (e.g., word processors, databases, bilingual dictionaries, flash-cards). PDAs cost US$100-500, but most programs are free, so running costs are zero.

Cell phones use the wireless Internet to exchange voice messages, email, and small web pages, anywhere and anytime. While they lack the flexibility of PDAs, cell phones compensate using the web: Students study foreign-language vocabulary using a PDA's custom flash-card program or hangman game; Students study using a cell phone's similar website. Cell phones are initially cheaper than PDAs: Japanese carriers subsidize hardware by bundling expensive service plans, so cell phones enjoy low initial cost (often zero), but high running costs (averaging US$700/year; the wireless web costs US$6-$70/hour). Since most students already carry phones, most classes are already equipped.

Mobile devices perform many of the functions of desktop computers, with the advantages of simplicity (being easier to learn and use) and improved **access** (being usable anywhere, anytime). But three limitations prevent mobile devices from replacing desktop PCs: bandwidth, running costs, and text input speed. The low **bandwidth** (data transfer rate) of most cell phones and wireless PDA modems prohibits quality video and sound (as needed for studying foreign-language pronunciation). A few new phones can stream media, but **cost** US$3-15/minute. Further, mobile **text input speed** is slow (10 words per minute on cell phones, 15-25 on PDAs; cf. 60 on desktop PCs). So m-learners need to limit their media to reading and multiple-choice questions.

3: Previous Work: Review of Educational Projects using Mobile Devices

Projects using mobile devices in various learning environments have begun to appear. We found nine such projects in Europe, Asia, North America and South America. These projects were set in universities, elementary schools, corporate training programs, and distance learning programs. The projects experimented with a wide range of educational activities on PDAs and cell phones: foreign-language vocabulary lessons via cell phone email; collaborative simulations using the infrared network ('beaming') capabilities of PDAs; 'just-in-time' administration (scheduling, study prompts, and reminders) via cell phones; business-oriented problem-based learning modules on PDAs; and recorded foreign-language listening materials accessed on cell phones. These projects all use mobile devices as one part of a *blended* educational program that may combine face-to-face, Web, and mobile components. They show that the unique combination of features in mobile devices - **portability, connectivity, and low cost** - makes them valuable educational tools.

Three projects are particularly notable. One, *Learning on the Move* [1], researches the educational use of mobile phone email at Japanese universities, where spaced (repeated, interval) practice of foreign language vocabulary is difficult to facilitate, since classes meet only once a week. But most Japanese university students constantly carry cell phones. This project emailed short, daily lessons to students, providing spaced practice of foreign-language vocabulary. The researchers observed few usability problems, and found cell-phone email produced learning superior to desktop email, mobile web, and paper.

Researchers in the United States have developed several educational programs for PDAs [2]. Designed for elementary schools, these programs allow educators to freely experiment with m-learning. These programs include the game-like quiz *Bubble Blasters,* the science simulation *Cooties,* and the concept map editor *PiCoMap.*

One of the earliest blended (Web + mobile phone) courses was offered for business training in Singapore. *eBusiness on the Move* [3] sent textual course content, quizzes, reminders, and human prompts to students' cell phones. Participants highly evaluated the convenience of mobile study, and appreciated the fine factoring of information enforced by the tiny size of their mobile

phones' memory and screen, but were skeptical about the idea of offering an entire distance course using only mobile phones.

3: Future Work: Research Proposal

Our proposed research examines both cell phones and PDAs in a blended environment for studying English as a foreign language at a Japanese university. One focus is pedagogy: therefore, a major part of our research is developing, evaluating, and analysing language learning activities, and then composing activities into a curriculum. We use Brown's [4] framework to design and maintain language curricula, which advocates continuously evaluating needs, objectives, tests, materials, and teaching (see Figure 1). We focus on evaluation, teaching, and materials, including mobile hardware and software.

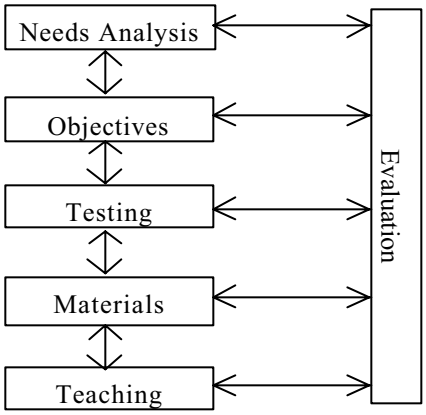

Figure 1. Systematic approach to designing and maintaining language curricula [4, p. 20, Fig. 1.2]

Brown describes teaching as comprising approaches, syllabuses, techniques, and activities. After analysing mobile hardware and software materials, we work bottom-up, first creating *activities* that are easily learned, easily used, and pedagogically appropriate. We combine them into *techniques* and *syllabi*, creating an *approach* for using mobile technology in language education.

Finally we *evaluate* the activities in Brown's three dimensions: process-product continuum, formative-summative dichotomy, and quantitative-qualitative continuum.

We brainstormed 31 activities for class administration (e.g., announcing homework assignments) and for study (e.g., emailing intermediate products of group work between members). (Although most of these activities could be used in any class, some apply only to the study of foreign-language speaking, listening, writing, and reading.) We analyze how well each of these activities exploit both the general concept of mobility, and specific mobile technologies such as infrared networks. In our future research, we will experiment with these activities in college classes, quantifying their advantages over non-mobile implementations. Our desired research outcomes include the following:

- a *taxonomy* of the relevant characteristics and educational uses of mobile technology
- a suite of classroom-tested mobile educational *software* and internet services
- a collection of technologically and pedagogically appropriate *activities*
- an *evaluation* of those activities
- a *curriculum* comprising well-evaluated activities
- a *method* or guideline for selecting or creating further m-learning activities.

4: Conclusion

Several studies have demonstrated the great promise of mobile learning. Conscious of the limitations of mobile hardware, we propose designing software for educational activities, and collecting these into a coherent method for m-learning. We feel that this research will help popularize and quantify the effects of m-learning.

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