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Ubiquitous Learning: Its Challenges and Opportunities

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Insook LEE, Professor, Sejong University

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Speaker's Name, Title, and Organization (M/F) *Insook LEE, Professor, Sejong University (F)*	
Postal Address: *Dept. of Educatio, School of the Liberal Arts,* *Sejong University* *98 Gunja-dong, Gwangjin-gu,* *Seoul, Republic of KOREA*	**Tel: +82-2-3408-3130** **Fax:+82-2-3408-3304** **E-mail:inlee@sejong.ac.kr**
Brief description of Lecture(including its purpose): The current paper intended to explore how the development of mobile technology impacts the direction of mobile learning paradigm and design. A technological revolution won't slow down anytime soon. Merging and converging of mobile computing hardware and software naturally influence into our nomadic life styles. Perhaps we are beginning to see the emergence of learning swarms, temporary learning zones, swarms, or experiences. Mobile devices have generally received a positive expectation in education. Mobile technology, as a result, nomadicity, has already had especially a significant influence on education in various ways. However, both these aspects pose the challenge of revising the curriculum to exploit them. There are main technical constrains facing effective mobile learning: most of the constrictions have quite profound design implications as well. All the guidelines share the concern that little attention is paid to the device's small screen size, restricted performance, and limited means of input; and mobile learning programs are not 'truly' mobile; they are merely portable. We need alternative design recommendations and guidelines to effectively deal with the issues of main technical features of mobile devices, including 'mobility'.	
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Ubiquitous Learning: Its Challenges and Opportunities

Insook Lee
inlee@sejong.ac.kr
Dept. of Education, Sejong University
Seoul, Republic of KOREA

Abstract

A technological revolution won't slow down anytime soon. Merging and converging of mobile computing hardware and software naturally influence into our nomadic life styles. Perhaps we are beginning to see the emergence of learning swarms, temporary learning zones, swarms, or experiences.

Mobile devices have generally received a positive expectation in education. Mobile technology, as a result, nomadicity, has already had especially a significant influence on education in various ways. However, both these aspects pose the challenge of revising the curriculum to exploit them. There are main technical constrains facing effective mobile learning: most of the constrictions have quite profound design implications as well. All the guidelines share the concern that little attention is paid to the device's small screen size, restricted performance, and limited means of input; and mobile learning programs are not 'truly' mobile; they are merely portable. We need alternative design recommendations and guidelines to effectively deal with the issues of main technical features of mobile devices, including 'mobility'.

1. Introduction

A number of recent reports, such as those produced by Becta, TechLearn and TechDis note the different technologies available (Rainger, 2002; Perry, 2003; Smith, 2003). A technological revolution through the emergence and convergence of various mobile technologies introduces promising potential for less expensive and more equitable than desktop computers and wired networking. The Internet has evolved into an environment of mobilization and will "accelerate the place at which nomadicity will evolve" (Hitch & McCord, 2004).

Kleinrock (2001) describes 'nomadicity' as 'transparent virtual networking'. The essence of the term is that the community of users - the end users- should be in charge of how, when, and to what to access in a way that is transparent, integrated, convenient and adaptive (Kleinrock, 2001; Hitch & McCord, 2004). Mobile means that "the device is small enough to fit comfortably into a purse, pocket, or holster so you can conveniently keep it with you at all times" (Livingtston, 2004). However, mobile or mobility implies more than this technical conception as we consider its potential functionality and influence into our nomadic lifestyles. This nomadic phenomenon stems not only from a multiplicity of devices but also from the immediacy that the Internet itself has facilitated.

The current paper, based on the understanding of revolutionary development and expansion of various mobile and ubiquitous technologies in the society, intended to explore how the development of mobile technology impacts the direction of mobile learning and the education paradigm as follows:

First, it reviews how mobile technology emerges, evolves, and expands; how it impacts on the society and its individuals. Second, it inquires specifically into the influences of mobile technology on education. Third, it reviews the concepts and features of mobile learning, the theoretical underpinnings. Lastly, it introduces guidelines and recommendations for designing mobile learning, after discussing the current constraints of mobile technology. In order to accomplish the study goals described above, it conducts a comprehensive literature review on the trends of mobile technology and reports and articles of mobile learning.

2. Emergence and Convergence of Mobile Technologies

2. 1. Expanding of Mobile Technologies

According to the Ministry of Information and Communication Republic of Korea (NCA Republic of Korea, http://www.nca.or.kr/), mobile phone users in Korea, as of February, 2005, are over 36.9 millions which turns out an incremental growth each month. Mobile phone users worldwide, as of the second fiscal year of 2004, have reached up over about 1.5 billion. EMS anticipates an additional 0.24 billion more users with a total of 2.0 billion during the second fiscal year of 2006. Figure 1 indicates the trends of mobile phone users worldwide.

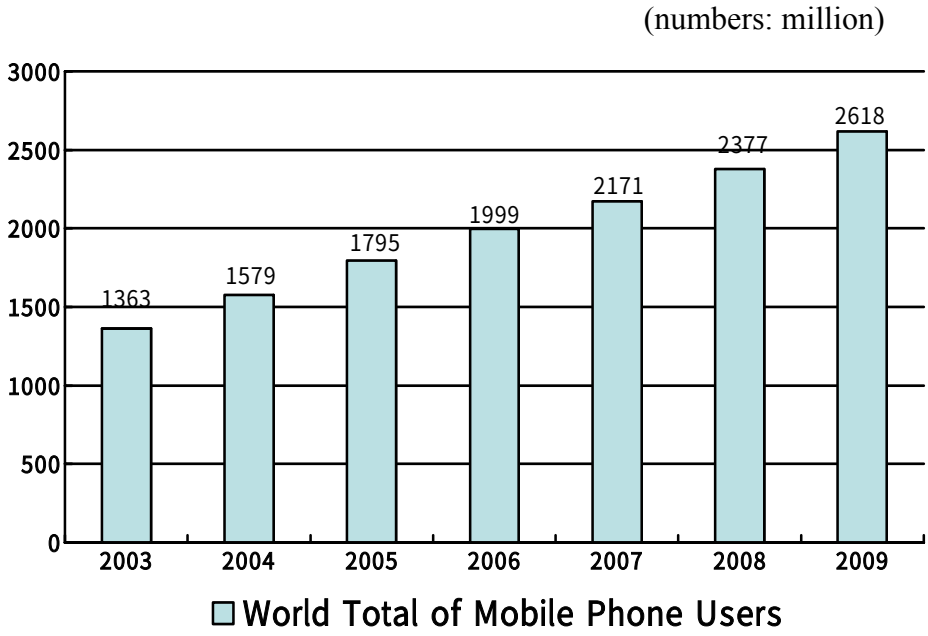

Figure 1. The Worldwide Tends of Mobile Phone Service Users (In-Stat/MDR, 2004)

Wireless technology now encompassing a broad spectrum of mobile devices (Moriarty, 2001) and especially handheld device and mobile phone technologies are expected incremental improvements. Both handheld devices and mobile phones will become increasingly wireless capable and multimedia savvy during the year as decreasing component size and increasing component performance further blur the lines between mobile devices and consumer devices (Slawsby, 2005). In fact, handheld computers are claimed to be at the forefront of the fourth wave in the evolution of technology (Pownell and Bailey, 2001).

What consists of mobile technology? First is surely hardware: mobile phones, laptops increasingly wireless, personal digital assistants (PDAs) including Pocket PCs, MP3 players, fusion devices, such as combination of phone/PDA/MP3-players, tablet PCs, digital cameras- still and motion-which are increasingly found in cellular phones, handheld gaming tools such as the NGage, which are increasingly found in celluar phones, USB drives, wireless connectivity detectors, Bluetooth-enabled devices, wireless access points, and RFID tags in the millions. There are also SMS - text messages, MMS – multimedia messages, including camera phones, VoiceXML – dialogues over the phone, J2ME – small games on mobile phones, WAP, MiniBrowser – a collection of technologies letting you browse websites from small screen devices. None of these technologies is particularly rich in itself, but combined appropriately they

can provide an engaging and beneficial experience for even the most resistant learner. (To see Figure 2- 10 for various sample images of mobile technologies)

Figure 2 Mio 169 GPS Pocket PC[1]

Figure 3. LG-lp4400 combination of phone/PDA/MP3-player[2]

Figure 4. tablet PC[3]

Figure 5. LG-lp5500 digital cameras with still and motion/MP3[4]

[1]source:http://www.digitimes.com/NewsShow/Article.asp?datePublish=2005/05/18&pages=PR&seq=205

[2]source: http://www.cyon.co.kr/good/product/product_view1.jsp?product_id=159

[3]source: http://blog.naver.com/chanoori/100009754745

[4]source: http://www.cyon.co.kr/good/product/product_view1.jsp?product_id=163

Figure 6. Nokia N-Gage smart phone protocol[5]

Figure 7. LG-sv360: Phone/Camera/Gaming tool[6]

Figure 8. LG-sb120(DMB Phone/Camera/ Receiving digital Satellite Broadcasting[8]

Figure 9. Digital Door Lock (with RFID Tag)[7]

Figure 10. Bluetooth-enabled devices: Keyboard and Mouse Logitech® Cordless Desktop® MX™[9]

[5]Source: http://www.slashphone.com/87/1943.html
[6]source: http://www.cyon.co.kr/good/product/product_view1.jsp?product_id=164
[7]Source: http://www.thinkgeek.com/gadgets/security/77af/?cpg=cj
[8]Source: http://www.cyon.co.kr/good/product/product_view1.jsp?product_id=154
[9]Source: http://blog.naver.com/z_ag.do?Redirect=Log&logNo=4923456

Unlike desktops and laptops which are more expensive, heavy, and short in electronic endurance, mobile devices are more feasible in various features including such as small, portable, compact, lightweight, relatively low cost, and long in electronic endurance. For example, palmtop computers are easier to use than desktops, possibly due to their size and comparative simplicity (Graham, 1997). The results of a recent UK schools trial (Perry, 2003) also suggest that students adapt quickly and enthusiastically to palmtops. Another benefit is the ability for palmtops with limited memory capacity to use wireless technology to access large information sources on local web servers (Ray and McFadden, 2001).

However, at the same time, "the constraints of mobile devices and the supported software are very important for delivering effective contents" (Avellis et al, 2004). The small screen size of mobile devices makes some people question their worth as e-learning delivery tools. Some critics do point to the restricted input capabilities of some of these devices, questioning students' ability to enter large amounts of text into a device to take notes or answer essay-type questions. Most of the constrictions have quite profound design implications.

2. 2. Impact of Mobile Technology to the Society: Swarming and Nomadicity

In a broader sense, mobile and wireless computing technology has changed the rhythms of social time and the uses of social space. An emergent trend is swarming: wireless and mobile technologies have enabled a variety of social groups to swarm effectively (Arquilla and Ronfeldt, 2000). Wireless and mobile computing technology is resulting in escalating transformations of the educational world too (Alexander, 2004). Perhaps we are beginning to see the emergence of learning swarms, temporary learning zones, swarms, and experiences (Bey, 1985). These can be very meaningful and positive in memory, or play a building-block role in subsequent learning, or they can do both (Alexander, 2004).

In some ways, we are presently under the similar circumstances as the early 1990s when we were connecting up campus spaces with the network for the first time and wondering about the new World Wide Web concept (Alexander, 2004). We may experience the decline of the lab and the rise of the multiconfigurable class: one result is growing interest in mobile chairs, desks, and displays; a second result is an increase in blended or hybrid learning as Internet access and collaborative learning are enhanced by

m-learning; perhaps this is becoming the default, expected form of learning; a third is the rising interest in new learning spaces such as information commons, where wireless, mobile connectivity admits the full informatic range of the Internet into any niche or conversation (Alexander, 2004).

"Ubiquitous connectivity, then, drives a more fundamental change in concepts of distance and location. Living in a fully connected world means that individuals can participate in real-time dialogues from anywhere, at any time, communicating using beepers, telephones, the Net, chat rooms, and teleconferencing." (Frand, J. L., 2000) Most young people today are more comfortable working on a keyboard than writing on a paper, reading from the screen than hardcopy. For them, 'staying connected', 'constant connectivity' or 'keeping in touch with' at any time, from any place is of utmost importance.

User's intimacy with and emotional investment on mobile devices, even on shared devices with others, become natural (Center for Educational Technology, 2004). And multitasking and collaborative use has extended and intensified as people can move and interact more easily between human, software, and hardware within the mobile technology environment. For example, especially mobile phone has potential as a collaborative learning platform.(Attewell and Savill-Smith, 2004) for young people who use phone calls and messaging for 'friendship rituals' such as gift giving and sharing (Taylor and Harper, 2002; Bauman, 2003).

3. Influences of Mobile Technology on Education

Since mobile technology has not matured, there are presently more possibilities relating to what could be done with this technology for learning than concrete or successful implementations. We are only beginning to see the potential of mobile devices in training and performance support, however, with the number of mobile devices and bandwidth for mobile devices predicted to increase dramatically in the short term, mobile e-learning appears certain to become an important part of training in the future (Lee, 2003; Avellis et al., 2004).

There are various educational benefits of handheld mobile technology; most often cited, such as portability and ease of access, the integration of computing into a wide variety of educational activities, promoting autonomous learning and student organization, promoting student motivation, promoting student collaboration and communication, and supporting inquiry-based instructional activities (Roschelle, J. &

Pea, R., 2002). However, there should expect more as mobile technology evolves and if we can learn how to integrate them into the learning, training, and education environment; for example brining nomadicity into the environment of campus.

3. 1 Brining Nomadicity into Campus

Mobile technology, as a result, nomadicity, has already had a significant influence especially on higher education various ways. A survey conducted by in the USA, in 2004, confirms its strong potential to impact higher education. Students are in contact with various mobile technologies, which demonstrate the explosive expansion of consumer technology on campus. We need to adapt to these nomadic trends and attempt to accommodate them into the campus technology resources. A more mobile environment might alter the type and shape of computing and services, such as reducing the need for general purpose labs and increasing the need for 24 hours, 7 days a week support. and a growing demand for multiplatform and device support (Hitch & McCord, 2004).

Hitch & McCord (2004) maintain that nomadicity and its associated consumerization will impact campuses in three significant ways: how to build and support the infrastructure, how to staff IT organizations and provide IT services to the campus community, and how to fund IT infrastructure and services. Flexibility is a key to nomadicity to be considered in support systems. It is especially a major task to maintain an open, flexible network that needs security and protection against malware and other vicious attacks (Hitch & McCord, 2004). Kleinrock (2001) recognizes that we need to support an infrastructure that deals with the issues of 'the usual problems of bandwidth, latency, reliability, error rate, delay, storage, processing power, component to component interface, interoperability, user interface and cost". Yet we may also need to monitor, establish governance for or control: "synchronization, directory information, access, privacy, partnerships of services, maintenance of geographically dispersed computing resources, regulatory policy, shared social ontologies, business frameworks, surveillance, privacy and even 'new time regimes of work', write Lyytinen and Yoo (2002).

In addition, nomadic users are likely to have more advanced technologies, come to campus with multiple devices of their own, and may expect that each of these devices be supported regardless of where it is permanently or temporarily housed. This suggests a necessary model very different than a Help Desk that only services a certain brand or two of desktop computer.

Having an impact on the budget, "we may see those cost savings absorbed by the increase in support costs and licensing fees needed to access software remotely; by the need to offer storage capacity; by the requirement for WAP and other tools to provide learning and administrative services to PDAs and cell phones; and by the increased costs for security." (Hitch & McCord, 2004)

3. 2 Increasing Collaboration, and Sharing

The potential for ubiquitous 'ready-at-hand' palmtops to change this situation is great. Ubiquitous computing, through the pervasive use of computing, can increase learning, collaboration and sharing (Savill-Smiths and Kent, 2003; Soloway et al., 2001; Inken, 1999; Gay et al, 2002). Together with web-based services, mobile learning can enable collaborative learning and access to different information sources in actual problem-solving situations (Jonassen, 1995; Sharples, 2000; Leino et al., 2002).

"Desktop computers do not meet students' learning needs for mobility within and outside classrooms. Nor were they designed to empower students to take their technology with them for field testing, thus providing them with both a sense of ownership of the technology and ownership of their own learning process. Moreover, even if the students have a space on the school's network to store their work, thoughts, ideas, data, and drawings, this information is not usually available to the student at home or in their neighborhood."(Crawford and Staudt, 1999) "New handheld technologies, coupled with inexpensive networks, could enable students to carry personal tools of inquiry into the field, between their classes, and between school and home. They could empower collaboration and networking regardless of location."(Kate Crawford and Carolyn Staudt)

There is mounting evidence that daily, pervasive use of computing leads to increased learning (Soloway et al., 2001). Inken (1999) and Gay et al (2002) maintain the notions that learning through the use of portable computers are most successful when they are used for collaboration. One trial using Radio-based wireless (eg Bluetooth™) by technology at school level by Pfeifer and Robb (2001) notes the extended possibilities for collaboration using portable keyboards. Infra-red beaming can also be used by students to exchange concept maps for peer critiques in which students can demonstrate their understanding of a topic, eg the weather in the MaLTS project using the PiCoMap program (Luchini et al. 2002).

3. 3 Promoting Active, Flexible, and Reflective Learning

Mobile computing technology offers the possibility of ubiquitous computing.- users are in the central focus in a computing environment, flexible access to computing, providing 'augmented reality' (Savill-Smiths and Kent, 2003). Palmtops can be used anywhere inside an educational institution, or outside, for example on field trips. One vision of ubiquitous computing is that of augmented reality, in which for example buildings on a campus or objects in a museum will be able to 'talk' and offer information about themselves to the pocket computers of passers-by and museum visitors. Such information can be tailored to the native language reading level or learning style of the user and from the information programmed into the handheld device.

An inexpensive handheld unit eases the problems of access to powerful representational tools, such as graphing calculator, tools for mapping concepts, running simulations, gathering data, etc are also appearing in handheld form. (Roschelle, 2003). An exciting aspect of wireless mobile technologies for education is that tools that first existed only on expensive desktop machines are now being made available on inexpensive handheld units (Soloway et al., 2001).

Handheld technologies can provide access to computing at the places where children's activities and learning occur, unlike desktop computers which are often segregated from other learning activities in the classroom (Inkpen, 1999). Flexible access means opportunities to integrate learning technology into children's daily activities (eg the success of handheld toys like Gameboy™ and Tamagotchi™), where the products themselves become part of the children's culture.

Palmtops support flexible 'cycles of doing and reflecting' (not tied to infrequent, timetabled access to a computer laboratory), and direct and immediate 'collaboration and sharing' (especially via infrared 'beaming' between palmtops.) However, both these aspects pose the challenge of revising the curriculum to exploit them." (Soloway, 2001; Soloway et al., 2001). The need for students to record their experiences, both to report back information to their tutors (to be assessed about their performance in practice) and to encourage students to be reflective about their learning experiences (Alderson and Oswald, 1999; Sommers et al., 2001). It also appears to encourage the students to work collaboratively in a clinical environment by taking notes (Ubaydli and Dean, 2001).

4. What is Mobile Learning?

4. 1 Concept of Mobile Learning

The concept of mobile learning is relatively new; however, it has recently attracted the interest of various stakeholders, i.e., researchers, educators, learners, and business groups. Mobile learning can be defined as 'learning using mobile and wireless computing technologies in a way to promote learners' mobility and nomadicity nature'.

Mobile learning is often defined as learning that takes place with the help of mobile devices (eg Quinn, 2000). Milrad (2003) notes e-learning as 'learning supported by digital "electronic" tools and media' and mobile learning as a special kind of e-learning, using mobile devices and wireless transmission'. Both of these terms encompass a wide variety of the state-of-the-art technologies and initiatives (Stone, 2004). Mobile learning is bound by a number of special properties, such as 'the form factor of mobile devices' (Stone, 2004), which is the size and physical arrangement and configuration, the capability and features of devices, bandwidth and other characteristics of the network technologies being used, etc. Moreover, mobile learning is a heterogeneous environment; it encompasses a range of devices and network technologies (Stone, 2004).

4. 2 Fragmentation in mobile learning

Sociological research on mobile use indicates the growth of flexibility but also of the micro-level inefficiency, for example when meetings are cancelled at the last minute (Cooper, 2002; Kopomaa, 2000; Laurier, 2002). Therefore, the promise to work or learn regardless of time and place should not automatically be included in the definition of mobility or mobile learning (Syvanen, Pehkonen and Turunen, 2004). Learning with mobile devices is a highly fragmented process which should be taken into account in designing as well as in developing evaluation methods for mobile learning materials and environments (Regan, 2000; Syvanen, Pehkonen, Turunen, 2004) .

Fragmentation in learning is understood as when the learning experience does not form a meaningful continuum because of the environmental disturbances, poor concentration of the learner and technical problems, such as bad network connections or problems with the devices and the applications (Syvanen, Pehkonen, & Turunen, 2004). Regan (2000) raised the issue that on-the-go learning situations are often disrupted or take place unexpectedly, and the focus of attention in this situation can easily be

distracted. It can be questioned whether these on-the-go situations form a strong foundation for meaningful mobile learning (Leino et. al., 2002).

"Moreover, when people access information sources and learning objects via different devices from different locations, there are still many usability, compatibility and accessibility related questions that hinder seamless mobility and mobile learning." (Syvanen, Pehkonen and Turunen, 2004) According to Cowan (1995), the presence of attention is a key element at the time of both information processing and recall.

4. 3 Constructivism

In some literature, the ideas of constructivism are most frequently discussed as underpinnings to be considered when designing mobile learning. And development in pedagogy has moved away from the transmissive mode of teaching and learning toward the constructivist or sociocognitive models. The focus of constructivism (see Duffy & Jonassen, 1992) and socio-cognitive view (see Rogers, 2002) is on learner control. A few examples of applying those concepts include collaboration, sharing, communication, contextual learning, and reflection through experiences.

Although the use of a mobile technology might seem, on the surface, to be an extremely isolated, individualistic activity, young people can communicate with each other quite successfully in the process of using the devices (Colley and Stead, 2004). Collaborative group work and sharing with peers and others can be a powerful way of confronting one's own pre-conceptions and contributing to restructuring one's cognitive schemas or creating new conceptions.

Educational research into situated learning has also noted the importance of giving learning a 'context'. In the situated learning approach, knowledge and skills are learned in the contexts that reflect how knowledge is obtained and applied in everyday situations (Lave and Wenger, 2001). Situated cognition theory conceives learning as a socio-cultural phenomenon rather than an individual phenomenon of decontextualized knowledge acquirement. In that sense, mobile materials, especially games can be developed that are usable by groups as well as by individuals (Colley and Stead, 2004). Furthermore, social constructivism considers socio-affective factors and the role of mediation of action through artifacts to be significant in encouraging learning. "This is highly relevant to mobile learning features." (Taylor, 2004)

5. Guidelines and Recommendations for the Design of Mobile Learning

The most significant design restrictions of palmtops, according to Hayhoe (2001), are the small display screen, and the limited brightness and contrast. Considering this restrictions, he suggests the following suggestions:

- Realize that reading online at low resolution reduces reading comprehension significantly
- . Think in terms of nuggets or specks, not chunks
- . Be prepared to display text in larger type than you are accustomed to seeing in documents designed to be read on the desktop
- . Apply bold, italics and color with caution
- . Don ‘t expect to have access to a large variety of fonts
- . Employ graphics in very minor supporting roles rather than as a primary means of communicating information.
- . Don’t assume that other supporting media will be available
- . Remember that most of the current installed base of handheld and wireless devices have very modest capabilities
- . When designing for a particular installed base, consider the capabilities of the standard device in design decisions
- . When designing Webpages for reading on handheld devices, remember that the screen orientation is portrait not landscape, and that the screen width is very narrow

Based on the nature of mobile devices, with their small screens and poor input capabilities, Anna Trifonova (2003) also suggests instructional design tips considering certain constraints in mind. According to her, short, simple, area/domain specific content might be very suitable for using the mobile device efficiently for learning purposes, considering its certain constraints, which are quite interesting for instructional designers as follows:

1) Short, no more that 5-10 minutes long, modules: The participants should be able to use their small fragments of waiting time (i.e. waiting for a meeting or while traveling in a train) for learning, like reading small pieces of data, doing quizzes or using forums or chat for finding answers to “on field” questions.

2) Simple, funny and added value functionality: The computational power and other properties of mobile devices make it difficult to use complex and multimedia content. It should be possible to use an m-learning system without having to read a thick

user manual, and one should find it more interesting or necessary and useful (or at least equally) to study using this m-learning system in his/her 5 min. break than playing a game on the same device.

3) Area/Domain specific content, delivered just in time/place: The mobility should bring the ability to guideline and support students and teachers in new learning situations when and where it is necessary. The dependency of the content can be relative to location context (i.e. the system knows the location where the learner resides and adjusts to it), temporal context (i.e. the system is aware of time dependent data), behavioral context (i.e. the system monitors the activities performed by the learner and responds to them adjusting its behavior) and interest specific context (i.e. the system modifies its behavior according to the user's preferences). Of course a mix of the contextual dependencies is possible and likely."

In addition, online help systems are an important supporting component for educational software. However, Hayhoe notes some technical problems with interoperability between different mobile devices. For example, PalmOS cannot multi-task and although PocketPC systems can, the interface is not helpful for switching between programs. Thus, he suggests that help systems, web content and e-books include the following.:

- Consider seriously the need to provide user assistance for all handheld and wireless applications, no matter how simple
- . Convince programmers to provide a link from the application to the online help
- . Include a one-page table of contents for at least the first level help topics
- . Ensure that help is task-based, succinct and sufficient for various user types
- . Organize help topics using a streamlined step model
- . Offer HTML, HDML and WML versions of web content 25
- . Provide suitable navigation, writing, content depth, information display and supporting media for each version
- . Use each platform's de facto standard format to deliver e-book content to handheld devices
- . Use the appropriate platforms to write and test documents
- . Never ship a document without testing it with real user

Finally, considering that user environments for handhelds are very diverse, Hayhoe makes the following suggestions for designers relating to users' environments and the tasks the users perform.

- . Always analyze users, their tasks and their environments when designing online documents for wireless and handheld platforms
- . When applying the results of your analysis to the design, be sensitive to the wide range of places, times, atmospheric conditions, lighting and noise levels in which your electronic documents will be used
- . Minimize file sizes to ensure quick loading of documents and to reduce the space required to store the document and load it in working memory
- . Limit the amount of interactivity and scrolling required avoiding user annoyance and frustration
- . Recognize that these devices are almost always held in one hand, so the user has only one hand free for interaction with the device
- . Be aware of a variety of user postures
- . Limit the use of sound, and allow the user to mute it easily

6. Challenges and Opportunities for Designing Mobile Learning

A technological revolution won't slow down anytime soon: palmtop computing devices are evolving rapidly and the Internet has evolved into an environment of mobilization. Merging and converging of mobile computing hardware and software naturally influence into our nomadic life styles. Perhaps we are beginning to see the emergence of learning swarms, temporary learning zones, swarms, or experiences.

Wireless technology now encompasses a broad spectrum of no mobile devices and it is composed of various hardware and software. However, none of these technologies is particularly rich in itself, but combined appropriately they can provide an engaging and beneficial experience for even the most resistant learner. Mobile devices are small, portable, compact, lightweight, relatively low cost, and have a long electronic endurance or using a couple of standard disposable or rechargeable batteries. However, there is a concern of the small screen size so not fit as e-learning delivery capability and the restricted input capabilities.

Mobile technology, as a result, nomadicity, has already had a especially significant influence on higher education in various ways. Ubiquitous computing, through the pervasive use of computing, can increase learning, collaboration and sharing. An

exciting aspect of wireless mobile technologies for education is that tools that first existed only on expensive desktop machines are now being made available on inexpensive handheld units. Palmtops support flexible 'cycles of doing and reflecting' and direct and immediate 'collaboration and sharing'. However, both these aspects pose the challenge of revising the curriculum to exploit them.

Mobile devices have generally received a positive expectation in education. However, there are main technical constrains facing effective mobile learning: most of the constrictions have quite profound design implications. In this paper, there are two different design guidelines introduced, especially considering the constraints of mobile devices. First one is a more compressive guideline (Hayhoe, 2001) covering whole range of issues in the guidelines; the other (Trifonova, 2003) is 'tips,' of sorts, which might be a quick user guide for designing mobile learning.

All the guidelines share the concern that little attention is paid to the device's small screen size, restricted performance, and limited means of input; and mobile learning programs are not 'truly' mobile; they are merely portable. We need alternative design recommendations and guidelines to effectively deal with the issues of main technical features of mobile devices, including 'mobility'.

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