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Critical Issues for Successful m-Learning in Elementary Schools

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This research provides implications. Multiple case studies with three elementary schools conducted through observations and interviews have identified critical factors for success and challenges. For m-learning implementation using ubiquitous computing for future, extended operation, several considerations are suggested within the areas of organization, teaching, learning, and technology.

Keywords: m-learning, primary education, success factors, ubiquitous computing

RESEARCH BACKGROUND AND GOALS

In a broad sense, mobile and wireless computing technology has changed the rhythms of social time clock and the uses of social space. The nature of wireless and ubiquitous technology is a personal, constant presence on or about the user's person. Its importance to teenage identity and friendship especially makes it extremely popular among those young people. With the number of mobile devices predicted to surpass the number of conventional computers in total web access in the near future and with bandwidth for mobile devices predicted to increase dramatically in the short term, mobile learning appears certain to become an important part of learning, education, and training in the future (Lee, 2003; Avellis et al., 2004).

> "As ICT become more ubiquitous and as communication habits change, it is inevitable that educational applications will also evolve, with pressure coming both from the demand side and the supply side. That is, consumers of education will increasingly demand access to learning through the new mobile ICT delivery systems and providers of education, that is corporations, governments, and educational institutions, will seek ways to offer their instructional services to the broadest audience in the most convenient fashion, and at the lowest price."(Lee, 2006)

Mobile technologies are composed of various hardware and software, e.g. mobile phones, laptops increasingly wireless, personal digital assistants (PDAs), MP3 players, combination phone/PDA/MP3 players, USB drives, Bluetooth-enabled devices, wireless access points, and RFID tags and many others. None of these technologies is particularly rich in and of itself, but combined appropriately they can provide an engaging and beneficial experience for even the most resistant learner.

With the same expectations of the previous notions, Korea MOE & HRD and Apple Korea have employed joint efforts to integrate mobile personal computer technology in the form of wireless laptop computers into the regular classroom setting. In the fall semester of 2005, three selected elementary schools in Seoul Metropolitan city, Incheon Metropolitan City, and Gyeongi Province were selected. During the first year of the 3-year project, those schools mainly put their time and effort into setting up hardware and software infrastructures and providing relevant IT training and education to teachers, students, and some parents. During the spring semester of 2006, those schools had implemented wireless laptop computers into regular classroom activities; however, those practices were not accepted by Korea MOE as either very systematic or well organized. At the outset of the second year, the MOE & HRD proposed the need for measuring learning achievement for the purpose of quality control.

At last, learning achievement had been measured after 5-week pre-planned lessons, and in addition, the level of learners' satisfaction, self-efficacy, and motivation, regarding the Mac-wireless computer integrated instruction/learning process and results were measured. Research results from comparing pre- and post-test scores showed, in general, that three schools experienced very positive learning enhancement after the 5 week treatment. The questionnaires of satisfaction, self-efficacy and motivation also proved to be positively impacted by the Mac-integrated activities in general. However, there were slight differences among schools. Discovering what might be the reasons behind those differences is the challenge leading to the present study.

The overall research aim is to identify the positive and negative factors impacting Mac-wireless computer integrated instruction/learning activities. Based on these findings, the paper is intended to provide future strategies for operating this experiential project for the greater enhancement of learning achievement and satisfaction.

PREVIOUS RESEARCH ANALYSIS

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 has been often defined as learning that takes place with the help of mobile devices (e.g. Quinn, 1996). Milrad (2003) describes 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'. However, mobile learning can be better defined as 'learning using mobile and wireless computing technologies in a way to promote learners' mobility, nomadicity, and swarming nature.' In a pedagogical sense, the evolution and expansion of mobile technology has produced various changes in the educational sector. Lee (2006) introduced 'nomadicity' and 'swarming' as positive key concepts when considering the educational applications of mobile technology.

Nomadicity

The concept of nomadicity has been described in various articles, but each description basically shares the idea of 'the locus of control of information technology in the hand of the end users'. 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 on our nomadic lifestyles. 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).

This nomadic phenomenon stems not only from a multiplicity of devices but also from the immediacy that the Internet itself has facilitated. The wide range of campus information services, which had been once limited to physical sites such as the wired desktop, can now be accessed from anywhere and on any type of Internet-enabled electronic devices. And our community of users will not want to have to duplicate information on each of their devices (Hitch & McCord, 2004).

Most students today are more comfortable working on a keyboard than writing on paper and reading from a screen than a hardcopy. For them, 'staying connected' is one of utmost importance. They are trying to keep in touch with friends and family at any time, from any place. "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)

Mobile technology and, as a result, nomadicity has already had a significant influence especially on higher education various ways. A survey conducted in 2004 confirms its strong potential to impact

higher education: most CIOs (Chief Information Officers) defined mobile technology as wireless and saw wireless technology augmenting, not replacing, wired networks. Many questioned how to control the nomads and how to address security. Several envisioned that a more mobile environment might alter the type and shape of computing and services (such as reducing the need for general purpose labs and 24/7 support). And all CIOs saw a growing demand for multiplatform/device support (Hitch & McCord, 2004).

Swarming

An emerging 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 a network for the first time and wondering about the new World Wide Web concept. We may experience the decline of the lab and the rise of the multi-configurable 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, and 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).

Teaching, Learning, and Communication Factors in Successful m-Learning

Hill, Reeves & Heidemeierd (2000), after reviewing various educational projects in ubiquitous computing environments, provided a comprehensive 'recommendations for u-computing environments using portable technologies in three areas: teachers and teaching, students and learning, and communication activities.

Table 1. *Recommendation for Supporting Teachers and Enhancing Teaching Practices*

Training in the use, integration and management of technology is critical and should be provided throughout the implementation (Peacock & Breese, 1990)
On-going, just-in-time training and support is needed and required to ensure the success of the project (Gottfried, 1997)
Anticipate and prepare for shifts in expectations in terms of how the technology is used and corresponding levels of support (Robertson et al., 1997).
Teachers need time on many levels: time to revise their lesson plans to integrate the technology, time to play with the technology, and time to adjust their strategies to incorporate the technology into their teaching practices (Becker, 1994; Decort,1994; Ely, 1990; Gottfried, 1997; Newhouse, 1997)
Allow teachers to personalize their laptop. Teachers need to take ownership and use the technology in ways that will support their individual needs and accommodate individual styles. This will assist with building positive attitudes and make gaining experience easier, two elements discussed as necessary for successful implementation of laptops (McMillan & Honey, 1993; Newhouse, 1997).
Encourage teachers to explore ways to adjust their lessons to more tightly integrate the technology with the content (Gardner et al.). To be truly integrated, the laptops need to move from being a product technology to an idea technology (Hooper & Riever, 1995).
Make the network as reliable as possible, and ensure teachers that they are working in a safe and stable environment.
Assist teachers in making the transitions in the roles they play in the classroom, and well as meeting the expectations of the students (Rowe, 1993).

Table 2. *Recommendations for Supporting Students and Enhancing Learning Activities*

Training in the use and management of technology is critical and should be provided throughout the implementation (Peacock & Breese, 1990)
On-going, just-in-time training and support is needed and required to ensure the success of the project(Gottfried, 1997)
Anticipate and prepare for shifts in expectations in terms of how the technology is used and corresponding levels of support. Also be prepared for expectations of regular and frequent use of the laptops (Robertson et al., 1997). ` Students need time to play with the technology so they can increase their proficiency with the tools (Becker, 1994; Decort, 1994; Ely, 1990; Gottfried, 1997; Newhouse, 1997)
Allow students to personalize their laptop. Students need to take ownership and use the technology in ways that will support their individual needs and accommodate individual styles. This will assist with building positive attitudes and make gaining experience easier, two elements discussed as necessary for the successful implementation of laptops (McMillan & Honey, 1993; Newhouse, 1997).
Students will quickly develop competence and independence with the technology. Promote development of self-directed self-regulated skills, and assist students with developing literacy with the tools (computer, information, etc.)
Make the network as reliable as possible, and ensure students that they are working in a safe and stable environment.
Assist teachers in making the transitions in the roles they play in the classroom and increased levels of responsibility (Rowe, 1993).

Table 3. *Recommendations for Enhancing Communication Activities*

Make the network as reliable as possible, and ensure teachers, students, staff and parents that they are working in a safe and stable environment. On-going, just-in-time training and support is required to ensure the success of the project(Gottfried, 1997)
Use communication technologies to extend and enhance communication and the community (Smith & Anderson, 1994)
Establish communication ground rules and expectations.

METHODS AND PROCESSES

The current research has been conducted with qualitative methodologies. Qualitative collective case study (Stake, 1995) was intended to discover in depth the features related to learning achievement and satisfaction, efficacy, and motivation; and to further analyze the cultures of school, teachers, and students. Various documents produced by schools were reviewed, interviews with focus groups were conducted and observations in and outside classrooms were made during the period of 6th of Nov. - 15th of Dec, 2006:

1) Document analysis of participating school's project proposal, 1st year interim report, the next year proposals, 5-weeks lesson plans, designed instructional and activity material, learning outcomes.

2) Interviews of teachers (class teachers, colleagues, research leaders), students, parents, principals, and the APPLE Korea staff, in order to find out various dimensions levels from diverse data sources. Especially, the first interview results with teachers and students have been implemented to revise the first draft interview questionnaires of the satisfaction and motivation survey.

3) Observation to discover if the lesson plans are implemented as planned, how students perform their activities, how Mac laptops work in classroom setting, and how teachers perform inside and out of classroom and how school leadership and culture functions.

Table 4. *Field Information Collection Timetables and Purposes*

Date	Location	Purpose/Data
Oct. 2nd	KERIS	First meeting with school teachers
Nov. 6th	KERIS	Second meeting with school teachers
Nov. 9th	Apple Korea	Visit and Software workshop
Nov. 20th , Dec. 6th Dec. 19th	S Elementary	School visit: Interview & observation 5 teachers, principal, 2 students
Nov. 22nd Dec 8th	I Elementary	School visit: Interview & observation Campus, 2 classes
Nov. 24th, Dec. 11th Dec. 26th	G Elementary	School visit: Interview & observation 3 teachers. Vice principal, 2 students, 2 parents

INTRODUCTION TO THE THREE EXPERIMENTAL SCHOOLS

S Elementary School is located in Seoul operating three different classes of the 4th grade with either Korean Language or social studies. This school turned out to integrate relatively more Macintosh software into activity-centered and collaborative/cooperative learning activities within the regular classes than the other schools. I Elementary School is located in Incheon. It operates two different classes of the 5th grade with either Korean or social studies. This school operated teacher-led lectures using the Mac laptops for individual worksheet activities. G Elementary School is located in Gyuangmyung operating one 4th grade class for Social studies. This school also implemented more Macintosh software in regular classes of activity-centered and collaborative and cooperative learning activities. Please refer to the following table for specifics information of participants.

Table 5. *General Information of Participants*

School	Grade	Class	Subject	Numbers of Students	Total
S Elementary School	4	1	Korean Language	26	168
		2	Social Studies	27	
		4	Social Studies	25	
I Elementary School	5	4	Korean Language	30	
		8	Social Studies	28	
G Elementary School	4	5	Social Studies	32	

In July 2006, those schools submitted the first year interim reports to the MOE and soon after, in August, the second year proposal. Wireless Apple laptop computers were been provided within regular classroom settings. Main software implemented was Safari, Keynote, Pages, Garage Band, Comic Life, ARD and imovie HD.

Keynote, a presentation tool with various templates and simple interface, can be easily inserted movies, music, and images with a simple drag of the mouse has been broadly used for learning activities and tasks. The Safari web browser was most frequently observed the classroom activities, used to search various resources during the learning process. Pages, newspaper and report publishing software, helped students to produce high quality reports and newsletters with simple drag and drop functions. Pages is very often

used along with Keynote. Garage Band enabled the production of music and mp3 files through a microphone. Comic Life helped learners produce comics easily by using ready-made comic templates and bubble insertion functions. Comic life was used in H Elementary School. ARD in the teacher's computer can monitor and control each learner's computer screen. However, this advanced function was not used in those schools. I-movie HD (movie editing software) helped teachers to flexibly edit and use movie recourses. It can be used to shoot and edit actual video images by connecting it to iSight. S Elementary school partially used podcast with a link to ipods. iChat, a communication chatting tool, can support a total of 4 computers at the same time for chatting during video-conferencing. However, in those schools, teachers used iChat to simply transmit materials to students. The following Figure 1 introduces some of the software:

Figure 1. *Key Software Used in Schools*

FINDINGS AND IMPLICATIONS

The present investigation research discovered, through observations, interviews, and document analysis, important factors influencing on the processes and products of Mac-wireless computer integrated instruction/learning.

Table 6. *Positive and Negative Factors in the m-Learning Effort*

Section	Positive factors	Negative factors
Organization-administration	◦ Principal's proactive understanding and encouragement, public expression of interest ◦ Principal's participative leadership ◦ teacher colleagues support and encouragement ◦ School stakeholders' (teachers, students, parents) interest and pride in participating in the m-learning project ◦ approach of experimenting with the same student members for multiple years ◦ school location in areas of economic stability ◦ parents' high interest in education in general	◦ school disposition of sharing (insufficient) IT with everyone ◦ approach of experimenting with the different student members each year ◦ school administration designating research teachers who lack deep understanding of m-learning project ◦ lack of interest by other colleagues ◦ School stakeholders' (teachers, students, parents) lack of interest in m-learning project ◦ disposition of the school that parents might not be interested in education or m-learning in general ◦ school location of low income areas

Class room	Teaching -teachers	◦ positive attitude of class teachers (toward m-learning and their students) ◦ class teachers' challenge concerning new instructional methods and educational utilization of IT ◦ class teachers' curiosity and specialties in IT ◦ class teachers' fluent teaching skills ◦ technology support teachers' IT competencies ◦ learning-teaching models appropriate to m-learning: self-directed, participatory, and cooperative/collaborative ◦ subject areas suitable to m-learning activities ◦ physical arrangement appropriate to m-learning and related learning models ◦ selecting software responding to individual learners' preference ◦ instruction process of clear learner roles	◦ Negative attitude of research teachers (toward m-learning and their students) ◦ research teachers' lack of challenge concerning new instructional methods and educational utilization of IT ◦ research teachers' lack of curiosity and specialties in IT ◦ Textbook & Teacher-led learning styles ◦ teachers' short teaching experience ◦ lack of challenge to a new instructional method and IT use (especially Mac) ◦ lack of competencies to grab learners' interest
	Learning -learners	◦ learners' high motivation to m-learning ◦ Active learning attitude ◦ high proficiency concerning m-learning ◦ attitude to apply what has been learning within the class to outside ◦ high communication and time management skills	◦ repeated negative experiences of IT (system failures, internet disconnections ◦ distractions during the class ◦ low competencies of using software
Technology		◦ Stable computer system ◦ Easy access to hardware ◦ m-technology use based on school needs, conditions and learning goals ◦ IT training in advance to m-learning implementation ◦ customized IT consultation during m-learning implementation ◦ quick repairs ◦ internal and prompt competencies of facility repair	◦ unstable system and frequent program errors ◦ frequent laptop software and hardware troubles and lack of in-time repairs ◦ absence of continuous and needs-specific training on Apple computer ◦ lack of Korean manuals ◦ low accessibility and compatibility: one computer per many students, short battery duration, sharing computers with multi-classes, no wireless connection outside school

In slight contrast to Hill, Reeves & Heidemeierd (2000)'s frame of teaching, learning, and communication, the present research came to identify critical factors in the areas of organization-administration, teaching-teachers, learning-students, and technology infrastructure. Especially 'communication' areas might not have emerged very distinctly since this m-learning project is only at the beginning stages of using portable technology and in addition is still limited within classroom setting. However, the current investigation confirmed the critical nature of training in technology use and instructional design, time,

mind shift and role changes, competency in the use of IT, and technology infrastructure support.

I learned following issues for the successful use of portable technologies within elementary schools as (Refer to Table 6 for more comprehensive factor lists): The principle's sincere interest and support and appreciation of the organization-administration, colleagues' active concerns and support, coherent operation of classes, students' economic stability, and parents' high levels of interest. There are various critical support factors for teachers,: positive attitudes toward students and technology, posting challenges toward mobile learning and IT application, curiosity and competency concerning IT, several years of teaching, selecting of subject areas appropriate to mobile technology, classroom operation implementing instructional design considering mobile learning and technology features, and classroom settings and environment appropriate to mobile learning and technology. In students there should exist students' high motivation, an active attitude, and advanced skills concerning mobile learning and technology; willingness to use learned information and skills; time management skills; communication skills. Lastly, of technology infrastructure, there are stable computer and network systems, error-free programs, easy access to hardware(computer), specialized/customized operations fitting to specific schools, selective uses of software and functions appropriate to learning goals; IT training sessions provided before actual classroom implementation, IT consulting and prompt A/S, internal competencies in fixing devices.

Mac-wireless computer integrated instruction/learning practices can be further extended to more schools and a longer period of experimentation at each school should be allowed. However, for the future extended operation of this Mac-integrated instruction project, I especially suggest considering the following approaches:

(1) ensure principle's active leadership, which might be the initial step in developing a promising mobile learning environment,
(2) express out pride continuously and share it among stakeholders (administrators, teachers, students, and parents) that might be the must to build confidence about the success of mobile learning within schools,
(3) pose active and challenging disposition,
(4) develop and save field-oriented mobile learning and instruction models and cases,
(5) assure an infra system early before operating mobile learning activities,
(6) continually supply computer devices and software into classrooms; and
(7) provide and diversify related IT training and education.

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