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（第 1 年）

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1. Introduction

Computers and the Internet designed for educational purposes have fundamentally altered school education, especially in universities. With the enormous advances in computers and the Internet, the e-learning (electronic learning) urgently needs the application of new technologies in order to enhance the quality of teaching and learning (Liaw, 2002). In essence, e-learning systems, such as the Blackboard or WebCT, possess four characteristics (Liaw & Huang, 2003). First, e-learning offers a multimedia environment. Second, e-learning system supports interactive communication whereby users have full control over their own learning situations. This high-level interaction gives them dynamic control of information. Third, e-learning supports networking for accessing and sharing information. An e-learning system goes beyond static Web pages, by creating fully interactive networks with information exchange between learners and servers. And fourth, by implementing as a web-based application, e-learning provides a cross-platform environment, which allows e-learning systems to be executed independently on various computer operating systems. In an e-learning system, information and resources from around the world can be accessed by anyone from anywhere in the world as long as he/she has a computer with an Internet connection.

Although e-learning has educational benefits and thousands universities employ it, exploring learners' attitudes toward it is an essential issue for empowering e-learning effects. In recent years, researchers have initiated studies that explore which factors are relevant to learner satisfaction, intention, or education effectiveness in the e-learning environment. Volery and Lord (2000) conducted a survey amongst students enrolled in an online management course at an Australian university, and identified critical success factors in e-learning were characteristics of technology, the instructor, and the previous use of the technology from a student's perspective. Sun, Tsai, Finger, Chen and Yeh (2008) investigated positive factors for e-learning and the results revealed that learners' computer anxiety, instructor attitude toward e-learning, course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessments are all critical factors for affecting e-learning usage. Wang (2003) developed an instrument for measuring learner satisfaction with asynchronous e-learning systems and learner interface, learning community, content, and personalization are all significant factors. Chen, Lin and Kinshuk (2008) also analyzed users' satisfaction toward e-learning and results presented four factors that including administration, functionality, instruction and interaction.

An educational theory of e-learning should embrace the considerable part of learning that occurs outside classrooms and lecture halls as people keep doing their learning activities. The activity theory is a cultural-historical activity system and is

mediated by tools that both constrain and support learners in their goals of transforming their knowledge and skills. In activity theory, the activity of e-learning can be separated into two perspectives, or technological layers, of tool-mediated activity (Sharples, Taylor & Vavoula (2005). The semiotic layer describes learning as a semiotic system in which the learner's object-oriented actions are mediated by cultural tools and signs. The learner internalizes public language, instantiated in writing and conversation, as private thought which then provides the resource for control and development of activity (Vygotsky, 1978). The technological layer represents learning as an engagement with technology, in which tools such as computers serve as interactive agents in the process of coming to know, creating a human-technology system to communicate, mediating agreements between learners and aiding recall and reflection (Sharples, et al., 2005)

II. A e-learning framework based on activity theory

Portraying learning as a mobile activity is not to separate it from other forms of educational activities, since some aspects of learning are fundamentally mobile in the ways outlined above. By placing mobility of learning as the objective of analysis we may understand better how knowledge and learning materials can be transferred across contexts such as homes and schools, how learning can be delivered and managed across life transitions, and how new technologies can be designed to support schools (Sharples, et al., 2005). Most technology-based learning, such as personal computers, has anytime-anyplace restriction. A wireless device overcomes this limitation by allowing learners to disseminate information and complete other course work even when they are away from their hard-wired Internet connections. This capability enhances the anyplace potential of wired Internet to the next level, namely, anywhere-anytime. A wireless device has the potential to give instant gratification to students by allowing them to interact with Internet, access course materials, and retrieve information from anywhere.

A central concern is that we must understand how people artfully engage with their surrounding environments to create impromptu sites of learning. Sharples (2000) contends that the advances in learning and technology have facilitated setting the stage for a successful mobile learning environment. As learning has become more individualized, learner-centered, situated, collaborative, and ubiquitous, continuing technology has similarly become more personalized, user-centered, mobile, networked, ubiquitous, and durable (Motiwalla, 2007). Based on Sharples (2000) concept, mobile technology provides four approaches for enhancing learning: First, intelligent tutoring systems offer value-added knowledge. Second, simulation and modeling tools that serve as learners' assistants act as mentors providing. Third, system tools or resources aid learners in organizing knowledge, such as learning

organizers, concept maps, or learning planners. Fourth, personalized communication functions assist learners' interaction and communication.

From the concept of activity theory, Engeström analyses the collective activity through an expanded framework that shows the interactions between tool-mediated activity and the cultural Rules, Community and Division of Labor. Rules operating in any context or community refer to the explicit regulations, policies, and conventions that constrain activity as well as the implicit social norms, standards, and relationships among members of the community (Jonassen, 2002). The community consists of the individuals and subgroups that focus at least some of their effort on the object. Division of labor refers to both the horizontal division of tasks between cooperating members of the community and the vertical division of power and status (Engestrom, 1999). Sharples, et al.(2005) adapted Engeström's framework to show the dialectical relationship between technology and semiotics, so they renamed the terms – control, context and communication – that could be adopted either by learning theorists or by technology designers (Figure 1). In other words, based on technological approach of activity theory (such as mobile devices for learning), learning is mediated by knowledge and technology as instruments for productive enquiry, in a mutually supportive and dynamically changing relationship. The mediation can be analyzed from a technological perspective of human-computer interaction, physical context and communication activities.

---Insert Figure 1 here---

The *control of learning* may rest primarily with the teacher usually, or it may be distributed among the learners. Control may also pass between learners and technology, for example in a dialogue for online instruction. The technological benefit derives from the way in which learning is delivered; such as whether learners can access e-learning materials conveniently, and whether they can control the learning pace and style of interaction. Thus, the control of learning is based on learners' self-regularity or autonomy.

The *context of learning* is an important construct and the term of context has many connotations for different theorists. From a technological perspective there has been debate about whether context can be isolated and modeled in a computational system, or whether it is an emergent and integral property of interaction. Context also embraces multiple communities of actors (both people and interactive technology) who interact around a shared objective (Sharples, 2005). From the m-learning system perspective, the context of learning is based on the quality of system interactive functions, physical context, or learning content. Basically, the higher quality of system's functions, the more satisfaction learners have.

If a technological system enables certain forms of communication (such as

email or online discussion), learners begin to adapt their communication and learning activities accordingly. As learners become familiar with the technology, they invent new ways of interacting by creating new rules and exclusive communities. This appropriation of technology not only leads to new ways of learning, it also sets up a tension with existing technologies and practices. On a broader scale, mobile technology supports interactions and communication, such as file and information retrieving or knowledge sharing. Therefore, the communication of learning is regard as various m-learning activities.

Moreover, Arievitch (2007) stated that the main educational principles originating from activity theory can be outlined as follow: first, students are active learners, not passive recipients of knowledge. Second, students acquire new knowledge within meaningful learning activities. And third, teachers have to provide adequate learning technology or tools for students' learning activities and to frame the mastery of a new activity in a series of interrelated stages leading students to master new knowledge. Arievitch (2007) also argued to ensure the learned actions were effectiveness, three psychological requirements should be fulfilled during learning: to ensure the action is meaningful and intelligent, to ensure the action is based on operating with cognitive tools, such as signs or symbols, and to ensure the action is independent and competent.

Based on technology approach of activity theory that adapted by Sharples, et al.(2005)-- control, context and communication, as well as from Arievitch's (2007) perspective of educational technology on activity theory, in our m-learning research, the control of learning can be viewed as learners' autonomy toward m-learning. The context of learning can be referred as m-learning system functions and satisfaction toward system functions; and the communication of learning can be pointed as interactive and communicative activities of m-learning. The Table 1 presents the three components based on activity theory and m-learning.

---Insert Table 1 here---

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Table 1: The components based on activity theory and e-learning perspectives

Component	Activity theory perspective	e-learning perspective
The control of learning	* Learners directly access learning materials conveniently. * Learners control the learning pace and style. * Learners are independent and competent.	* Systems provide self-regularity or autonomous learning functions. * Learners use systems personally and independently.
The context of learning	* Context is an integral property of interaction. * Context embraces the multiple communities of actors who interact around a shared objective.	* Systems offer functions for learning activities, such as retrieval content or information, sharing knowledge. * Systems provide high quality functions to encourage and enhance learners' usage.
The communication of learning	* Learners adapt their communication and learning activities. * Learners invent new ways of interacting that create new rules and exclusive communities.	* Systems supply various interaction and communication to support diversely learning activities. * Systems provide meaningful communication. * Learners use systems individually or collaboratively.

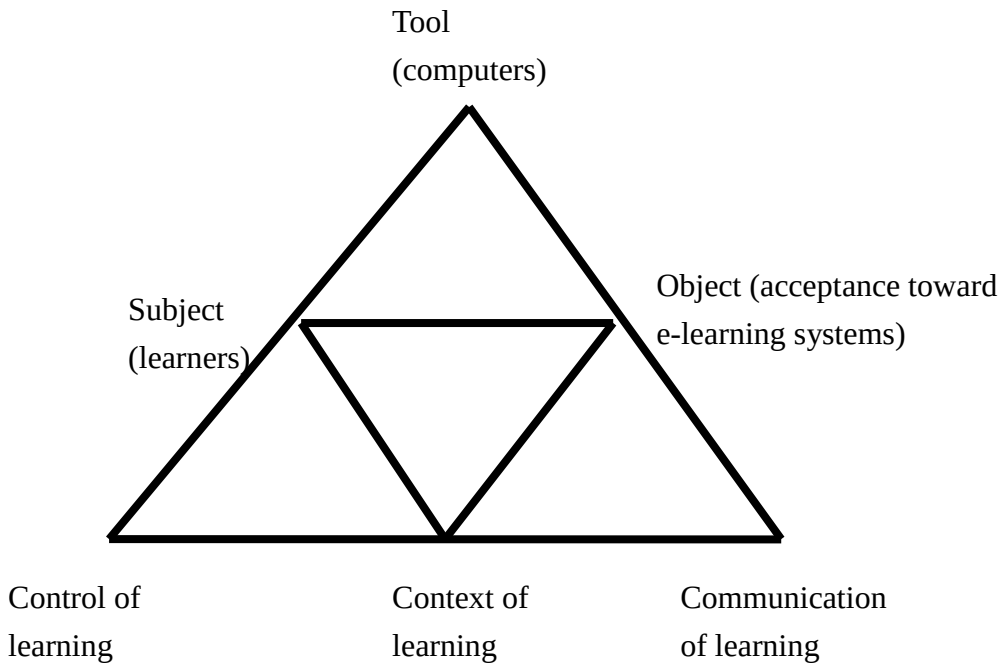

Figure 1: A Framework for analysing e-learning based on activity theory