# UBIQUITOUS LEARNING: DETERMINANTS IMPACTING LEARNERS' SATISFACTION AND PERFORMANCE WITH SMARTPHONES

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Although the concept of ubiquitous technologies has been introduced to many parts of society, there have been limited applications, and little is known about learners' behavior toward ubiquitous technologies, particularly in the context of English learning. This study considers a sample of Korean students to identify the key factors that influence English-language learners' (ELLs') satisfaction with ubiquitous learning (u-learning). The proposed model incorporates ubiquitous characteristics (omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment) as well as learner characteristics (innovation, learning motivation, and computer self-efficacy) and their impact on ELLs' satisfaction. In addition, the study assesses the effects of satisfaction on expectation in the context of English learning and employs structural equation modelling (SEM) to test the hypotheses. The results were based on a sample of 376 students using u-learning to study English and indicate that all the variables for ubiquitous characteristics and two variables for learner characteristics (innovation and computer self-efficacy) had significant effects on satisfaction with u-learning and that this satisfaction had a positive effect on expectation.

**Keywords:** Online Teaching & Learning, Computer-Assisted Language Learning, Learners' Attitudes

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## INTRODUCTION

Rapid advances in information and communication technology (ICT) and various applications have led to the development of digitalized user environments for learning. In addition, there has been an increase in the demand for both traditional and alternative learning systems as well as lifelong education because of the establishment of a knowledge- and information-based society. This situation is also reflected in the fields of general education, which has induced many individuals to search for new learning environments and content, including ubiquitous learning (u-learning). In particular, educational environments have shifted from traditional teacher-oriented learning to individual self-directed learning, reflecting the constructivism paradigm, which requires new learning methods such as u-learning (Song, Kim & Jung, 2009). In addition, the low cost of mobile internet services based on wireless broadband (WiBro) and high-speed downlink packet access (HSDPA) has led to their wide commercialization and access to meet the demand from every part of society.

Based on this phenomenon, the convergence of electronic learning (e-learning), mobile learning (m-learning), mobile devices, and wireless technologies has made u-learning possible for learners anytime, anywhere. One big difference between m-learning and u-learning is that u-learning provides the right learning materials according to learners' situation by getting information from learning contexts. U-learning makes use of mobile technologies such as smartphones (e.g., Galaxy, iPhone, and Blackberry) to provide learners with self-directed learning opportunities without imposing time and location constraints (Joiner, Nethercott, Hull & Reid, 2006). In fact, u-learning facilitates innovation by incorporating unique

characteristics such as ubiquity, self-directed learning, mobility, interactivity, personalization (context customization), accessibility, and portability into web-based learning environments (Shotsberger & Vetter, 2000).

In addition, with the globalization of many parts of society, including commerce and education, English has become the most popular and important language in many non-English-speaking countries. Therefore, many studies have attempted to develop effective teaching methods for English education, including e-learning, blended learning, and m-learning. Collins (2005) claimed that using appropriate learning strategies and developing effective learning activities that support English learning play a crucial role in computer-assisted language learning (CALL), and therefore many studies have focused on e-learning or web-based learning (e.g., Lee & Lee, 2008). In fact, previous studies of e-learning have highlighted the rapid development of wireless and ubiquitous technologies such as smartphones and sensor technologies, and therefore the research topic has recently shifted from e-learning to m-learning and then to u-learning (Chen, Chang, & Wang, 2008).

However, few CALL studies have investigated learners' attitudes and behaviors in innovative learning environments. That is, previous studies of u-learning have focused mainly on descriptive aspects or applications of u-learning in various learning contexts (e.g., Liu & Chu, 2010). In this regard, the present study is motivated by the following three important trends in the English-learning environment:

- The rapid development and adaptation of ubiquitous technologies in the English-learning environment
- A lack of empirical research considering ELLs' u-learning behavior in terms of their satisfaction and expectation
- The existence of group differences based on the level of educational in explanation of ELL's u-learning behaviors

Given this gap in the CALL literature, this study provides a better understanding of ELLs' u-learning behavior in terms of satisfaction and expectation. Therefore, the main objective of the study is to propose and empirically test a research model that incorporates ubiquitous characteristics as well as learner characteristics to explain ELLs' satisfaction and expectation in the context of u-learning. In this study, ubiquitous characteristics include omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment. Learner characteristics include innovation, learning, and computer self-efficacy. In addition, the study investigates the level of education as a moderator to examine group differences across three levels of education (elementary school, junior/high school, and university degrees) for each path in the proposed model. Based on previous research, these constructs are expected to have positive effects on ELLs' satisfaction and thus their expectation of language learning.

## THEORETICAL BACKGROUND

### Ubiquitous learning

U-learning is a new learning paradigm that makes learning possible anytime, anywhere for various educational materials. Yahya, Ahmad, and Jalil (2010) claimed that u-learning is an extension of previous learning paradigms because learners are shifting from traditional learning to e-learning and then to m-learning, followed by u-learning. However, rapid changes in the learning environment can make it difficult to define u-learning (Hwang, Yang, Tsai & Yang, 2009). In this regard, scholars have defined u-learning in diverse ways. For example, Ogata and Yano (2004) defined u-learning by comparing four learning environments (desktop-assisted learning, m-learning, pervasive learning, and u-learning) and classified pervasive learning and m-learning as u-learning. Casey (2005) provided support for this definition by claiming that u-learning combines e-learning and m-learning. In addition, Yang, Kuo, Hwang, and Chu (2008) noted that u-learning is widely defined as learning based on u-computing

technologies such as Radio Frequency Idntification (RFID) and Wi-Fi-enabled smartphones.

Based on these definitions, this study defines u-learning as a new learning paradigm that provides learning resources (networks) with communication and connectivity anytime, anywhere based on the learner's situation using smart devices such as a smartphone, tablet PC, and smart PC. Figure 1 provides a conceptual understanding of u-learning in the cases of two devices: RFID and Wi-Fi-enabled smartphones. U-learning systems generally consist of three components. First, the learning management system (LMS) is a comprehensive and secure web-based learning system employing a simple built-in interface for learners. The LMS is a software application for the administration, documentation, tracking, and reporting of learning programs, classroom events, u-learning programs, and training content and is connected to a database of learning content. Here learners using either RFID or Wi-Fi-enabled smartphones can access the LMS via wireless networks to conduct a wide range of learning activities such as sharing learning materials with others and communicating with other learners and instructors.

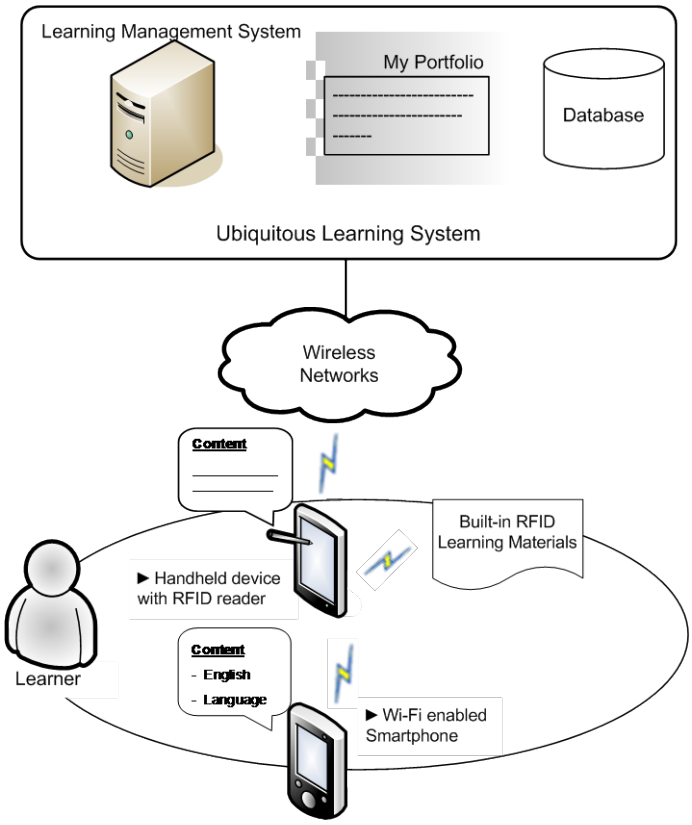


*Figure 1*. Concept of u-learning

**Previous research on u-learning**

Because u-learning for language learning is a relatively recent trend, few studies have explained various aspects of this concept. In addition, various educational settings require the performance and examination of u-learning in different contexts such as ubiquitous pedagogy, classroom-centered u-learning modes, faculty education for u-learning implementation, development standards for u-learning resources, and the development of u-learning management systems (Liu, Li & Carlsson, 2010).

Previous studies have emphasized the role of information technology (IT), particularly computers and the Internet, in language learning. Based on CALL, the roles of computers can be classified into three models

(Koschmann, 1996): the tutor, tutee, and tool models. The tutor model provides an algorithm designating learners' learning paths in advance and plays a role as a controller of learners. In the tutee model, learners participate in technology-enabled simulations to interact with learning programs. Finally, in the tool model, technologies play a role as a mediator of the relationship between learners and learning materials but control neither. When learners become IT-savvy, they are able to use u-learning not only to play these three roles but also to enjoy other CALL characteristics, including the self-directed learning environment on a real-time basis. Harrison (1999) claimed that innovative technologies play a key role in making self-directed language learning in CALL possible.

Many studies of English learning under the u-learning environment have provided experimental analyses or case studies or both. For example, Myers (2000) claimed that mobile devices capable of reorganizing voice data and portable translation programs are useful English-learning tools for Chinese students and suggested that technology mobility has a positive effect on their satisfaction and thus performance. Several descriptive studies have examined the effectiveness of mobile phones. For example, Kiernan and Aizawa (2004) evaluated the usefulness of mobile phones (a representative mobile device) as well as the advantages and disadvantages of using them for English learning. Similarly, Stanford Learning Lab (SLL) examined the effectiveness of voice and e-mail communication through mobile phones for Spanish learning and found that they can facilitate language learning because they represent an effective tool for delivering quizzes and other learning materials.

Thornton and Houser (2005) claimed that m-learning and u-learning can be distinguished by their unique characteristics in terms of the learning environment, including omnipresence, mobility, interactivity, personalization, and self-directed learning, as well as by learner characteristics such as innovation, motivation, and self-efficacy. Such characteristics can facilitate learning, particularly language learning. In this study, instructors regularly sent English vocabularies to Japanese students through mobile devices such as their phones for English learning. The results indicated that mobile devices are more effective for English vocabulary learning than other methods such as e-learning. Furthermore, m-learning can provide learners with more learning opportunities than other learning methods and stimulate enjoyment, thereby facilitating English learning.

Recent studies have focused on the technological development of u-learning, particularly context-aware ubiquitous learning, by using experimental methods (e.g., Chiou, Tseng, Hwang & Heller, 2010; Chu, Hwang & Tsai, 2010; Hwang, Kuo, Yin & Chuang, 2010). Chiou et al. (2010) formulated a navigation support problem to find learning paths for individual learners for context-aware ubiquitous learning and proposed two navigation support algorithms by considering learning and navigation efficiency, suggesting that the proposed algorithms can better facilitate learners' effective and efficient use of learning resources and realization of learning efficacy than other methods.

Similarly, Chu et al. (2010) developed computer-based tools and learning environments that can serve as an extension of the mind and referred to them as "mindtools" for context-aware u-learning as a knowledge engineering approach. They demonstrated that this approach can increase learning motivation and enhance students' learning achievement. Liu and Chu (2010) investigated the effects of ubiquitous games on English learning and motivation by considering the Handheld English Language Learning Organization (HELLO), a context-aware u-learning environment for learners to engage in ubiquitous games in an English-learning environment and found that integrating ubiquitous games into English-listening and speaking courses can better improve learning outcomes and motivation than a non-gaming approach.

However, previous studies of u-learning have been limited particularly in terms of explaining learners' behaviors. For example, most studies of u-learning have focused on developing and experimentally testing new learning approaches in designed learning environments. That is, these studies have generally focused on the u-learning technology itself instead of understanding learners' u-learning behavior. In

addition, few studies have considered u-learning in the context of English learning. In this regard, the present study examines u-learning users' attitudes and behaviors in the context of English learning.

### Satisfaction and expectation

User satisfaction and expectation are considered to be desirable outcomes of various technologies and services because they are the most important criteria for assessing information systems (IS) success. In this regard, previous studies have examined these factors in various educational settings, including e-learning and m-learning (e.g., Ramayah & Lee, 2012; Sun, Tsai, Finger, Chen & Yeh, 2008), as key outcomes of technology use. In addition, previous studies of IT/IS adoption and success in various contexts have found that user satisfaction and performance (or expectation) are key determinants of product or service quality (Oliver, 1993) as well as users' behaviors (Fullerton & Talyor, 2002). Bailey and Pearson (1983) claimed that if users are highly satisfied with particular technologies such as computers and the Internet, then they are likely to show better task/job performance. In this regard, DeLone and McLean (1992) found that satisfaction has a significant effect on individuals' performance, facilitating the successful implementation of new technologies in various environments.

In the context of new technologies for education, previous studies have examined the positive relationship between satisfaction and expectation and found that outcomes of adopting new technologies in educational settings can be measured by the level of learners' (users') satisfaction (Ali, 2011). For example, Desimon and Harris (1998) claimed that learning satisfaction and expectation increase if learners are motivated and perceive the usefulness of relevant technologies in certain learning environments. This implies that if learners perceive the usefulness of computer-assisted language learning, including u-learning, then they are more likely to be satisfied and thus show a higher learning expectation or better learning performance.

Song et al. (2009) found a positive effect of ELLs' satisfaction with m-learning on their performance/expectation. More specifically, those learners who are satisfied with m-learning tend to show a higher expectation and better performance in various English-learning contexts such as communication and certification exams. However, no study has examined the effects of learners' satisfaction with u-learning on their expectation. This suggests that any analysis of u-learning environments in the context of language learning requires a better understanding of the relationship between satisfaction and expectation.

## RESEARCH MODEL AND HYPOTHESES

### Research model

Figure 2 shows the proposed research model, which highlights the importance of the constructs, namely ubiquitous characteristics and learner characteristics pertaining to satisfaction with u-learning in the context of English learning based on a literature review and interviews with actual u-learning users with some experience studying English through smartphones. The model includes five constructs for ubiquitous characteristics (omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment) and three constructs for learner characteristics (innovation, learning motivation, and computer self-efficacy). These eight constructs are expected to have positive effects on u-learning satisfaction and thus on expectation in the context of English learning.

In terms of ubiquitous characteristics, Song et al. (2009) claimed that these characteristics have considerable influence on innovation adoption in the context of English learning. Previous studies have found that these characteristics, which include omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment, have significant positive effects on ELLs' attitudes toward u-learning and satisfaction (Shih, Chu, Hwang & Kinshuk, 2010). Therefore, the proposed research model includes ubiquitous characteristics to evaluate u-learning satisfaction.

In terms of learner characteristics, Zangyuan (2003) and Shih et al. (2010) claimed that these

characteristics are important drivers of technology-based learning environments and u-learning satisfaction. In this regard, the proposed research model includes three constructs for learner characteristics, including innovation, learning motivation, and computer self-efficacy, to investigate the key factors influencing satisfaction with u-learning in the context of English learning.

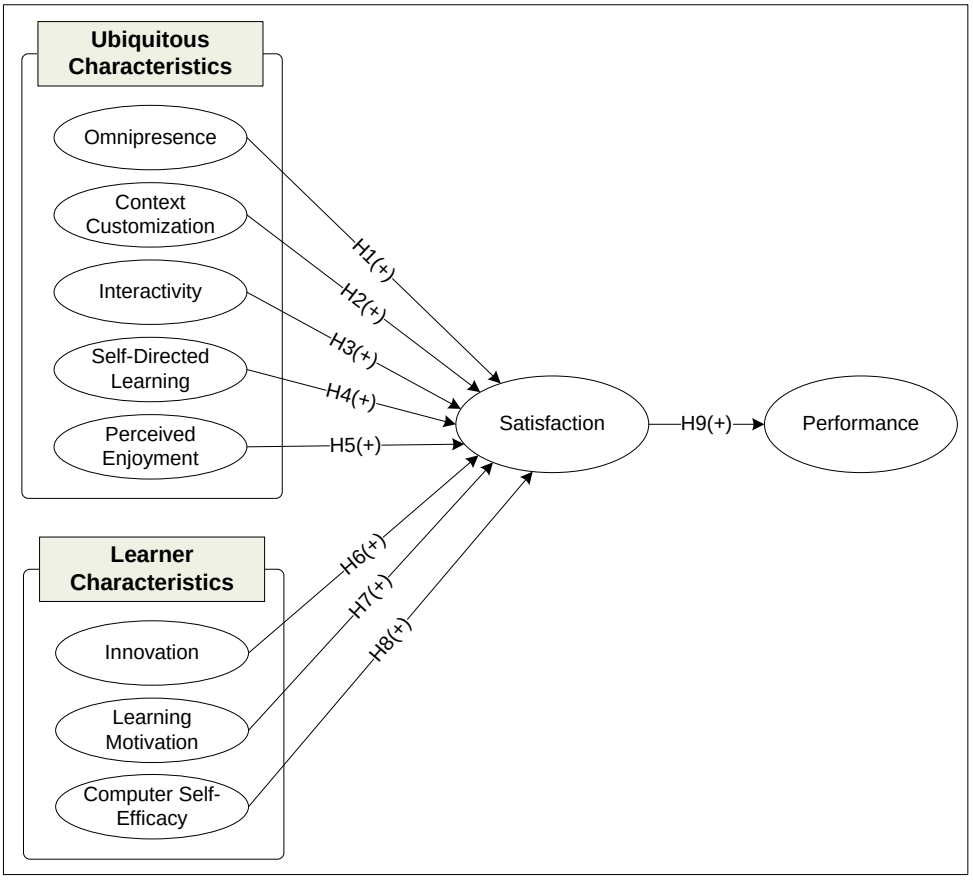


*Figure 2*. Proposed research model with hypotheses.

## Hypotheses

### *Ubiquitous characteristics*

The first construct for ubiquitous characteristics is omnipresence. This study defines omnipresence as ELLs' perception of the extent to which u-learning offers personalized and uninterrupted connections and communication between the learners and other learners and/or learning contexts (Kim, 2008). That is, omnipresence, which is synonymous with ubiquity, implies communication and connectivity in learning environments anytime, anywhere. The increasing proliferation of smart technologies has enabled learners to acquire and connect to learning materials and instruction anytime, anywhere. In particular, smartphones are regarded as a new learning method for various applications and skills (e.g., English dictionaries, games, and English proficiency) for ELLs.

Looney, Jessup, and Valacich (2004) claimed that the ubiquitous nature of smart technologies provides learners with exceptional efficiency, flexibility, and convenience, thereby influencing their satisfaction. In addition, omnipresence is one of the most well-known advantages of smart technologies and a main reason for the adoption of smartphones by many learners (Dholakia, Dholakia, Lehrer & Kshetri. 2004). In this regard, the following hypothesis is proposed:

Hypothesis 1: Omnipresence has a positive effect on u-learning satisfaction for ELLs.

The second construct for ubiquitous characteristics is customization, which is defined in this study as the extent to which u-learning provides ELLs with useful content based on the learners' learning environment (Figge, 2004; Kannan, Chang & Whinston 2001). Some studies have referred to context customization as contextual offerings, representing one of the traditional ubiquitous characteristics for language learning. The nature of the learning environment plays a critical role in influencing ELLs' attitudes and behaviors toward u-learning. Kim (2008) claimed that the distinct learning condition encountered by learners is a key driver of their attitudes and thus influences their behaviors.

In fact, ELLs face rapidly changing learning environments and thus require learning contexts that fit given learning conditions. In such contexts, the context customization of u-learning can provide the most effective and optimal learning information and services based on the overall situation, including time and location constraints, facing ELLs. Bhattacherjee and Sanford (2006) suggested that ELLs who view u-learning as pertinent to their learning outcomes are more likely to be motivated to actively explore it as a technological learning option. This suggests that ELLs who consider u-learning as relevant to their learning are likely be satisfied because of context customization. This argument leads to the following hypothesis:

Hypothesis 2: Context customization has a positive effect on u-learning satisfaction for ELLs.

The proposed research model includes interactivity as the third construct for ubiquitous characteristics. Wang (2006) defined interactivity as the interaction between ELLs and learning resources. It should be noted that this definition of interactivity is different from interactions between human interlocutors. In this regard, this study defines interactivity as the technological interaction between learners and technological tools such as smartphones. That is, ELLs interact with learning content through ubiquitous devices such as smartphones.

Previous studies focusing on e-learning and m-learning in language education have found that interactivity is an important determinant of learners' satisfaction (e.g., Khan & Vega, 1999; Reeves & Reeves, 1997). U-learning is much more likely to facilitate interactivity than other technology-based learning methods because of communication offering continuous interactivity, that is, communication anytime, anywhere (Kannan et al., 2001). Interactions between learners and learning materials are much easier today than in the past not only because of the diversity of smart devices but also because of the functional variety provided by the technology.

ELLs can use their own set of learning materials and service frameworks without restrictions for certain frames by using smart devices. With the development of user-oriented smart devices, such interactions are likely to be increasingly relevant to English learning. In addition, as ELLs become more knowledgeable about new technologies, their interactions in u-learning environments are likely to intensify, which increases their satisfaction with u-learning. In this regard, the following hypothesis is proposed:

Hypothesis 3: Interactivity has a positive effect on u-learning satisfaction for ELLs.

Self-directed learning is a typical characteristic of various types of computer-based learning methods, including e-learning, m-learning, and u-learning (Zhang & Nunamaker, 2003). In this regard, this study defines self-directed learning as a process by which learners take the initiative to find their learning needs, articulate learning objectives, identify sources for learning, select and implement learning strategies, and evaluate learning outcomes (Knowles, 1975). That is, self-directed learning implies that learners process learning through their own motivation after choosing their own learning goals, content, method, and many others for English learning.

Previous studies (e.g., Joo, Kim, & Cho, 2008; Lee & Choi, 2007) have emphasized the importance of self-directed learning in the context of various learning outcomes such as learners' achievement, satisfaction, and participation in diverse learning environments. For example, Lindner and Harris (1998) claimed that self-directed learning is a key attribute used to explain learners' satisfaction and expectation and found a significant relationship between self-directed learning and learning satisfaction, particularly in the context of higher education. In addition, Lee and Lee (2006) investigated the relationship between self-directed learning and satisfaction in the context of e-learning and found that even when e-learning has time and location limitations, self-directed learning can provide learners with learning opportunities and thus is positively related to their overall satisfaction.

U-learning makes self-directed learning possible through smart devices. Learners can ensure their learning process and outcomes without facing time and location constraints. Therefore, learners can control their learning process based on their ability, which is differentiated from self-directed learning in e-learning. This suggests that ELLs are more likely to be satisfied with self-directed learning in u-learning environments than in e-learning ones. In this regard, the following hypothesis is proposed:

Hypothesis 4: Self-directed learning has a positive effect on u-learning satisfaction for ELLs.

Perceived enjoyment has been defined as the extent to which u-learning use is perceived to be enjoyable in its own right, aside from any performance consequences of using the system (Lee, Kozar & Larsen, 2003). Previous studies have emphasized the effect of enjoyment resulting from the use of new technologies. For example, Davis (1992) and Gordon and Anand (2005) claimed that enjoyment from using mobile devices has a positive effect on users' attitudes through perceived usefulness. Lee and Lee (2006) found that enjoyment has a significant effect on satisfaction through perceived usefulness in the context of e-learning.

Learners may be more likely to perceive enjoyment for u-learning than for other technology-based learning methods such as e-learning because of various functions provided by the u-learning environment. For example, ELLs using smartphones can download various applications for language learning from application providers, which are often referred to as application stores. Some applications are free and very useful and thus can motivate learners to use smartphones and induce their learning satisfaction. In this regard, the following hypothesis is proposed:

Hypothesis 5: Perceived enjoyment has a positive effect on u-learning satisfaction for ELLs.

### *Learner characteristics*

Previous studies have considered various technologies and highlighted the importance of individuals' characteristics in examining the relationship between a new technology and user satisfaction. Learners' characteristics are important in analyzing a given technology itself, and it is the user's perception of the technology's attributes that influences his or her satisfaction (Kim & Garrison, 2010). This study proposes three constructs for learner characteristics (innovation, learning motivation, and computer self-efficacy) that may have positive effects on u-learning satisfaction.

This study considers innovation as individuals' voluntary intention to use new technologies (Agarwal & Karahanna, 2000) and thus defines it as the extent to which ELLs make voluntary use of smartphones for their English learning. Highly innovative learners tend to adopt new learning technologies and are likely to be satisfied with the use of new technologies for their learning. In particular, smartphones provide learners with many benefits. For example, ELLs can access learning content and communicate with other learners and instructors anytime, anywhere. Lee and Lee (2009) claimed that u-learning can increase learner satisfaction through ubiquitous characteristics that innovative learners seek from new technologies. In this regard, the following hypothesis is proposed:

Hypothesis 6: Innovation has a positive effect on u-learning satisfaction for ELLs.

Learning motivation is another learner characteristic, and in the context of learning, it is considered to play an important role in language development (Chen, Fang, Chen & Wu, 2010; Bin & Lixia, 2009). A lack of learning motivation can hinder ELLs' development, and therefore this study includes it as an important factor influencing u-learning satisfaction in the context of English learning. This study defines learning motivation as the learner's motivation for learning new behavioral patterns in terms of the use of a new technology (e.g., u-learning) (Taris & Kompier, 2005).

Even when ELLs have sufficient knowledge and skills for studying learning materials, little or no learning motivation can produce low satisfaction and expectation. In this regard, Noe and Schmitt (1986) and Liu and Chu (2010) claimed that learning motivation in any learning setting stimulates learners' passion for learning, providing them with opportunities to master learning materials. U-learning materials can reinforce intrinsic and extrinsic motivation during its design process and thus have a positive effect on u-learning satisfaction as well as on expectation. In addition, innovative learners are generally more likely to show a higher level of learning motivation with new technologies such as smartphones (Kim, 2008). In this regard, the following hypothesis is proposed:

Hypothesis 7: Learning motivation has a positive effect on u-learning satisfaction for ELLs.

Bandura (1995) defined computer self-efficacy as the user's confidence in his or her knowledge and skills to successfully complete a specific task and suggested that such confidence has considerable influence on the user's satisfaction and perseverance in a wide range of activities. Compeau and Higgins (1995) defined computer self-efficacy as the universal belief that users are able to use computer technologies to complete certain tasks. Based on these definitions, the present study defines computer self-efficacy as the degree of ELLs' confidence in making successful use of u-learning technologies such as smartphones. Such confidence includes learner's ability to handle both hardware/software (HW/SW) aspects of technologies.

Smartphone users can be considered early adopters of new technologies and often have a considerable passion for and in-depth knowledge of new technologies that can be used as learning tools. Therefore, ELLs who can better understand and have the necessary skills to use new technologies are more likely to be satisfied with using those technologies. Previous studies have examined computer self-efficacy in various technology-enabled learning contexts (e.g., Lee & Lee, 2008; Wangpipatwong, 2008) and verified that it is positively related to perceived usefulness as well as to satisfaction (Lee & Lee, 2009). The present study provides an empirical analysis of the effects of computer self-efficacy on u-learning satisfaction in the context of English learning. In this regard, the following hypothesis is proposed:

Hypothesis 8: Computer self-efficacy has a positive effect on u-learning satisfaction for ELLs.

***Satisfaction and expectation***

Ives et al. (1983) defined satisfaction as the extent to which a user believes that a given technology meets his or her information requirements. Doll and Torkzadeh (1988) also defined it as a user's opinion about a specific technology. Based on these definitions, this study defines satisfaction as ELLs' opinion or belief that a given u-learning technology meets their performance needs. Scholars have traditionally assumed that satisfied users outperform unsatisfied ones in the IS context (Bailey & Pearson, 1983). In addition, DeLone and McLean (2003) proposed a model of IS success and suggested that user satisfaction is a key measure of IS success (performance).

Previous studies have suggested a positive relationship between satisfaction and expectation/performance for ELLs based on u-learning systems. In the case of smartphones, ELLs can access learning materials

anytime, anywhere. In addition, u-learning is considered a self-directed learning method and provides customized contexts, a high degree of interactivity, and enjoyment. All these features of u-learning make it more likely to satisfy learners than other learning environments. Despite the importance of the relationship between satisfaction and expectation, little is known about this relationship in the context of u-learning, particularly in terms of English learning. In this regard, the following hypothesis is proposed:

Hypothesis 9: U-learning satisfaction has a positive effect on ELLs' u-learning expectation.

## RESEARCH METHODOLOGY

### Target population and data collection

In this study, K-12 and college/university students in Korea were considered as the target population because these students represent a large and diverse population and make frequent use of u-learning to study English as well as smartphones. For maximum generalizability, groups of various sizes across South Korea were surveyed. These students were solicited because they were expected to be very interested in using smartphones for more efficient English learning.

Data were collected through two-stage procedure. First, a pilot study was conducted. A group of middle school, high school, and university students with some experience using Wi-Fi-enabled smartphones for English learning was identified through a survey and asked to participate in this study. Then, a list of potential respondents was prepared, and the questionnaire was sent by mail and e-mail. The responses were collected over a two-week period, and any response with missing and inappropriate data was excluded from the analysis. As a result, a total of 69 usable responses were obtained for the pilot study. The construct validity (item reliability, internal consistency, and discriminant validity) of the pilot test was assessed to determine any issues associated with the study's design and methodology.

The participants of the pilot study consisted of 10 elementary students, 20 junior/high school students, and 10 college/university students. A total of 79 responses were collected for the pilot study. Most had more than two years of experience using u-learning for English. In addition, the participants used various types of learning content, including communication, English exams, and English certification exams. According to the results of the pilot study, there was sufficient construct validity. Cronbach's alpha for all the constructs exceeded the recommended threshold of 0.7, and the factoring loadings for all the items exceeded 0.7. Finally, the square root of the average variance extracted (AVE) exceeded the correlation between the constructs.

After the pilot test, the questionnaire was sent to 2,000 students at 10 middle schools, 11 junior schools, 9 high schools, and 10 colleges/universities by mail and e-mail. For maximum generalizability, school locations and sizes were randomly selected. In addition, the questionnaire was posted online for those who preferred an online survey. A total of 389 responses were collected through online and offline surveys. Among these, 13 were discarded because of missing or inappropriate data. As a result, a total of 376 responses were used to test the proposed research model.

The respondents represented an educationally diverse group. More specially, 62.8% had a college degree or more. The ages of the respondents ranged from 14 to 39 (average age = 22.4), and 53.4% were male. In addition, 26.1% engaged in u-learning for less than one year while 33.2% of respondents used u-learning more than one year, but less than two years. Regarding time spent on u-learning, 68.4% spent more than three hours a week learning English through smartphones. Table 1 shows the demographic characteristics of the respondents.

Table 1. *Demographic Characteristics*

| Demographic Categories | Frequency | Percentage |
|---|---|---|
| Age (Years) | | |
| 14-19 | 101 | 26.9% |
| 20-25 | 90 | 23.9% |
| 26-30 | 115 | 30.6% |
| 30+ | 70 | 18.6% |
| Gender | | |
| Male | 158 | 42.0% |
| Female | 218 | 58.0% |
| Education Level | | |
| Elementary school | 25 | 6.6% |
| Junior/High school | 76 | 20.2% |
| College/University | 141 | 37.5% |
| Graduate School | 95 | 25.3% |
| Other | 39 | 10.4% |
| U-learning Experience | | |
| < 1 year | 98 | 26.1% |
| ≥1, <2 years | 125 | 33.2% |
| ≥2, <3 years | 99 | 26.3% |
| ≥3 years | 54 | 14.4% |
| Lecture Hours/week | | |
| Less than 1 hr. | 31 | 8.2% |
| 1-2 hrs. | 88 | 23.4% |
| 3-4 hrs. | 157 | 41.8% |
| More than 5 hrs. | 100 | 26.6% |
| Learning Content (multiple responses) | | |
| Communication | 205 | 54.5% |
| English Exams | 277 | 73.7% |
| English Certification Exams (e.g., TOEFL and TOEIC) | 239 | 63.6% |
| Other | 91 | 24.2% |
| Total | 376 | 100% |

**Measurement variables**

This study's measures were obtained from previous studies but were modified to fit the context of u-learning for studying English. For example, the items for omnipresence and self-directed learning were adapted from Lim (2001) and Kim (2008), and those for the other variables in the research model were developed by adapting and combining measures from other sources (e.g., Hicks & Klimosky, 1987; Lee & Lee, 2007). Each respondent was asked to indicate the extent to which he or she agreed with each item on a seven-point Likert-type scale ranging from "strongly disagree" (1) to "strongly agree" (7).

**Data analysis**

***Assessment of the measurement model***

For the analysis of the data, a partial least square (PLS) approach using SmartPLS 2.0 was taken for several reasons. First, this study is more exploratory than confirmatory, which is the strength of the PLS approach (Leimeister, Leimeister & Knebel, 2009). Second, SmartPLS 2.0 can resample the initial data set and enlarge it by 100 to 200 times, thereby reducing the required sample size. Third, SmartPLS 2.0

takes a two-step approach to test a model: an assessment of the measurement model and an evaluation of the structural model. That is, it can evaluate the reliability and validity of an instrument simultaneously. Therefore, the PLS approach was suitable for this study.

Before testing the structural model, the reliability and validity of the measurement model were assessed through item reliability, internal consistency, and discriminant validity. For item reliability, individual item loadings were considered. Chin (1998) considered items with loadings greater than 0.7 to be acceptable. Here such items explain approximately 50% of the variance in a specific measure, implying that the items in the measurement model measure the same variable. The results for item reliability indicate that all items exceeded the accepted threshold, implying that the items were sufficient for measuring each construct individually.

Cronbach's alpha was used to evaluate internal consistency for each construct. Nunnally (1978) suggested a minimum threshold of 0.7 for each item loading. Cronbach's alpha for all the variables exceeded this threshold, ranging from 0.84 and 0.96. The results for convergent validity and reliability are shown in Appendix A.

Finally, the AVE was used to assess discriminant validity, which measures the lack of a relationship between measures that theoretically should not be related. The AVE measures the variance explained by indicators relative to the measurement error, which should be greater than 0.5 to justify the use of a construct (Chin, 1998). Latent variables describe the variance shared between constructs and should not exceed the AVE for sufficient discriminant validity. Table 2 shows the squared correlations between the latent variables, which did not exceed the AVE, indicating sufficient discriminant validity.

Table 2. *Squared Correlations Between Constructs*

| Latent Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) Omnipresence | **.85** | | | | | | | | | |
| (2) Context Customization | .30 | **.83** | | | | | | | | |
| (3) Interactivity | .28 | .27 | **.84** | | | | | | | |
| (4) Self-Directed Learning | .45 | .36 | .33 | **.76** | | | | | | |
| (5) Perceived Enjoyment | .48 | .40 | .37 | .43 | **.79** | | | | | |
| (6) Innovation | .32 | .41 | .39 | .32 | .40 | **.80** | | | | |
| (7) Learning Motivation | .25 | .28 | .36 | .51 | .37 | .42 | **.78** | | | |
| (8) Computer Self-Efficacy | .46 | .43 | .48 | .33 | .37 | .45 | .40 | **.82** | | |
| (9) Satisfaction | .54 | .41 | .42 | .37 | .39 | .33 | .35 | .47 | **.84** | |
| (10) Performance | .25 | .27 | .29 | .28 | .23 | .30 | .34 | .39 | .56 | **.88** |

*Note: Numbers in bold type along the diagonal indicate the square root of the AVE.*

### Analysis of the structural model

The independent relationships between the constructs in this study were tested using structural equation modeling (SEM) with the primary data ($n$ = 376). The structural model was formulated using SmartPLS 2.0, which provided two important pieces of information. First, SEM calculates the path coefficient (i.e., the standardized beta), which implies the strength of the causal relationship between two constructs. The results in Figure 3 provide support for the proposed hypotheses. The five variables for ubiquitous characteristics (omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment) had positive effects on user satisfaction. The path coefficient from omnipresence to

satisfaction was 0.508 and significant at $p < 0.01$, and context customization had a significant positive effect on satisfaction ($\beta = 0.383$, $p < 0.01$). These results provide support for H1 and H2, respectively. Interactivity ($\beta = 0.386$, $p<0.01$), self-directed learning ($\beta = 0.350$, $p < 0.01$), and perceived enjoyment ($\beta = 0.371$, $p < 0.01$) had significant positive effects on satisfaction, providing support for H3, H4, and H5, respectively.

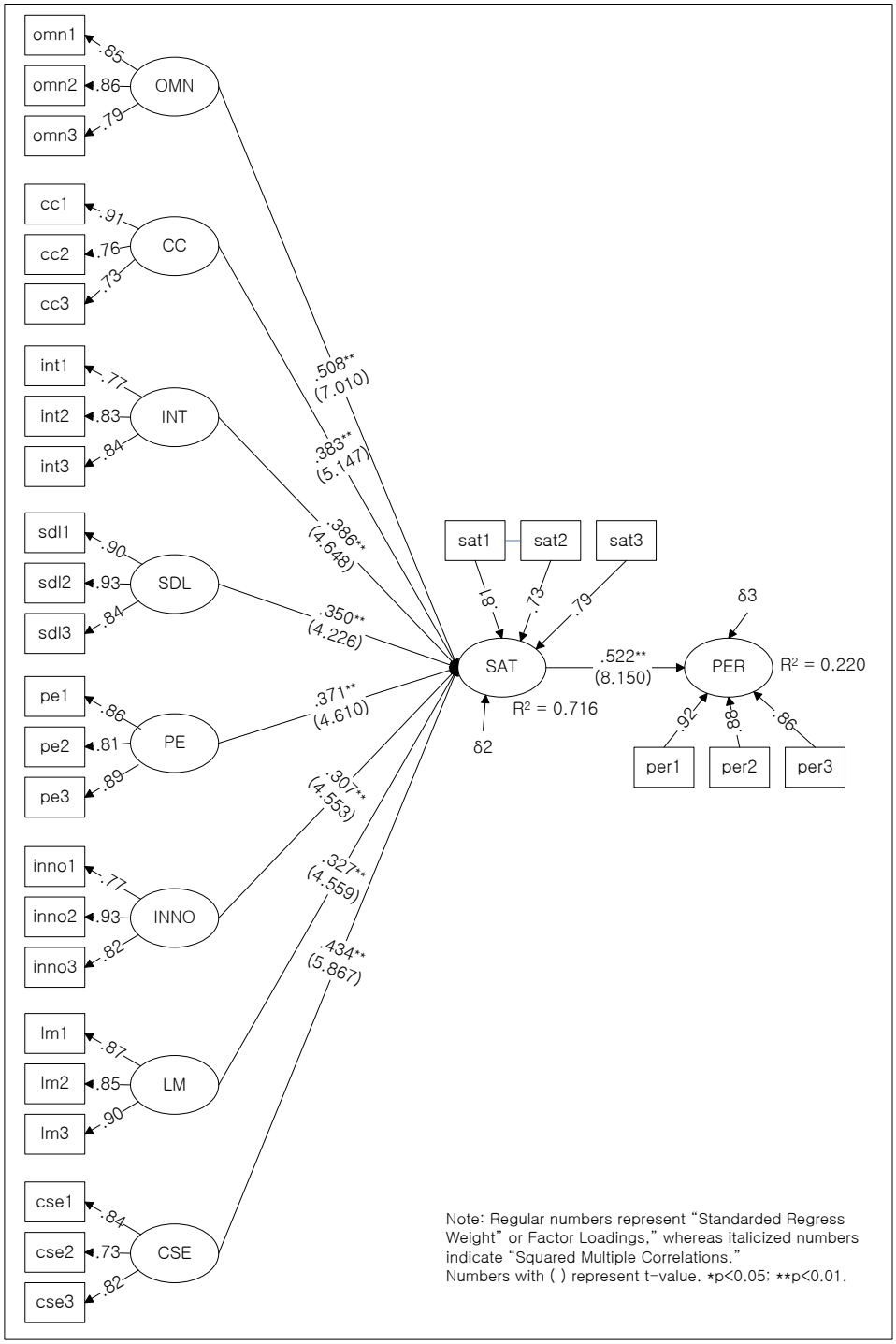


Figure 3. *SEM analysis of the proposed model*

In terms of the variables for learner characteristics, innovation ($\beta$ = 0.307, p < 0.01), learning motivation (($\beta$ = 0.327, p < 0.01), and computer self- efficacy ($\beta$ = 0.434, $p$ < 0.01) had significant positive effects on user satisfaction, providing support for H6, H7 and H8, respectively. Finally, the path coefficient from u-learning satisfaction to performance was 0.422 and significant at p < 0.01, providing support for H9.

The second piece of information was the squared multiple correlation ($R^2$) for each endogenous variable in the research model. The $R^2$ value measures the percentage of the variance explained by each construct in the model. The $R^2$ value for the endogenous variable (satisfaction) was 0.716, implying that all the independent variables together explained 71.6% of the variance in u-learning satisfaction. In addition, u-learning satisfaction explained 22.0% of the variance in u-learning performance. Figure 3 shows the standardized path coefficients ($\beta$) and their respective significance levels and variance explained. In the figure, the numbers in parentheses indicate the t-value for each path. Table 3 shows the results for the hypotheses.

*Table 3.* Results for Hypotheses

| Hypothesis | Path | Standardized Coefficient | *t*-value | Results |
|---|---|---|---|---|
| H1 | Omnipresence → Satisfaction | .508** | 7.010 | Accepted |
| H2 | Context Customization → Satisfaction | .383** | 5.147 | Accepted |
| H3 | Interactivity → Satisfaction | .386** | 4.648 | Accepted |
| H4 | Self-Directed Learning → Satisfaction | .350** | 4.226 | Accepted |
| H5 | Perceived Enjoyment → Satisfaction | .371** | 4.610 | Accepted |
| H6 | Innovation → Satisfaction | .307** | 4.553 | Accepted |
| H7 | Learning Motivation → Satisfaction | .327** | 4.559 | Accepted |
| H8 | Computer Self-Efficacy → Satisfaction | .434** | 5.867 | Accepted |
| H9 | Satisfaction → Performance | .522** | 8.150 | Accepted |

*Note: *p < 0.05; **: p < 0.01.*

**Analysis of group difference**

After the analysis of each path in the research model based on all data, multi-group moderating effects were tested to investigate the role of the education level. In this context, the user's education level was a moderator, and there were three groups (elementary, school, junior/high school, and university degrees). To test group differences for each path in the research model, the chi-square difference between the unconstrained (free) and fully constrained models was examined. A path-by-path analysis was conducted to determine any difference in each path between the three groups. Therefore, each path in the research model was constrained one by one, which increased one degree of freedom (D*F*), and then the constrained model was run to calculate the chi-square of the constrained model. If the chi-square difference exceeded the threshold (3.84 at $p$ < 0.05; 6.63 at $p$ < 0.01), then the path was considered to be different across education levels. The chi-square of the unconstrained model was 392.427.

*Table 4*. Results of Group Difference at Each Path (Elementary vs. Junior/High)

| Path | Chi-square ($X^2$) | $\Delta X^2$ | Difference |
|---|---|---|---|
| Omnipresence → Satisfaction | 399.874 | 7.447** | Yes |
| Context Customization → Satisfaction | 398.996 | 6.569* | Yes |
| Interactivity → Satisfaction | 402.541 | 10.114** | Yes |
| Self-Directed Learning → Satisfaction | 400.369 | 7.942** | Yes |
| Perceived Enjoyment → Satisfaction | 412.258 | 19.831** | Yes |
| Innovation → Satisfaction | 394.214 | 1.787 | No |
| Learning Motivation → Satisfaction | 416.123 | 23.696** | Yes |
| Computer Self-Efficacy → Satisfaction | 398.587 | 6.160* | Yes |
| Satisfaction → Expectation | 400.217 | 7.790** | Yes |

*Note: *: $X^2(1) = 3.84$, $p<0.05$; **: $X^2(1) = 6.63$, $p<0.01$.*

Table 4 shows the results for the differences between the elementary and junior/high school groups for all paths. Except for the path between innovation and satisfaction, all paths were different between these two groups.

*Table 5*. Results of Group Difference at Each Path (Elementary vs. University)

| Path | Chi-square ($X^2$) | $\Delta X^2$ | Difference |
|---|---|---|---|
| Omnipresence → Satisfaction | 403.817 | 11.390** | Yes |
| Context Customization → Satisfaction | 403.147 | 10.720** | Yes |
| Interactivity → Satisfaction | 396.777 | 4.350* | Yes |
| Self-Directed Learning → Satisfaction | 408.387 | 15.960** | Yes |
| Perceived Enjoyment → Satisfaction | 404.517 | 12.090** | Yes |
| Innovation → Satisfaction | 394.283 | 1.856 | No |
| Learning Motivation → Satisfaction | 399.096 | 6.669** | Yes |
| Computer Self-Efficacy → Satisfaction | 397.658 | 5.231* | Yes |
| Satisfaction → Expectation | 396.397 | 3.970* | Yes |

*Note: *: $X^2(1) = 3.84$, $p<0.05$; **: $X^2(1) = 6.63$, $p<0.01$.*

The same results were found between the elementary school and university groups (see Table 5). However, Table 6 shows that there was no significant difference in satisfaction between the junior/high school and university groups. This implies that the level of education had significant effects on the hypothesized relationships.

*Table 6.* Results of Group Difference at Each Path (Junior/High vs. University)

| Path | Chi-square ($X^2$) | $\Delta X^2$ | Difference |
|---|---|---|---|
| Omnipresence → Satisfaction | 399.141 | 6.714** | Yes |
| Context Customization → Satisfaction | 396.316 | 3.889* | Yes |
| Interactivity → Satisfaction | 396.403 | 3.976* | Yes |
| Self-Directed Learning → Satisfaction | 397.703 | 5.276* | Yes |
| Perceived Enjoyment → Satisfaction | 397.796 | 5.369* | Yes |
| Innovation → Satisfaction | 392.976 | 0.549 | No |
| Learning Motivation → Satisfaction | 401.058 | 8.631** | Yes |
| Computer Self-Efficacy → Satisfaction | 407.685 | 15.258** | Yes |
| Satisfaction → Expectation | 392.611 | 0.184 | No |

*Note: *: $X^2(1) = 3.84$, $p<0.05$; **: $X^2(1) = 6.63$, $p<0.01$.*

## DISCUSSION

This study provides an empirical analysis of the determinants of factors influencing ELLs' satisfaction and its subsequent impact on their u-learning performance. In particular, the study considers ubiquitous characteristics (omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment) and learner characteristics (innovation, learning motivation, and computer self-efficacy) as the key factors influencing u-learning satisfaction. The SEM results verify sufficient reliability and validity for all the variables for the measurement model. In addition, the results for the structural model demonstrate that the path coefficients were significant for all the variables.

The results provide educators and learners with important insights into u-learning in the context of English education. The five variables for ubiquitous characteristics were positively related to u-learning satisfaction, providing support for the notion that ELLs are more likely to be satisfied with u-learning if they regard it as having the capability to be combined seamlessly with their daily learning. H1, which proposed a positive relationship between omnipresence and satisfaction, showed the highest path coefficient from ubiquitous characteristics and thus was supported. This suggests that omnipresence is a key attribute of u-learning and that ELLs are likely to be satisfied with learning environments that provide learning anytime, anywhere.

The results provide support for H2 (context customization → satisfaction), H3 (interactivity → satisfaction), H4 (self-directed learning → satisfaction), and H5 (perceived enjoyment → satisfaction). This suggests that ELLs are more likely to perceive benefits from these u-learning characteristics than from other learning environments (e.g., e-learning and blended learning) and thus that they are more likely to be satisfied with u-learning. These results are consistent with the findings of previous studies (e.g., Lee, Chung & Noh, 2007; Song et al., 2009) claiming that learners are likely to be satisfied with new learning environments, including u-learning, because of their unique characteristics.

H6 (innovation → satisfaction), H7 (learning motivation → satisfaction), and H8 (computer self-efficacy → satisfaction) predicted positive relationships between the variables for learner characteristics and u-learning satisfaction. Innovation and computer self-efficacy had significant positive effects on u-learning satisfaction, which suggests that, with the rise of English as a global language, learners tend to consider new ways of studying English by adopting new technologies. That is, learners are more likely to adopt innovative methods than traditional ones as they become more IT-savvy. These results provide support for H6 and H8. In addition, learning motivation had a significant positive effect on u-learning satisfaction

for ELLs, implying that the u-learning environment provides them with both enjoyment and challenges. That is, the learner's motivation to learn new behavioral patterns through u-learning may increase his or her satisfaction with the new technology.

The results are consistent with previous research. For example, Bin and Lixia (2009) and Jonassen (1997) claimed that learning motivation is relevant to u-learning expectations. That is, u-learning may motivate learners to a certain extent. In addition, learning motivation in u-learning can not only induce learners' attitudes but also determine their behaviors. This suggests that, unlike in the case of traditional English education, the attitudes of learners toward English education are of great relevance to u-learning.

Finally, previous studies have verified a positive relationship between satisfaction and expectations (e.g., Lim, Le & Nam, 2007), and this study's results provide support for this relationship. This suggests that the higher the u-learning satisfaction for English education, the higher the learner's English-learning expectations. That is, learners' satisfaction is an important determinant of their learning expectations. In addition, the results of the multi-group moderation test show differences in all paths in the research model between the three groups (elementary school, junior/high school, and university groups) except for the path between innovation and satisfaction. This implies that the level of education had significant effects on the hypothesized relationships. That is, the learner's attitudes or behaviors explaining the relationship between ubiquitous and learner characteristics are difference according to the level of education.

## CONCLUSION

### Contributions and implications

This study highlights the uniqueness of u-learning for ELLs, which provides educators and developers with important insights into these learners' behaviors. The research model provides a logical framework for understanding why ELLs may or may not be satisfied with u-learning as an innovative learning method. Instead of focusing on the technological characteristics that influence learners' behaviors, the research model assesses ubiquitous characteristics (omnipresence, context customization, interactivity, self-directed learning, and perceived enjoyment) and learner characteristics (innovation, learning motivation, and computer self-efficacy) in the context of u-learning satisfaction.

This study contributes to the literature on u-learning by considering ELLs with some u-learning experience. The study limits the sample to u-learning users to provide a better understanding of the relationships between the proposed external variables and satisfaction and between satisfaction and expectation. In addition, the study provides important insights into some non-technological constructs that are key predictors of u-learning satisfaction. In this regard, the study explains the innovation decision process at the individual and learning environment level by evaluating the characteristics of individuals and learning environments, not technological attributes. Further, the results provide English-language educators considering u-learning adoption with a better understanding of the key factors influencing u-learning satisfaction and thus the needs of English-language learners.

In terms of practical implications, the results demonstrate the increasing popularity of u-learning for English education among Koreans. ELLs with a solid understanding of the technological benefits are likely to be better positioned to integrate u-learning into their daily routines. This suggests that those organizations and educational institutions considering u-learning for English education should better educate their members and educators to enable them to search for and respond to emerging technologies in a more efficient and effective manner. That is, educational institutions should focus more on increasing IT awareness among their educators and staff members to be more opportunistic and gain a competitive advantage over other educational methods for English learning.

### Limitations and future research

This study has some limitations. First, the cross-sectional design limits the generalizability of the results. In addition, the use of a key informer to gather data is a limitation in that a single individual may not be representative of the entire group. However, the study addresses this limitation considering ELLs with some u-learning experience. In this regard, future research should increase the generalizability of this study's results by considering a wider range of educational organizations or respondents representing various countries. Second, the study considers items adapted from previous studies, and therefore the potential misspecification of some constructs constitutes a limitation. Third, this study focuses on u-learning satisfaction as the sole factor impacting u-learning expectation. In this regard, future research should identify other determinants of u-learning satisfaction and performance in the context of English learning.

The results suggest many interesting avenues for future research on English education. For example, English education may impact the extent to which learners intend to adopt u-learning, and therefore ELLs should learn from their experience to remain viable and adapt to rapidly changing educational environments. With the introduction of new technologies for English education, satisfied (as well as dissatisfied) ELLs may rely on how well they apply what they learn. In this regard, future research should explore how individuals learn in terms of the mechanisms and processes they employ, what the most efficient ways to disseminate new knowledge are, and how ELLs can modify their behavior to reflect new knowledge and insights.

This study investigates the effects of only ubiquitous characteristics and learner characteristics on u-learning satisfaction, and therefore future research should consider other characteristics that may influence this satisfaction. In addition, future research should examine the moderating effects of demographic factors such as gender, age, and experience on the relationships between learner characteristics and satisfaction.

## APPENDIX A. Results of Convergent Validity and Reliability

| | | Mean | *SD* | Loading | Cronbach's alpha |
|---|---|---|---|---|---|
| Omnipresence | | | | | 0.84 |
| 1: | I can use necessary content for English learning anytime, anywhere. | 4.83 | 0.66 | 0.85 | |
| 2: | I can obtain necessary information for English learning instantly. | 4.98 | 0.59 | 0.91 | |
| 3: | U-learning frees me from time and location constraints. | 4.86 | 0.78 | 0.79 | |
| Context Customization (CC) | | | | | 0.86 |
| 1: | With u-learning, I can get customized learning content. | 5.22 | 0.58 | 0.85 | |
| 2: | U-learning provides me with English-learning materials based on my English skills. | 5.07 | 0.74 | 0.82 | |
| 3: | I can design my own English learning materials with u-learning system. | 5.13 | 1.07 | 0.83 | |
| Interactivity (INT) | | | | | 0.92 |
| 1: | I can interact with other ELL through u-learning. | 4.11 | 0.91 | 0.89 | |
| 2: | U-learning facilitates simultaneous, real-time communication for both English learning and content providers. | 4.20 | 0.98 | 0.79 | |
| 3: | U-learning facilitates mutual communication between ELL | 4.78 | 0.76 | 0.85 | |

| | | | | | |
|---|---|---|---|---|---|
| | and content providers. | | | | |
| Self-Directed Learning (SDL) | | | | | 0.96 |
| 1: | I can find English-learning content that I want to study by myself through u-learning. | 4.95 | 0.90 | 0.78 | |
| 2: | I can study necessary English-learning content through the self-directed learning process. | 4.84 | 0.81 | 0.74 | |
| 3: | I can study needed English-learning content directly through u-learning. | 4.08 | 0.92 | 0.76 | |
| Perceived Enjoyment (PE) | | | | | 0.87 |
| 1: | English learning under the u-learning environment is exciting. | 5.13 | 0.97 | 0.74 | |
| 2: | Using u-learning to study English is more enjoyable. | 4.24 | 1.07 | 0.86 | |
| 3: | English learning through u-learning makes me feel good. | 4.85 | 0.89 | 0.76 | |
| Innovation (INNO) | | | | | 0.88 |
| 1: | I like to try new ways of learning English. | 4.18 | 0.51 | 0.87 | |
| 2: | I like something new and different when studying English. | 5.02 | 0.66 | 0.79 | |
| 3: | I am a kind of person who tries something new before others. | 4.03 | 0.93 | 0.74 | |
| Learning Motivation (LM) | | | | | 0.90 |
| 1: | Learning English in u-learning environment is a challenge that I enjoy. | 4.34 | 0.73 | 0.74 | |
| 2: | I very much enjoy learning English in u-learning environment. | 4.72 | 0.92 | 0.86 | |
| 3: | Since using u-learning, I spend more time learning English. | 5.00 | 1.02 | 0.73 | |
| Computer Self-Efficacy (CSE) | | | | | 0.87 |
| 1: | I understand the hardware for my current u-learning system. | 3.91 | 0.67 | 0.80 | |
| 2: | I understand the software for my current u-learning system. | 5.13 | 0.78 | 0.75 | |
| 3: | I can fix any technical problem with my current u-learning system. | 4.68 | 0.81 | 0.91 | |
| Satisfaction | | | | | 0.85 |
| 1: | I am satisfied with u-learning in terms of learning English. | 4.74 | 0.82 | 0.77 | |
| 2: | English learning through u-learning meets my learning expectations. | 4.92 | 0.67 | 0.83 | |
| 3: | I am more satisfied with u-learning than other English-learning methods. | 4.11 | 1.05 | 0.91 | |
| Expectation (EXP) | | | | | 0.92 |
| 1: | I can improve my English knowledge to expected levels through u-learning. | 5.39 | 0.51 | 0.94 | |
| 2: | I can improve my grade in English through u-learning. | 5.21 | 0.66 | 0.81 | |
| 3: | English-related knowledge and information provided by u-learning can help me improve my grade in English. | 4.99 | 0.47 | 0.87 | |

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