Empirical Study on the Adoption of Mobile Learning: Based on Extended Technology Acceptance Model

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We certify that this work has passed the scholastic standards requested by the Information and Communications University as a thesis for the degree of Master

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Abstract

Mobile telecommunication technology is opening an era that enables access to many information services, including advanced educational techniques and wireless Internet connections. As the use of wireless Internet increases, many traditional industries are attempting to develop new ways of conducting business using a wireless service delivery channel. The education industry is no exception.

Mobile learning (m-learning) is an advanced method of learning that has evolved from web-oriented learning; it emphasizes portability and mobility in learning and easy access to knowledge databases and educational service providers regardless of time and place.

The perceived ease of use and perceived usefulness are widely recognized as the principal factors determining the uptake of m-learning. This paper discusses other factors that affect the adoption of mobile learning, using the
extended technology acceptance model (TAM). These additional factors are the perceived system quality, perceived contents quality, subjective norm, and perceived cost. We examined the factors that affect users’ adoption of mobile learning, and validated and empirically tested our research model.
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1. Introduction

As the use of wireless Internet increases, many traditional industries are attempting to develop new ways of conducting business using a wireless service delivery channel. The education industry is not an exception. E-learning has also been improved, like other information system industries.

Web based learning is not the only tool for e-learning any more. Existing web based e-learning has some limitations, which means that users are required to be at the designated place. Users can not learn whenever they want and wherever they want. The development of mobile terminals, mobile telecommunication, and mobile Internet changes the characteristics of e-learning. Mobile learning is “any sort of learning that happens when the learner is not a fixed, predetermined, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technology (O’Malley, Vavoula et al. 2003).

Mobile learning (m-learning) emerges by the convergence of education and mobile technology. Mobile learning is an advanced method of learning and especially it emphasizes mobility in learning and easy access to knowledge databases and educational service providers. Therefore, users can utilize their time effectively and learn whenever and wherever (Virvou and Alepis, 2003; Shaples, 2000). Users can keep up with their studying or job demands using
PDA (Personal digital assistant), laptops, PMP (Portable Multimedia Player) and other handheld devices. Advancements in mobile devices provide users’ information sharing, learning and training. These devices are becoming the ideal tools for just-in-time learning.

This paper aims to predict users’ acceptance of mobile learning to promote mobile learning based on the factors which influence the adoption. TAM (Technology acceptance Model) is widely used to examine and predict user behavior and the determinant of the behavior of accepting information systems (Davis, 1989). The perceived ease of use and perceived usefulness are widely recognized as the principal factors determining the uptake of information systems. This paper discusses other factors that affect the adoption of mobile learning, using the extended technology acceptance model (TAM). These additional factors are perceived system quality, perceived contents quality, subjective norm, and perceived cost. Perceived system quality and perceived contents quality are major factors enabling to make the mobile learning environments like the stability of network and the quality of contents. Another factor is subjective norm. Most users are students or workers. They are affected from their friends or colleagues to adopt new information systems. The last factor is perceived cost. Mobile learning requires new mobile devices. The price of mobile devices is quite expensive. Their prices are a very critical determinant in the adoption of mobile learning.
The next will review the status of mobile learning and its features. Sections 3 will examine the theoretical background of this paper. Section 4, 5 will introduce the hypothesis and its outcome. The last section will induce the conclusion based on the results.
1. Mobile Learning

The market for e-learning is expected to grow steadily with strong demand by the corporate, household, government, and educational sectors (KRG, 2005). In e-learning markets, web-based Instruction (WBI) has been a major form of e-learning. Khan (1997) defined WBI as “a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported.” WBI has some features which can overcome obstacles of class based learning: Users can easily access the educational sources, can learn at a reasonable price when compared to private education. We expect to lower the private educational expenses through the WBI. Finally, WBI makes it possible to make users control their learning procedure, level, contents, etc by themselves.

The International Data Corporation has predicted that the compound annual growth rate of the world e-learning market will be as high as 36.5% until 2006, and the market size would amount to US$80 billion. According to a fact finding survey by the Ministry of Commerce, Industry and Energy and the Korea Institute for Electronic Commerce, e-learning market size was 14,525 billion won in 2005, which increased 12.4% nationally when compared to 2004 (Digital
Table 1. E-learning Business Total Sales

(Unit: million won)

<table>
<thead>
<tr>
<th></th>
<th>solution</th>
<th>contents</th>
<th>service</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>244,814</td>
<td>336,320</td>
<td>889,683</td>
</tr>
<tr>
<td>2004</td>
<td>222,954</td>
<td>287,498</td>
<td>788,082</td>
</tr>
<tr>
<td>2005</td>
<td>215,002</td>
<td>243,521</td>
<td>618,518</td>
</tr>
</tbody>
</table>

Source: Digital Times 06-01-13

E-learning is made up of three business domains, e-learning solution, e-learning contents, and e-learning service. E-learning solution is HW and SW, which make it possible to study using the internet. There are two types of e-learning solutions, LMS (Learning Management System) and LCMS (Learning Contents Management System). E-learning contents are the most significant area in e-learning. The contents should be made based on the purpose of given learning. The development of various contents and contents quality is needed than any other things. E-learning service distributes educational contents by the provided solution. It plays a role of mediation between e-learning contents area and e-learning solution area.
As the market has expanded and wireless technology has matured, e-learning service is evolving to be more convenient for customers. Learners want to use educational services anytime and anywhere they want. New wireless digital communications technology allows educational service providers to deliver more learner-centered, personalized, and differentiated services to learners (Sharples, 2000).

Thus, in the e-learning market, the web-based learning system is evolving into a mobile learning system. Mobile learning, called m-learning, is a new system that enables users to learn by using portable computing devices, such as notebook computers,
personal digital assistants, smart phones, portable multimedia player, and other handheld devices. The biggest difference between e-learning and m-learning is the existence of portability. Users can access the mobile learning contents with portable devices. However, web-based learning is impossible to carry on devices. Mobile learning has other features, mobility and ubiquity as well as portability. Users can learn something while on the move anywhere (Durlacher Research, 2002; Kalakota & Robinson, 2001; Kannam & Chang, 2001). The following table make a comparison between e-learning and m-learning.

Table 2. Comparison between e-learning & m-learning

<table>
<thead>
<tr>
<th>e-learning</th>
<th>m-learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>Mobile</td>
</tr>
<tr>
<td>Interactive</td>
<td>Spontaneous</td>
</tr>
<tr>
<td>Hyperlinked</td>
<td>Connected</td>
</tr>
<tr>
<td>Collaborative</td>
<td>Networked</td>
</tr>
<tr>
<td>Media-rich</td>
<td>Lightweight</td>
</tr>
<tr>
<td>Distance learning</td>
<td>Situated learning</td>
</tr>
<tr>
<td>More formal</td>
<td>Informal</td>
</tr>
<tr>
<td>Simulated situation</td>
<td>Realistic situation</td>
</tr>
<tr>
<td>Hyper-learning</td>
<td>Constructivism, situationism, collaborative</td>
</tr>
</tbody>
</table>

Source: Laouris, 2005

M-learning has been gaining in popularity, and both industry and academia
are attempting to devise new business models for its use. Digital multimedia
broadcasting and WiBro (wireless broadband) technologies, which enable high-
speed access to learning materials, and will be soon available in Korea, are
expected to play an important role in facilitating m-learning in that country.

M-learning services have already started at some educational institution,
EBS (Education Broadcasting System), Korea Cyber University, CREDU\(^1\) etc. However they provide just the download type. To realize a complete mobile
learning service, WiBro(Wireless Broadband) should be set up. The existing
wireless technology, WLAN (Wireless Lan), supports very high data but limited
coverage and mobility are not supported. In case of Cellular CDMA (Code
Division Multiple Access) network, it provides large coverage and fast mobility
but data rate is low and quite expensive. WiBro is mobile wireless broadband
access. It makes it possible to connect Internet on the go, guaranteeing at a
receiver speed of up to 37 miles per hour (60 km/ h). WiBro is now located in
the 2.3 gigahertz band and it will evolve to 4 generation network which supports
higher data and mobility afterwards (Electronic Times, 2005~2006). WiBro
service is expected to be launched by the middle of 2006. If WiBro services start,
the mobile learning market will be increased. Users do not need to download
learning contents from the web. They can access the mobile contents, while on
the move, through WiBro directly.

\(^1\) Online educational service company: www.cedu.com
2. Literature Review

To examine the research model, I adopt technology acceptance model (TAM) as a base model. Prior to explanation of TAM, I intended to introduce Theory of Reasoned Action (TRA).

2.1 Theory of Reasoned Action

The Theory of Reasoned Action (TRA) was introduced by Ajzen and Fishbein (Fishbein and Ajzen, 1975). TRA suggested that an individual’s behavior is determined by one’s intention to perform the behavior. The intention was a combination of one’s attitude toward the behavior and subjective norm. Attitude toward the behavior is an individual’s positive or negative feeling about performing a behavior. The determinants of one’s attitude are the behavioral belief that a particular behavior leads to a certain outcome and an evaluation of the outcome of that behavior. If the outcome is good for the individual, he or she intends to do a given behavior. The other factor which determines the intention is subjective norm. It is an individual’s perception of whether people important to the individual think that the behavior should be performed. In forming subjective norm, an individual considers the normative expectations of others who are
important to him or her. These people are friends, family, or colleagues. The individual may be inclined or not inclined to participate in a particular behavior based on their desire to comply with others. However, it is applied when the behavior is under an individual’s volitional control.

![Diagram of Theory of Reasoned Action (TRA)](image)

Figure 2. Theory of Reasoned Action (TRA)

### 2.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) is adapted from the theory of reasoned action (TRA). TRA is the theory to explain the general behavior of people. On the other hand, TAM is suggested to explain using behavior of computer technology and information technology by Davis (1989). TAM has been studied in IS research and predict the determinant factors of IT acceptance (Adams et al., 1992; Ajzen, 1985; Chau, 1996; Gefen and Keil, 1998; Thompson et al., 1991).

The adoption of a new system is determined by two determinants: perceived
usefulness and perceived ease of use. Perceived usefulness is defined as the extent to which a person believes that a particular information system would help his or her job performance or productivity; perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). Actual behavior is determined by behavioral intention. And behavioral intention is determined by attitude toward behavior and perceived usefulness. Attitude toward behavior is determined by the extent of perceived usefulness and perceived ease of use. Also, perceived usefulness is affected from perceived ease of use, because easier systems would be more useful.

TAM has been developed more robust and effective model in applying in many information systems. However, it did not consider social influence. When it was made from TRA, the subjective norm was not included. In TAM 2, TAM was expanded by adding the subjective norm. Venkatesh and Davis (2000) extend the TAM model to explain perceived usefulness and usage intentions in respect of social influence and cognitive instrumental processes.
Despite the robustness of TAM, the TAM is not strong enough to be applied to all information system environments. Using existing constructs cannot reflect the complex attributes of individual users in relations to various information systems (Moon & Kim, 2001). Therefore, many researchers have suggested variables to complement the TAM – for example, cost, gender, enjoyment, and trust etc. This study was intended to extend TAM to reflect the acceptance of mobile learning in wireless internet by mobile devices.
3. Research Model

The proposed research model is shown in figure 4.

Figure 4. Research Model
TAM (Technology Acceptance Model) was applied in many information systems areas, and was also verified its robustness (Hu et al., 1999; Legris et al., 2003; Taylor & Todd, 1995; Venkatesh and Davis, 2000).

The adoption of a new system is determined by two constructs: perceived usefulness and perceived ease of use. Perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). Perceived usefulness is defined as the extent to which a person believes that a particular information system would help his or her job performance or productivity (Davis, 1989). Perceived usefulness and perceived ease of use are important factors in using a system, and they have a significant effect on users’ attitudes; attitude, in turn, directly influences behavioral intention. In this paper, “attitude” is excluded to simplify the model (Ong & Lai, 2004; Wang, 2002). DeLone & McLean (2003) have suggested that the intention to use is a worthwhile alternative measure; thus, ‘intention to use’ is an attitude, whereas ‘use’ is a behavior. Substituting the former for the latter may resolve some of the process-versus-cause concerns that Seddon (1997) has raised. The usage of IT is determined by behavioral intention. Perceived usefulness is affected by perceived ease of use, because an easier system typically results in improved performance. Thus, perceived ease of use affects perceived usefulness.
in the mobile learning context. This leads to the first three hypotheses.

**H1** Perceived ease of use will have a positive effect on the perceived usefulness to use mobile learning.

**H2** Perceived ease of use will have a positive effect on behavioral intention to use mobile learning.

**H3** Perceived usefulness will have a positive effect on behavioral intention to use mobile learning.

However, the TAM is not strong enough to be applied to all information system environments. Using existing constructs cannot reflect the complex attributes of individual users in relation to various information systems. This study extends the TAM by adding subjective norm, perceived cost, perceived contents quality, and perceived system quality to the context of mobile learning.

**Perceived System Quality**

DeLone & Mclean (1992) employed system quality and information quality to show the success of information systems. System quality and information quality are useful external factors of perceived usefulness and perceived ease of use (Lin and Lu, 2000). System quality has included many determinants on
developing new technology or systems. Hamilton and Norman (1981) defined the meaning of system quality: data currency, response time, turnaround time, data accuracy, reliability, completeness, ease of use, and system flexibility.

The stability of a system in a mobile context is inferior to one in a wired context, so system quality should be considered. Seddeon (1997) introduced “bugs” which is concerned with system reliability. Lin and Lu (2000) also used response time and system accessibility to indicate the system quality. As the stream of business goes from e-commerce to m-commerce, the support of a stable system should be guaranteed in a mobile internet context. It is necessary to get the contents from the web in a mobile learning service. Users might be reluctant to use the mobile learning service, if the download time, the speed of connection, and system reliability are not enough guaranteed. It is also related to perceived ease of use and perceived usefulness. If perceived system quality is higher, users might be easy to use and might think that mobile learning is useful.

**H4** Perceived system quality will have a positive effect on perceived ease of use to use mobile learning.

**H5** Perceived system quality will have a positive effect on perceived usefulness to use mobile learning.

**Perceived Contents Quality**
According to DeLone & McLean (1992), information quality and system quality are the most significant constructs to measure the success of IS in an organization. The contents quality is usually similar to information quality (DeLone & McLean, 1992; Lin and Lu, 2000). The contents quality included the precision, accuracy, completeness of contents or information. Perceived contents quality affects perceived usefulness to use mobile learning.

**H6** Perceived contents quality will have a positive effect on the perceived usefulness to use mobile learning.

**Subjective Norm**

Subjective norm is defined that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Ajzen, 1975). Subjective norm is a significant factor which shows social influence (Venkatash & Brown, 2001). Subjective norm is a direct determinant in TRA and TPB. In TAM 2, subjective norm was added to investigate the impact of social influences. People may perform the given behavior despite being reluctant to do the behavior, if their referents should perform the behavior. In mobile learning context, users might be influenced by their peer or important person to
him or her.

**H7** Subjective norm will have a positive effect on behavioral intention to use mobile learning.

**Perceived Cost**

TAM has been researched in organizational context. However, new IS technology is transferred into user focused aspect, so TAM considers in user or adopter context than organizational aspect (Kim et al., 2005; Venkatesh and Brown, 2001). The perceived cost is one of the factors which explain individual aspects.

The perceived cost is defined as the extent to which a person believes that they would get the benefits by investing money. In mobile learning, perceived cost might be a critical determinant. A mobile learning service might fail, if it is expensive compared to an existing learning system. In TAM, the cost of using a particular technology was not considered as a main factor to affect performing the behavior. However, the importance of perceived value in relations to purchase intention was researched (Zeithaml, 1998). Cost is related to the benefit from the performing behavior. Users might give up some cost instead of getting some benefit from the behavior. In a mobile learning context, there are two types of costs. Users might buy new mobile devices and pay the mobile Internet fee. If
the price of service is high, users are reluctant to get the mobile learning service. Therefore, the perceived costs have a negative effect on the behavioral intention to use mobile learning.

**H8** Perceived cost will have a negative effect on behavioral intention to use mobile learning.
4. Research Methodology

4.1 Data Collection

An online survey was conducted by a market research company to examine the research model. The data collection was conducted from March 3 to 7 in 2006. The number of responses was 880. Among them, 852 respondents were selected, after excluding unusable responses. The questionnaires were from prior studies which proved the validity and reliability of the questions. Table 3 shows the descriptive statistics of respondent characteristics. The questionnaires were assessed using a seven-point Likert scale, with end-points “strongly agree” and “strongly disagree.” The majority of the sample is male, between 30 and 40, well-educated, and office workers.
Table 3. Descriptive statistics of the samples

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>522</td>
<td>61.3</td>
</tr>
<tr>
<td>Female</td>
<td>330</td>
<td>38.7</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before 19</td>
<td>56</td>
<td>6.6</td>
</tr>
<tr>
<td>20-24</td>
<td>95</td>
<td>11.2</td>
</tr>
<tr>
<td>25-29</td>
<td>161</td>
<td>18.9</td>
</tr>
<tr>
<td>30-34</td>
<td>182</td>
<td>21.4</td>
</tr>
<tr>
<td>35-39</td>
<td>163</td>
<td>19.1</td>
</tr>
<tr>
<td>40-49</td>
<td>131</td>
<td>15.4</td>
</tr>
<tr>
<td>Over 50</td>
<td>64</td>
<td>7.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>38</td>
<td>4.5</td>
</tr>
<tr>
<td>High School</td>
<td>229</td>
<td>26.9</td>
</tr>
<tr>
<td>College graduate</td>
<td>542</td>
<td>63.6</td>
</tr>
<tr>
<td>Advanced degree</td>
<td>43</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>138</td>
<td>16.2</td>
</tr>
<tr>
<td>Office worker</td>
<td>304</td>
<td>35.7</td>
</tr>
<tr>
<td>Service worker</td>
<td>34</td>
<td>4.0</td>
</tr>
<tr>
<td>Professional</td>
<td>81</td>
<td>9.5</td>
</tr>
<tr>
<td>Researcher</td>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>Housewife</td>
<td>110</td>
<td>12.9</td>
</tr>
<tr>
<td>Self-employer</td>
<td>92</td>
<td>10.8</td>
</tr>
<tr>
<td>Others</td>
<td>83</td>
<td>9.7</td>
</tr>
<tr>
<td>Construct</td>
<td>Operational Definition</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>The degree to which a person believes that using mobile learning would enhance his or her job performance</td>
<td>Davis et al.</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
<td>The degree to which a person believes that using mobile learning would be free of effort</td>
<td>Davis et al.</td>
</tr>
<tr>
<td>Perceived System Quality (PSQ)</td>
<td>The degree to which a person perceives response time and accessibility in using mobile learning</td>
<td>DeLone &amp; Mclean; Seddeon</td>
</tr>
<tr>
<td>Perceived Contents Quality (PCQ)</td>
<td>The degree to which a person perceives the precision or accuracy of contents or information in using mobile learning</td>
<td>DeLone &amp; McLean; Lin &amp; Lu</td>
</tr>
<tr>
<td>Subjective Norm (SN)</td>
<td>The person’s perception that most people who are important to him think he should or should not use mobile learning</td>
<td>Ajzen; Fishbein and Ajzen</td>
</tr>
<tr>
<td>Perceived Cost (PC)</td>
<td>The extent to which a person believes that they would get the benefits by using mobile learning.</td>
<td>Zeithaml</td>
</tr>
<tr>
<td>Behavioral Intention to use (BIU)</td>
<td>The degree of a person’s willingness to adopt mobile learning in the future</td>
<td>Davis et al.</td>
</tr>
</tbody>
</table>
4.2 Reliability and Validity of Measurement Model

The data were analyzed using SPSS 10.0. The internal consistency of each construct was examined using Cronbach’s alpha. This means that the items for measuring have consistent and stable values, measured using replications. The Cronbach’s alpha coefficients of the seven constructs were greater than 0.7, indicating sufficient reliability (Straub, 1988).

The validity of the constructs indicated that all of the individual factor loadings exceeded 0.6, and that there are high interrelations among the values. The suggested minimum factor loading is 0.6 (Nully, 1978). Discriminant validity was also examined by factor analysis, which has no-cross construct loading over 0.5. The results are shown in Table 5.
Table 5. Convergent validity and internal consistency reliability

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Factor loading</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>PU1</td>
<td>0.760</td>
<td>0.964</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>0.786</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>0.765</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU4</td>
<td>0.744</td>
<td></td>
</tr>
<tr>
<td>Perceived Ease of use</td>
<td>PEOU1</td>
<td>0.782</td>
<td>0.948</td>
</tr>
<tr>
<td></td>
<td>PEOU2</td>
<td>0.714</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PEOU3</td>
<td>0.763</td>
<td></td>
</tr>
<tr>
<td>Perceived System Quality</td>
<td>PSQ1</td>
<td>0.643</td>
<td>0.946</td>
</tr>
<tr>
<td></td>
<td>PSQ2</td>
<td>0.647</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSQ3</td>
<td>0.647</td>
<td></td>
</tr>
<tr>
<td>Perceived Contents Quality</td>
<td>PCQ1</td>
<td>0.683</td>
<td>0.965</td>
</tr>
<tr>
<td></td>
<td>PCQ2</td>
<td>0.703</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PCQ3</td>
<td>0.691</td>
<td></td>
</tr>
<tr>
<td>Subjective Norm</td>
<td>SN1</td>
<td>0.856</td>
<td>0.981</td>
</tr>
<tr>
<td></td>
<td>SN2</td>
<td>0.878</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SN3</td>
<td>0.883</td>
<td></td>
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<td></td>
<td>SN4</td>
<td>0.876</td>
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<td></td>
<td>SN5</td>
<td>0.878</td>
<td></td>
</tr>
<tr>
<td>Perceived Cost</td>
<td>PC1</td>
<td>0.928</td>
<td>0.980</td>
</tr>
<tr>
<td></td>
<td>PC2</td>
<td>0.940</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC3</td>
<td>0.941</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC4</td>
<td>0.939</td>
<td></td>
</tr>
<tr>
<td>Behavioral Intention to use</td>
<td>BIU1</td>
<td>0.644</td>
<td>0.978</td>
</tr>
<tr>
<td></td>
<td>BIU2</td>
<td>0.648</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BIU3</td>
<td>0.646</td>
<td></td>
</tr>
</tbody>
</table>
5. Empirical Results

5.1 Measurement of Model Fitness

To test the model, Structural Equation Modeling (SEM) was conducted by AMOS 4.0. One of the model fit indices, chi-square (χ²) test was not accepted, because it was affected by the sample size. Other model fit indices are GFI, AGFI, RMSR, NFI, CFI, and RMSEA. As shown in Table 6, GFI is 0.906, AGFI is 0.883, NFI is 0.968, CFI is 0.975, RMSR is 0.109, and RMSEA is 0.061. Most value met the recommended value except RMSR. RMSR is a little above the recommended value. However, the whole model fit is reasonable to the test model.
Table 6. Overall Model Fit Indices

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Recommended Value</th>
<th>Obtained value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
<td>-</td>
<td>1081.382</td>
</tr>
<tr>
<td>P-value</td>
<td>&gt;0.05</td>
<td>0.000</td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>-</td>
<td>261</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>&gt;0.80</td>
<td>0.906</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit Index (AGFI)</td>
<td>&gt;0.80</td>
<td>0.883</td>
</tr>
<tr>
<td>Root Mean Square Residual (RMSR)</td>
<td>&lt;0.08</td>
<td>0.109</td>
</tr>
<tr>
<td>Normed Fit Index (NFI)</td>
<td>&gt;0.90</td>
<td>0.968</td>
</tr>
<tr>
<td>Comparative Fit Index (CFI)</td>
<td>&gt;0.90</td>
<td>0.975</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA)</td>
<td>&lt;0.05 -0.08</td>
<td>0.061</td>
</tr>
</tbody>
</table>
5.2 Hypothesis testing

The results of the structural models are in Figure 5. All hypotheses, from H1 to H8 are supported.

As proven in the previous studies, PEOU positively affected PU($\beta =0.192$, $p<0.001$). Ease of use is more useful in using mobile learning. Users might not consider mobile learning useful if the learning tool is difficult to operate.

Figure 5. Result for the users
Hypothesis 2, PEOU positively affected BIU. It is supported ($\beta = 0.152, p<0.001$). PEOU is still a very significant factor to affect users’ behavior. Hypothesis 3, PU positively affects BIU. It is also supported (($\beta = 0.166, p<0.001$). However, the effect of PEOU to BIU is more significant than the effect of PU to BIU. After examining the results from H1 to H3, they are supported by all of the causal paths based on TAM.

Hypothesis 4, which examines the positive relations between PSQ and PEOU, was supported. The effect of PSQ on PEOU is most significant in any other relations ($\beta = 0.787, p<0.001$). Hypothesis 5, PSQ positively affect PU ($\beta = 0.325, p<0.001$). PSQ is a very important factor to affect PU and PEOU. Hypothesis 6, PCQ positively affects PU. It was supported ($\beta = 0.434, p<0.001$). PSQ and PCQ are critical determinants to affect PEOU and PU in acceptance of mobile learning.

Hypothesis 7, SN highly affected the adoption of mobile learning. SN was one of the most significant factors to affect users’ behavior ($\beta = 0.687, p<0.001$).

Lastly, Hypothesis 8 showed the causality between PC and BIU. The users are strongly affected by cost ($\beta = -0.122, p<0.001$). The details of the hypotheses are in Table 7.
Table 7. Results for Hypotheses Test

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Effects</th>
<th>Structural coefficient</th>
<th>p-value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>PEOU→PU</td>
<td>0.192***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H2</td>
<td>PEOU→BIU</td>
<td>0.152***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H3</td>
<td>PU→BIU</td>
<td>0.166***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H4</td>
<td>PSQ→PEOU</td>
<td>0.787***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H5</td>
<td>PSQ→PU</td>
<td>0.325***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H6</td>
<td>PCQ→PU</td>
<td>0.434***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H7</td>
<td>SN→BIU</td>
<td>0.687***</td>
<td>0.000</td>
<td>supported</td>
</tr>
<tr>
<td>H8</td>
<td>PC→BIU</td>
<td>-0.122***</td>
<td>0.000</td>
<td>supported</td>
</tr>
</tbody>
</table>

PEOU, Perceived Ease of Use; PU, Perceived Usefulness; PSQ, Perceived System Quality; PCQ, Perceived Contents Quality; SN, Subjective Norm; PC, Perceived Cost; BIU, Behavioral Intention to Use

*p<0.05, **p<0.01, ***p<0.001
6. Conclusion

6.1 Summary

The present study investigated the main factors in adopting mobile learning based on the TAM. The factors affecting adoption of mobile learning applied to the extended the TAM, which is a verified model in the IT context. The construct has adequate validity and reliability, as well as proper model fit.

As a result of the research, PEOU, PU, SN, and PC are determinants for the intention to adopt mobile learning. PEOU and PU are significant factors to affect behavioral intention to use in a mobile learning context as proven in other information systems. Also, PEOU affects PU as proven in other research.

PSQ is a very significant determinant to affect PEOU and PU each. PSQ is a more critical factor in a mobile environment than a cable environment. Users consider the speed of mobile Internet, accessibility, and system stability in mobile learning. PCQ is also a major factor to affect PU. The quality of contents and its reliability are main keys to determine its usefulness.

SN is normative belief to affect personal aspect than organizational aspect. Mobile learning is personal factor learning system. Compared to a traditional
learning system, it is an extremely personalized and specified learning system. So SN is key determinant to affect personal behavior. In accepting mobile leaning, significant people around users affect the users’ behavior so much than initial expectations. Family, friends, and colleagues have a critical role for users’ behavior as shown in the research results.

Other determinant, PC also affects behavioral intention to use as our hypothesis. In case of mobile learning, users should pay significantly more when compared to web-based learning. Users should buy new mobile devices, pay the expenses of contents and wireless Internet expenses. It is a critical factor to affect the users’ behavior.

6.2 Contribution

The research can be deduced the implication in respect of theoretical view and practical view. In theoretical view, this research extended successfully technology acceptance model to apply mobile learning in specific IT area. The added constructs, PSQ, PCQ, SN, PC are successfully examined the relation between BIU directly and indirectly.

In practical view, the study gives some suggestions for promoting mobile learning. PSQ affects PEOU and PU as seeing the relations among the PSQ, PCQ, PEOU, and PU. In mobile learning, the most significant factor is a stable
connection to the Internet. The success of mobile learning depends on well developed Wibro. The supports of stable mobile Internet and ease of use in mobile learning services will proliferate mobile learning in the future. PCQ also affects PU. There are many learning contents like foreign language, computer related lecture, or professional classes in e-learning market. However, its qualities are not guaranteed. The provision of qualified and, various and reliable contents should be developed by the examination of specialists.

The some additional costs are added in mobile learning. The arrangement of proper price should be set. Mobile learning is not a replacement of the traditional class, but a supplementary class. The cost which not reflected the users’ perception is hard to success. The differentiated price strategy is needed according to the provided services.

Finally, people are affected by other people. It is really a significant factor that the reputation from others around us links to users’ behavior. Recently, there are other channels like the Internet or mass media as well as significant people around the user which affect users’ behavior. Some marketing strategies considering the social affect should be considered.

6.3 Limitation and Further studies

The research has some limitations. First, the survey was conducted by
online survey, so it is hard to represent the whole population of mobile learning to generalize the research model. Although the population using the Internet is comparatively high in Korea, it needs a more representative survey, like an off-line survey.

Second, there are some price sets in mobile learning. For example, the price of WiBro service, contents, and devices. In considering the price, we need to classify the cost level according to each service. Also, the price which people recognize might vary because the cost is a very subjective factor. In further study, a differentiated price survey should be conducted.

Finally, there are other factors, which feature the mobile learning itself. Further study should add other new factors, which explains the feature of mobile learning.
WiBro

WiBro (TAM) 852 MHz

- 34 -
Reference


Appendix-Survey Questionnaire

- 40 -
1. WiBro(ワイルドブロードバンドラジオ)とはどのような通信システムですか。
   ① WiBro (2
   ② WiBro (3

2. WiBroはどのような通信システムですか。
   ① WiBro ② WiBro ③ WiBro ④ WiBro（）

3. WiBroはどのような通信システムですか。
   ① WiBro ② WiBro

4. WiBro (m-learning)とはどのような通信システムですか。
   ① WiBro ② WiBro ③ WiBro ④ WiBro

5. WiBroはどのような通信システムですか。
   （- - - - - - -）
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1. 2 3 4 5 6 7
2. 2 3 4 5 6 7
3. 2 3 4 5 6 7
4. 2 3 4 5 6 7
5. 2 3 4 5 6 7

- 42 -
<table>
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<td>5.</td>
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1) วดฏ ฏ Giải?
   (1)  ©  (2)  □

2) วดฏ ฏ Giải?
   (1)  © 15-19 □  (2)  © 20-24 □  (3)  © 25-29 □  (4)  © 30-34 □
   (5)  © 35-39 □  (6)  © 40-49 □  (7)  © 50 □

3) วดฏ ฏ Giải?
   (1)  ©  (2)  □

4) วดฏ ฏ Giải?
   (1)  ©  (2)  □  (3)  □  (4)  □  (5)  □  (6)  □

5) วดฏ ฏ Giải?
6) 重塑 (100~200) 重塑 (200~300) 重塑 (300~400) 重塑 (400~500) 重塑 (500~600)

(1) 100 重塑 
(2) 100~200 重塑 
(3) 200~300 重塑 
(4) 300~400 重塑 
(5) 400~500 重塑 
(6) 500 重塑 

7) 重塑 (100~200) 重塑 (200~300) 重塑 (300~400) 重塑 (400~500) 重塑 (500~600)

(1) 重塑 (2) 重塑 (3) 重塑 (4) 重塑 (5) 重塑 (6) 重塑 (7) 重塑 
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(15) 重塑 (16) 重塑 

※ 重塑 (17) 重塑 

KAIST