

Analysis of the Structural Relationships among Self-efficacy, Experience, Mobile Learning Quality, and Learner Satisfaction in Universities

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This study was designed to determine the factors affecting learner satisfaction and examine the relationships of these factors in mobile learning linked to pre-existing e-learning in universities. In the structural model used, three mobile learning quality factors are the endogenous variables, namely, system quality (SYQ), information quality (INQ) and service quality (SEQ) perceived by students, and learner satisfaction (LS), whereas students' self-efficacy (SE) and experience (EX) in mobile learning are the exogenous variables. The subjects were 900 students who registered for mobile learning courses offered by a private university in Seoul, Korea. The results indicated that SE in mobile learning had positive effects on SYQ, INQ, and SEQ. Furthermore, SE influenced LS when analyzed without quality factors as parameters. Mobile learning EX directly affected INQ, but not SYQ or SEQ. EX likewise had a direct effect on LS when analyzed without quality factors as parameters. Meanwhile, both SYQ and INQ showed a positive effect on LS, but not SEQ. SE and EX affected LS indirectly when SYQ and INQ were used as parameters. This study addresses the importance of increasing SE, EX, SYQ, and INQ to increase LS in mobile learning in universities

Keywords : Mobile learning, Self-efficacy, Experience, System quality, Information quality, Service quality, Learner satisfaction

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Introduction

Recent advances and the diffusion of mobile technology have enabled universities to provide their students with mobile learning services. In 2011, several leading universities in Korea launched mobile learning services, and the number of universities offering mobile learning credit-courses has been rapidly increasing since. Most of them have built their mobile learning systems by linking to already existing e-learning systems rather than developing the systems as independent ones. Lee (2008) proposed several methods for efficiently repurposing e-learning contents to serve as mobile learning contents, focusing on the gap in screen size of mobile devices and desktop PCs. Lee noted that university e-learning contents in Korea were usually instructors' lecture videos and lecture notes, which generally contain lecture key words. Lee's first method was to extract only the lecture videos of e-learning contents to be used as mobile learning contents. The second was to extract only the voice track of the lecture videos to complement the lecture notes. Most universities that offer mobile learning in Korea have adopted Lee's methods of repurposing e-learning contents, thus providing mobile learning alongside e-learning.

Mobile learning in universities must provide a more convenient learning environment for the students and enhance their learning outcomes, which usually involve learner satisfaction (LS) and academic achievement. LS means the student's belief as well as feeling and emotion defined by the quality of a learning program in which he or she participated while academic achievement indicates the result or level of ability that he or she has achieved after attending a learning program in behavior, skills, and knowledge. LS has been known as a factor positively affecting academic achievement in both conventional and revolutionary environment (Cho, 2015; Moon & Nam, 2007; Roca, Chiu, & Martinez, 2006; Ryu, 2007; Wachtel, 1998). Kim and Kang (2010) even proposed LS as a representative index of learning outcomes in higher education because LS had been closely related to

academic achievement. Meanwhile, there have been reported inconsistent results regarding the relationship: LS was not found to have a positive relationship with academic achievement (Joo, Hong, & Lee, 2011). It implies that the relationship can vary depending upon which variables a study involves and it is necessary to examine their relationship continually with different sets of variables (Cho, 2015). Regardless of the relationship between LS and academic achievement, this study involved only LS because the students' academic achievement data such as grade and test score could not be disclosed for research purposes concerning the privacy issue of the individual students.

A lot of studies have been identified various factors affecting LS. Among those factors, the quality of learning programs has been acknowledged as one of the most significant ones affecting LS (DeLone & McLean, 2003; Jung, 2009; Lee, 2011; Lee & Lee, 2010; Lee, Ryu, & Kim, 2007). The learning quality is usually subdivided into system quality, information quality, and service quality regarding e-learning environment. The system quality is what users perceive related to hardware, software, and web-page interface of an e-learning system. The information quality is related to information and contents provided by the system while the service quality is dependent on its learning management and support (Lee & Lee, 2010; Lee & Shim, 2006). Even if there were some differences among the studies, the influence of the information quality on LS was the most significant, the service quality was the next and the system quality was proven to be the least influential (Lee & Lee, 2010). However, because mobile learning is not the same as e-learning in its features, its effects on LS may be different from that of e-learning. It is necessary to conduct a study to clearly identify the effects of mobile learning quality factors on LS.

Learner characteristics are another important factor that influences LS. The cognitive traits of learners such as intelligence and prior knowledge had been examined in many studies until non-cognitive traits such as self-efficacy (SE), extroversion/introversion, and motivation came to receive educators' attention

recently (Busato, Prins, Elshout & Hamaker, 2000; Lee, 2013). Among various traits of learner characteristics, SE has been found to have a close relationship with LS consistently, especially in circumstances in which new instructional methods or technologies are applied (Lee & Kim, 2013). SE was selected as a factor in this study because the students were not much familiar with mobile learning and they might need a high level of self-efficacy to overcome the unfamiliarity.

Students' experience (EX) of using mobile learning systems was included in the current study even though it was a factor that had not appeared in the studies of e-learning. Since mobile learning had been offered along with its corresponding e-learning program in this study, the students could choose to study by mobile learning or e-learning each week and mobile learning EX varied among the students.

This study aims to determine the relationships among students' SE of mobile learning; their mobile learning EX; mobile learning quality factors of SYQ, INQ, and SEQ; and LS. The study was conducted under the context of a mobile learning system connected to an already existing e-learning system, the most common mobile learning environment in Korean universities. The results are expected to help ensure LS towards mobile learning and contribute to the successful establishment and spread of mobile learning in universities that attempt to provide e-learning-linked mobile learning services.

Theoretical Framework

SE and its influences on learning

Students' SE is as an individual assessment of the ability to organize and carry out behaviors to obtain pre-set educational performance goals (Schunk, 1989). It has been regarded as a major factor affecting various aspects of students'

motivation and achievement (Joo, Bong, & Choi, 2000; Liaw, 2008; Ong, Lai, & Wang, 2004). Learners who perceived themselves as efficient in learning new skills and solving problems tended to be more successful in actually doing them.

Students' SE has been consistently proven to have a positive effect on learning outcomes in both revolutionary learning and conventional environments (Kim & Joo, 2010; Joo, Bong, & Choi, 2000; Liaw, 2008; Ong, Lai, & Wang, 2004). Studies undertaken in revolutionary conditions, such as e-learning, have investigated SE with respect to technology use rather than general academic performance (Joo & Moon, 2004). Kim and Oh (2005) reported that learning outcomes could be enhanced by helping students believe that they could use cyber-learning systems well enough to achieve the learning objectives. As mobile learning involves a revolutionary learning environment, students' SE can be approached with a focus on technology use. Lee and Kim (2013) examined the effect of students' SE on their recognition of mobile learning quality, perceived usefulness, and LS; SE had positive effects on all three endogenous variables. Park, Nam and Cha (2012) reported that mobile learning SE had positive effects on perceived usefulness, perceived ease of use, and mobile learning attitude. Thus, students' SE in mobile learning contributes to their learning satisfaction and recognition of mobile learning quality.

EX and its influences on learning

User EX has been often examined as a factor in information technology acceptance studies. However, its conceptual definition varies: it has been understood as direct EX (Venkatesh, 2000), prior EX (Thompson et al., 1994), or past usage (Bajaj & Midumolu, 1998) of the same or similar systems to the system of interest (Baek, 2006). It has been generally measured by its quantity rather than quality, such as period and frequency of use or number of packages used (Baek, 2006).

In the case of studies examining the effect of EX in the area of e-learning or web-based learning, EX is understood as the prior use of the same or similar systems to the system of interest (Carwell et al., 2000; Kim, 2008; Park, 2012; Piccoli, Ahmad & Ives, 2000). EX has direct and indirect positive effects on students' learning. Students with prior e-learning EX tend to be less anxious about the technology and more able to manage their learning compared those who had limited EX (Kim, 2008). Previous learning EX has a positive effect on SE and learner satisfaction in web-based virtual learning environments (Piccoli, Ahmad, & Ives, 2000). Indeed, the lack of EX is the biggest obstacle in e-learning; e-learning EX could improve future learning by adding depth (Carwell et al., 2000). Students with favorable e-learning EX often hold a positive attitude towards e-learning and recommend e-learning courses to acquaintances (Park, 2012).

However, EX in the present study is neither prior EX nor past usage. It refers to the amount of direct EX in the system of interest, measured by the number of the target mobile learning weekly sessions in which students participated. A semester in Korean universities generally lasts 14 to 16 weeks, and most undergraduate courses are composed of 14 to 16 weekly sessions. The students, who registered for e-learning courses in universities offering corresponding mobile learning services, were able to engage in mobile learning as well as e-learning. As they were able to selectively participate in the mobile or desktop PC version of the weekly sessions, mobile learning EX largely varied from student to student. As mentioned, the concept of EX here differs from that in previous e-learning environment studies; indeed, few studies have examined the effect of EX under a mobile learning environment. Thus, it is uncertain that students' EX in mobile learning affects LS as a positive factor. Similarly, it is not certain that EX influences students' recognition of mobile learning quality.

Subordinate quality factors of a mobile learning system

A mobile learning system can be regarded as an information system similar to an e-learning system (Lee & Kim, 2013). The quality of a mobile learning system is mainly decided by its subordinate quality factors, namely SYQ, INQ, and SEQ (DeLone & McLean, 2003; Lee & Lee, 2010; Liu & Arnett, 2000; McKinney, Yoon, & Zahedi, 2002; Novak, Hoffman, & Yung, 2000; Palmer, 2002). SYQ is a technical state, such as system accuracy and operational efficiency of processing information (Lee, Ryu, & Kim, 2007). SYQ of an information system involves all of its hardware, software, and webpage interface (Lee & Lee, 2010). It is relevant to the stability of the technical and physical infrastructure, ease in screen navigation, screen design, and diversity of multimedia use in other previous studies (Kim, 2003). McKinney, Yoon, and Zahedi (2002) explained that lag in page switching and network spikes result in lowered learners' interest and intention to study and even logging out from the system despite high-quality information and service. SYQ has been regarded as an important factor that leads users to accept the system and acknowledge the same as a successful information system.

INQ refers to the quality of information, contents, and other output provided by an information system (Lee, Ryu, & Kim, 2007). Pitt, Watson, and Kavan (1995) insisted that the delivery of information is the most essential role of a website and that the most important matter is its INQ. INQ involves the accuracy, timeliness, reliability, concreteness, sufficiency, and usability of information provided by the system (DeLone & McLean, 2003). INQ has a positive effect on LS under both e-learning (Lee & Lee, 2010; Lee & Shim, 2006) and mobile learning (Lee & Kim, 2013) settings.

As for SEQ, it is a customer-oriented concept originated from marketing (Kim, 2009). Pitt, Watson, and Kavan (1995) argued that the quality of an information system should be discussed in terms of its SEQ as well as SYQ and INQ because systems usually contained a type of service element. Parasuraman, Zeithaml, and

Berry (1988) developed a SEQ model called SERVQUAL that highlighted the main components of high-quality service, reliability, assurance, tangibles, empathy, and responsiveness. SERVQUAL has been used in various studies, revised based on specific purposes and subjects. For example, Roh and Chung (2005) adopted only two dimensions, reliability and responsiveness, to measure the SEQ of mobile internet as a significant factor affecting user satisfaction. SEQ is a significant factor affecting user satisfaction where SYQ is assured (Lee & Lee, 2010; Lee & Shim, 2006), but not significant otherwise (Lee & Kim, 2013).

In general, the effect of INQ is the most significant on LS in higher education, followed by SEQ and SYQ, which is the least influential on LS (Lee & Lee, 2010). The implications of these previous findings are profound for mobile learning management. However, mobile learning is not exactly the same as e-learning in its all features. Although it provides mobility, portability, and instant accessibility that are absent in e-learning, mobile learning nonetheless contains shortcomings not found in e-learning. Thus, the effects of SYQ, INQ, and SEQ on LS need to be examined with respect to mobile learning.

Research hypotheses

Based on the purpose of the present study and the literature review, the following hypotheses are proposed:

- H1: University students' mobile learning SE has a positive effect on LS.
- H2: University students' mobile learning EX has a positive effect on LS.
- H3: The SYQ of a mobile learning system has a positive effect on LS.
- H4: The INQ of a mobile learning system has a positive effect on LS.
- H5: The SEQ of a mobile learning system has a positive effect on LS.
- H6: University students' mobile learning SE has a positive effect on their recognition of SYQ.
- H7: University students' mobile learning SE has a positive effect on their

recognition of INQ.

H8: University students' mobile learning SE has a positive effect on their recognition of SEQ.

H9: University students' mobile learning EX has a positive effect on their recognition of SYQ.

H10: University students' mobile learning EX has a positive effect on their recognition of INQ.

H11: University students' mobile learning EX has a positive effect on their recognition of SEQ.

H12: University students' mobile learning SE influences LS directly and indirectly.

H13: University students' mobile learning EX influences LS directly and indirectly.

Methodology

Research Design

A research model was developed based on the previous research on SE, EX, mobile learning quality factors, and LS. Figure 1 represents the model to be tested and analyzed. Exogenous variables, students' mobile learning SE, and their mobile learning EX were expected to influence the endogenous variables, quality factors perceived by learners, and LS directly and indirectly.

Participants

The participants were 900 university students of Konkuk University in Seoul, Korea. Konkuk University has offered about 30 e-learning credit courses every

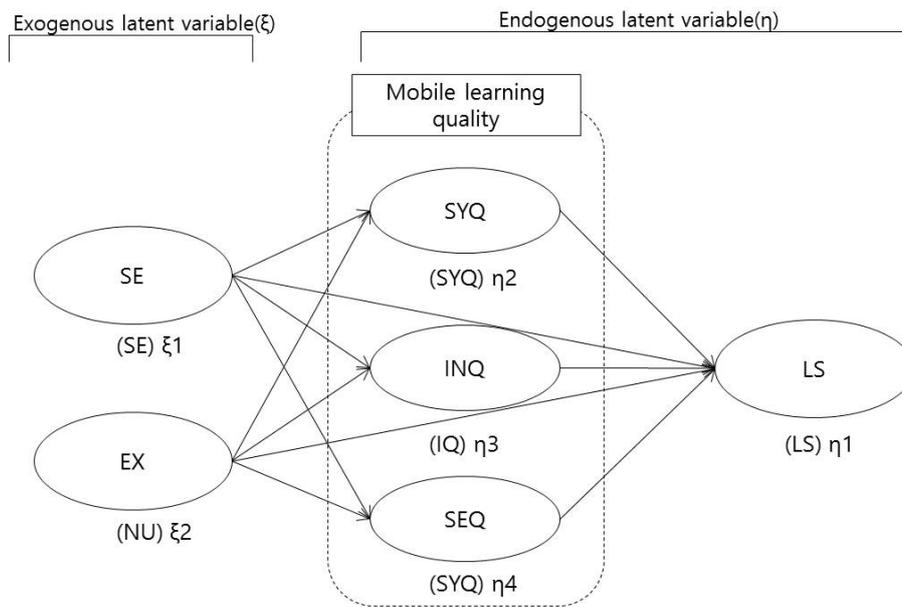


Figure 1. Research model

semester since 2005 and recently launched mobile learning services linked to its existing e-learning courses. Mobile learning at Konkuk University is typical of the service offered by other universities in Korea: Contents are repurposed e-learning contents with consideration for the characteristics of mobile devices, mostly smart phones. All other services provided under e-learning environment are also available under mobile learning. As mobile learning courses are provided along with their e-learning counterparts, students could choose to participate in the mobile or desktop version of the weekly sessions.

Nine mobile learning courses were offered in Konkuk University in the fall semester of 2014. The instructors of eight out of the nine courses agreed to participate in this study. Although the number of the students registered for the eight courses was 1,744 in total, only 927 had participated in mobile learning weekly sessions more than once. Of the 927 students, 27 submitted incomplete responses to the survey. Thus, only the data of 900 students were analyzed. Table 1 shows the demographic information of the final subjects.

Table 1. Demographic information of the subjects

Variables		Number	Percent (%)
Gender	Male	507	56.3
	Female	393	43.7
School year	Freshman	122	13.6
	Sophomore	190	21.1
	Junior	217	24.1
	Senior	371	41.2

Instrumentation

A two-part instrument was developed based on previous studies and the objectives of the present study. Part I was designed to identify the demographic attributes of the respondents, such as school year and gender. Part II included 19 items to measure SE, the amount of EX, SYQ, INQ, SEQ, and LS. To assess SE, four items were adopted from Kim (2009) and Cha (2011) with modifications. To assess SYQ, four items were adopted from Lee and Shim (2006) and Lee and Lee (2010); for INQ, three items from Lee and Lee (2010) and Choi (2006); and for SEQ, four items from Lee and Lee (2010) and Kim, Kim, and Kim (2008). LS was measured by three items adopted from Lee and Lee (2010) and Choi (2006).

The 18 items had responses using a five-point Likert-type scale: a score of 1 indicated “strongly disagree” and 5, “strongly agree.” Part II of the instrument also included a fill-the-blank type item to identify the number of weekly sessions in which the respondents had participated through their mobile devices. All eight courses involved offered 14 mobile weekly sessions, and students’ responses ranged from 0 to 14.

The validity of the instrument was checked by three educational technologists with doctoral degrees in educational technology. The readability of the instrument was also checked by 27 undergraduate students at Konkuk University’s Seoul Campus. The item composition and reliability of the instrument are given in Table 2.

Table 2. Item composition and reliability of the instrument

Sub-section	Items	Number of items	Cronbach's <i>a</i>
SE	<ul style="list-style-type: none"> • I have the necessary skills to complete mobile learning successfully. • It was easy for me to use the menu and software for mobile learning. • I have confidence in complementally using computer and mobile devices for mobile learning. • I understand computer and mobile device terms well for mobile learning. 	4	.93
SYQ	<ul style="list-style-type: none"> • I could easily access the mobile learning course for which I registered. • I could seamlessly maintain my connection to the mobile learning course. • It was convenient for me to use the mobile learning menu and software. • The lecture video played on mobile devices had a sharp picture 	4	.75
INQ	<ul style="list-style-type: none"> • The mobile learning course provided the materials relevant to the lesson objectives. • Mobile learning contents were designed to be easily understood just like e-learning contents. • The amount of the mobile learning weekly session was appropriate. 	3	.70
SEQ	<ul style="list-style-type: none"> • I got quick feedback on my questions through mobile devices. • I could check my learning progress using mobile devices. • It was easy to ask questions about learning contents during mobile learning. • The instructor was responsive to my learning through mobile devices. 	4	.77
LS	<ul style="list-style-type: none"> • I am generally satisfied with the mobile learning course. • I wish to study other courses by mobile learning. • I recommend the mobile learning course to my friends. 	3	.89
EX	<ul style="list-style-type: none"> • How many mobile learning weekly sessions have you participated in? 	1	
Total		19	

Procedures and data analysis

A survey was administered to analyze the structural relationships between the

variables of interest, SE, EX, three mobile learning quality factors, and LS at the end of the fall semester of 2014. All the eight courses whose instructors had agreed to take part in this study conducted paper and pencil-based final tests in regular classrooms. After completing the tests, the students were asked to respond to the survey under the instructors' direction. The questionnaires responded by the students who had not participated in mobile learning sessions at all were excluded. Those incompletely answered were also excluded.

The collected data were analyzed using SPSS 12.0 and AMOS 18.0. Setting the confidence interval at 95%, the correlations between the research variables were analyzed and confirmatory factor analysis was conducted to assess the validity of latent variables. After establishing a measure model, the estimated value of the model was calculated and a goodness-of-fit test was conducted.

Results

Descriptive statistics and correlations among the variables

To determine whether the data met the normality assumption, the means, standard deviations, skewness, and kurtosis for all the measured variables were analyzed. The means of the variables measured by the five-point Likert-type items ranged from 3.20 to 4.10, and the standard deviations from 0.70 to 0.88 (See Table 3). The mean of students' EX was 4.77, and the standard deviation was 4.03. The absolute values of the skewness ranged from 0.99 to 1.0, whereas the absolute values of the kurtosis ranged from 0.27 to 1.02. Neither exceeded the absolute value of 2.0, indicating the normal distribution of the data (Curran, West & Finch, 1996). Meanwhile, correlations were examined to assess the strength of the relationships between the variables. Significant correlations were found among all of the variables. As a rule, a correlation of 0.85 or larger indicates poor discriminant

validity in SEM (David, 1998). The results suggested an adequate discriminant validity of the measurement. The correlation matrix between variables is shown in Table 3.

Table 3. Means, standard deviations, and correlation coefficients (n = 900)

	M	SD	Correlation coefficient (Cronbach's alpha)					
			SE	EX	SYQ	INQ	SQ	LS
SE	4.10	.77						
EX	4.77	4.03	.17**					
SYQ	3.53	.71	.50**	.12**				
INQ	3.20	.79	.23**	.19**	.40**			
SEQ	3.21	.70	.32**	.07*	.53**	.51**		
LS	3.85	.88	.41**	.26**	.44**	.46**	.37**	

* $p < .05$, ** $p < .01$.

Assessment of the model fit

The fit of the measurement and research models was assessed. The goodness-of-fit indices for the measurement model indicated that it exhibited a good fit with the collected data. CMIN/*df* (chi-square divided by the value of degree of freedom) was 3.35; Tucker-Lewis index (TLI); 0.96; comparative fit index (CFI), 0.97; root mean square residual (RMR), 0.04; and root mean square residual (RMSEA), 0.05. The goodness-of-fit indices for the research model indicated that it exhibited a good fit with the data collected. CMIN/*df* was 3.24; TLI, 0.96; CFI, 0.97; RMR, 0.04; and RMSEA, 0.05. Table 4 shows the goodness-of-fit indices for the measurement and research models.

Table 4. Goodness-of-fit indices for the measurement and research models

Model	χ^2	CMIN/df	TLI	CFI	RMR	RMSEA
Measurement model	404.93	3.35	.96	.97	.04	.05
Research model	388.95	3.24	.96	.97	.04	.05
Recommended value	$p > .05$	$< 3.0 \sim 4.0$	$> .90$	$> .90$	$< .05$	$< .10$

Hypothesis testing

Based on the research model, the effects of SE, EX, SYQ, INQ, and SEQ were assessed. The non-standardized coefficient (B), standardized coefficient (β), standard error ($S.E.$), and t -value were calculated for testing the hypotheses. Table 5 shows the test results.

Table 5. Results of the hypotheses tests

Hypothesized path	B	β	S.E.	t-value	Result
SE \rightarrow LS	.23	.22	.05	4.78*	Supported
EX \rightarrow LS	.02	.11	.01	3.02*	Supported
SYQ \rightarrow LS	.23	.17	.10	2.40*	Supported
INQ \rightarrow LS	.62	.51	.10	6.13*	Supported
SEQ \rightarrow LS	-.20	-.12	.11	-1.72	Not supported
SE \rightarrow SYQ	.50	.60	.04	14.04*	Supported
SE \rightarrow INQ	.24	.27	.04	6.36*	Supported
SE \rightarrow SEQ	.26	.37	.03	8.84*	Supported
EX \rightarrow SYQ	.01	.04	.01	1.17	Not supported
EX \rightarrow INQ	.04	.21	.01	4.89*	Supported
EX \rightarrow SEQ	.00	.01	.01	.35	Not supported

* $p < .05$.

Testing revealed that 8 out of the first 11 research model hypotheses were all statistically significant. More detailed test results are as follows:

First, in testing the direct effects of SE, EX, SYQ, INQ, and SEQ on LS, SE showed a statistically significant effect on LS ($\beta=0.22$, $t=4.78$), supporting hypothesis 1. EX had a statistically significant effect on LS ($\beta=0.11$, $t=3.02$), supporting hypothesis 2. SYQ had a statistically significant effect on LS ($\beta=0.17$, $t=2.40$), supporting hypothesis 3. INQ had a statistically significant effect on LS ($\beta=0.51$, $t=6.13$), supporting hypothesis 4. However, hypothesis 5 was not supported by the data.

Second, in testing the direct effects of SE on SYQ, INQ, and SEQ, SE was found to have a statistically significant effect on SYQ ($\beta=0.60$, $t=14.04$), supporting hypothesis 6; on INQ ($\beta=0.27$, $t=6.36$), supporting hypothesis 7; and on SEQ ($\beta=0.37$, $t=8.84$), supporting hypothesis 8.

Third, in testing the direct effects of EX on SYQ, INQ, and SEQ, EX revealed a statistically significant effect on only INQ ($\beta=0.21$, $t=4.89$), supporting hypothesis 10. Hypotheses 9 and 11 were not supported by the data.

Direct, indirect, and total effects between the variables

Direct, indirect, and total effects between the variables of interest in this study were evaluated. To assess the indirect effect, bootstrapping was conducted. Setting the bootstrap number to 500 and confidence interval at 95%, the statistical significance was tested. The results of the analysis are shown in Table 6.

Table 6. Direct, indirect, and total effects between the variables

Hypothesized path	Standardized estimate			Result of hypotheses
	Direct effect	Indirect effect	Total	
SE → LS	.22*	.19*	.41	Supported
EX → LS	.11*	.11*	.22	Supported

* $p < .05$.

First, SE had a statistically significant direct effect on LS; its β weight was 0.22. The indirect effects mediated by SYQ, INQ, and SEQ were statistically significant ($\beta=0.19, p<0.05$); the β weight of their total effects was 0.41. Second, students' mobile learning EX had a statistically significant direct effect on LS, with a β weight of 0.11. The indirect effects mediated by SYQ, INQ, and SEQ were also statistically significant ($\beta=0.11, p<0.05$); the β weight of their total effects was 0.22.

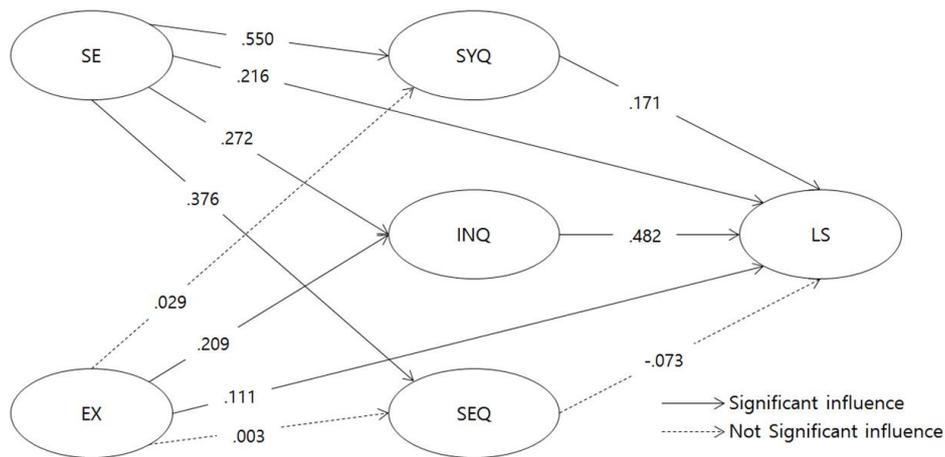


Figure 2. Final structural equation model

Thus, SE, EX, SYQ, and INQ had direct influences on LS. SE and EX indirectly affected LS using SYQ and INQ factors as parameters. Figure 2 shows the final structural equation model and the relationships between the variables.

Discussion and Conclusion

This study attempted to establish a research model to analyze the structural relationships among LS and its related factors in mobile learning in universities and then assessed the model fit and relationships between the variables. The results are

as follows:

First, students' mobile learning SE showed a significant effect on their recognition of SYQ, INQ, and SEQ, the three subordinate factors of mobile learning quality. This finding is consistent with the results of Kang, Jung, and Jung (2010) and Compeau and Higgins (1995) on the positive effect of users' SE on their recognition of INQ in an information system. Meanwhile, SE had the most powerful positive effect on students' recognition of SYQ, reflecting the logic that a higher SE leads to better ease in using a mobile learning system and to higher satisfaction with its SYQ. Moreover, the higher SE a student possesses, the more effort he or she might make in understanding the learning contents and the more active in interacting with his or her instructor and peers. These possibilities might eventually induce students to be more satisfied with INQ and SEQ

Second, students' mobile learning SE had a direct effect on their learning satisfaction without being mediated by the mobile learning quality factors. In other words, regardless of the quality of mobile learning, a higher SE brings more satisfaction with the learning process. This finding supports the results of Park, Joo, and Bong (2007) and Bures (2000) on the effect of students' SE on LS in web-based learning and computer conferencing. Student's SE might lead students to participate in their learning more actively and to be more satisfied with their learning. As such, it is important to enhance students' SE to implement mobile learning successfully in universities. Feasible strategies that enhance students' SE need to be formulated.

Third, students' mobile learning EX was found to have a positive effect on their recognition of INQ but few effects on SYQ and SEQ. When students first encountered mobile learning systems, they might have been unfamiliar with its usage and be committed to figuring it out. They then may have tended to spare limited attention to its contents and possibly recognize its quality as low. However, as their mobile learning EX increased, they became familiar with the system and could concentrate on the contents. Those accustomed to the mobile learning

system were eventually more satisfied with the content.

Students' mobile learning EX was found to have a positive effect on their LS regardless of the quality of mobile learning. This result supports those in the studies that reported the positive influence of students' e-learning EX on their learning satisfaction (Piccoli, Ahmad & Ives, 2000). As students participated in mobile learning more often and became acquainted with it, their learning satisfaction was raised. If students' mobile learning EX had a negative effect on their satisfaction, mobile learning services could not be sustained. The results of this study regarding students' EX provide a sound ground to implement and spread mobile learning in universities.

Fourth, both SYQ and INQ, but not SEQ, had positive effects on LS, coinciding with the results of Kim et al. (2011) and Delone and Mclean (2003) for web-based instruction. This finding confirms the importance of ensuring the qualities of the system and content in improving students' satisfaction with their learning. SEQ was found to have few effects on students' learning satisfaction, which is contradictory to the results of the e-learning studies by Lee and Byun (2012) and Jung (2011). As e-learning has been available for more than 15 years in universities, the qualities of both its system and contents of most e-learning courses may be sufficiently high, which may explain the minor influence of SYQ and INQ on LS. Only SEQ might be different according to the course on offer, leading to its significant effect on LS. Meanwhile, mobile learning has a relatively short history; SYQ and INQ have not been ensured and differ among the courses. The few effects of SEQ on LS might also be attributed to the fact that few mobile learning courses require student–instructor interactions.

Finally, both SYQ and INQ were found to mediate the influence of SE on LS. In other words, students' mobile learning SE positively influenced their recognition of SYQ and INQ and seemed to increase LS consequently. Again, increased student SE played a remarkable role in increasing LS.

The results imply the necessity of increasing students' SE to increase LS with

mobile learning in universities. Students should be encouraged to participate in mobile learning with a high level of SE through various ways, such as offering orientation sessions on the use of mobile learning systems and supporting students' learning continuously and systematically to maintain their SE. Regarding the positive influence of mobile learning EX on LS, it is a good idea to encourage students to participate in mobile learning sessions more often. The easiest way will be that the instructors or supporting personnel who are in charge of mobile learning courses send their students a short smartphone message urging their participation. Other institutional inducements such as providing mobile learning users a type of rewards can be made to increase students' mobile learning EX and finally LS. Meanwhile, a strategy to manage the quality of mobile learning is to improve INQ first and then SYQ. It is efficient to invest effort in producing quality content above all. Next, it is recommended to update the system to provide more reliable and convenient services. Investment in improving SEQ may be behind INQ and SYQ. Considering budget constraints for all aspects of mobile learning, the results of the study suggest this feasible, step-by-step strategy for universities to invest in increasing students' satisfaction with mobile learning.

Additionally, some suggestions for further studies can be made based on the limitations of the study. First, the study results were solely based on the data collected by a student self-reporting survey. The student responses were based on their perception not the facts. Thus, it is recommended for further studies to attempt to use the data stored on the mobile learning system itself. It will make the findings of the study more reliable. Second, the current study couldn't include the students' academic achievement as an outcome variable. It is necessary for further studies to involve both LS and academic achievement, if the purpose of the study is to enhance student learning outcomes not just LS.

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Received: August 26, 2016 / Peer review completed: September 30, 2016 / Accepted: October 5, 2016