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Structural relationships between learning persistence in mobile learning and other influencing factors at a cyber university

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***Abstract*— The purpose of this study is to analyze the mobile learning satisfaction of cyber university students and use structural analysis to determine how continued use of the factors affect the degree of relationship, and improve them to be present in the room. This research examined the significant variables affecting learners' learning persistence in a mobile learning environment linked with e-learning. The research results will provide useful suggestions for the design of e-learning and mobile learning.**

Keywords—mobile learning, learning persistence, expectation-confirmation, technology acceatance model

I. Introduction

Research regarding the diffusion and acceptance of mobile learning has most widely utilized the Technology Acceptance Model (TAM) due to its simplicity. The ultimate success of mobile learning depends on its continuous use, rather than its initial acceptance (Bhattacherjee, 2001). Once mobile learning is accepted, there arises a need to study a learner's continuous use of it. Since there is a limitation in identifying learning persistence in information system use, Bhattacherjee proposed the Post Acceptance Model (PAM), based on the expectation-confirmation theory. Accordingly, the purpose of the current study is to analyze and investigate the structural relationships between factors affecting satisfaction and usage persistence, targeting mobile learners at a cyber university, and to propose strategies to boost their satisfaction and usage persistence. Therefore, the purpose of this study is to analyze the mobile learning satisfaction of cyber university students and use structural analysis to determine how continued use of the factors affect the degree of relationship, and improve them to be present in the room. To this end, we add an extended review of the existing empirical research and suggest a new model by modifying the TAM to accommodate ease of use. Based on the purpose of this study, the following research questions are posed: 1) Does perceived ease of use affect expectation-confirmation? 2) Does perceived ease of use affect perceived usefulness? 3) Do expectation-confirmation, perceived ease of use, and usefulness affect satisfaction? 4) Do expectation-confirmation, perceived ease of use, usefulness, and satisfaction affect learning persistence?

II. Research Method

The research participants were mobile learners engaged in e-learning linked to mobile learning at a cyber university in South Korea. After excluding 19 incomplete responses, 253 out of 273 survey responses were included in the final analysis. The participants were 86 men (34%) and 166 women (66%). Their average age was 46.75. More specifically, 0.4% of the participants were in their 10s, 3.6% were in their 20s, 9.1% in their 30s, 41.5% in their 40s, 40.7% in their 50s, 4.3% in their 60s, and 0.4% in their 70s.

The measurement instrument used a five-point Likert scale from 1 to 5 (1: disagree very much, 2: disagree, 3: it's ok, 4: agree, 5: agree very much). To measure the expectation-confirmation (Bhattacherjee, 2001), three items were used (e.g., "My expectations for mobile learning were mostly satisfied"). The inter-item consistency had a Cronbach's α of 92. Perceived usefulness is the degree of the learner's belief that learning outcomes will improve. Six items from Davis's (1989) instrument were used (e.g., "Mobile-assisted learning helps me study better"). The perception of ease of use is "the degree of efforts that are required for learners to use the mobile services." It was measured using six items from the instrument by Davis (1989). The inter-item consistency had a Cronbach's α of 90. Satisfaction was defined as the emotions

of the learner's use of mobile learning. It was measured using four items from Bhattacherjee's (2001) instrument (e.g., "I am satisfied with the function and service of mobile learning"). The inter-item consistency had a Cronbach's α of 91. Learning persistence was defined as the learner's intention for continuous use. It was measured using three items from the instrument by Bhattacherjee (2001) (e.g., "I will continue mobile learning, if possible"). The inter-item consistency had a Cronbach's α of 91.

The data analysis method was selected to confirm the single factor through factor analysis and reduce the error of measurement by using a bundle index. We confirmed that the condition of normal distribution of the structural equation was satisfied by analyzing the descriptive statistics of correlation (Skewness under 3 and Kurtosis under 10).

After confirming the validity by confirmatory factor analysis using AMOS, we investigated the fitness of the measurement model through the maximum likelihood estimate as the first step. Then, as the second step, we investigated the fitness of the structural model by confirming that it satisfied the criteria of TLI, CFI, and RMSEA.

III. Research Results

A. Measurement Model Examination

We estimated the fitness of the measurement model by maximum likelihood estimation based on the second confirmation procedure of the potential model estimate before examining the potential model estimate and fitness of the structural regression model of the research model. The fitness estimate results are as displayed in TABLE 1. As seen in TABLE1, the fitness of measurement model was confirmed to be good because it met the acceptance level of the measurement model with indices of TLI and CFI over .90 and RMSEA under .80.

We can confirm the convergent validity when the standard factor loading is more than .30 (Hair, Tatham, & Black, 1995) and the distinctive validity when the correlation of each latent variable is less than .80 (Moon, 2009). An examination of the relationship between the latent variables and measurement variables showed that the standard factor loading of the measurement variable for all latent variables ranged from .87 to .99, which were significant at the α-level of .05. It was proved that all the selected variables measured each latent variable in the current research model. Further, the correlations between latent variables ranged from .68 to .89, which showed enough distinctive validity between latent variables. Accordingly, it was proved that all latent variables of research model could be measured with statistical accuracy.

B. Structural Model Examination

All the goodness of fit indices of the measurement model satisfied the criteria. Since the model estimate possibility of the structural regression model was theoretically confirmed, we estimated the fitness of the structural model through maximum likelihood estimation, as shown in TABLE 2. As indicated by the results of the fitness indices, the model has a good fit, TLI = .985, CFI = .991, RMSEA = .061.

The results of examining the relationships between expectation-confirmation, perceived ease of use, perceived usefulness, satisfaction, and learning persistence are displayed in Figure 2. First, the effect of expectation-confirmation on perceived ease of use was statistically significant ($\beta = .76$, $t = 12.770$, $p < .05$). Second, the effect of expectation-confirmation on perceived usefulness was $\beta = .43$ ($t = 6.551$, $p < .05$) and that of perceived ease of use on perceived usefulness was $\beta = .76$ ($t = 12.770$, $p < .05$), which are all statistically significant. Third, expectation-confirmation ($\beta = .61$, $t = 8.084$, $p < .05$), perceived usefulness ($\beta = .20$, $t = 2.590$, $p < .05$), and perceived usefulness ($\beta = .15$, $t = 2.121$, $p < .05$) significantly affected satisfaction. Finally, the results of investigating the significance of variables affecting learning persistence revealed that perceived usefulness ($\beta = .46$, $t = 5.172$, $p < .05$), perceived ease of use ($\beta = .16$, $t = 2.003$, $p < .05$), and satisfaction ($\beta = .26$, $t = 3.002$, $p < .05$) had significant influences.

In the results of investigating the indirect effects of each variable, expectation-confirmation showed significant effects on learning persistence by being mediated by perceived ease of use, perceived usefulness, and satisfaction. Perceived ease of use significantly affected learning persistence by being mediated by perceived usefulness and satisfaction. Perceived usefulness significantly affected learning persistence by being mediated by satisfaction. The indirect effects in various paths between variables were identified. We examined the significance of indirect effects using bootstrap method. The results of analysis of the direct and indirect effects of the structural model are summarized in TABLE 3.

IV. Conclusion

The current study analyzed the ultimate effects of expectation-confirmation, perceived ease of use, perceived usefulness, and satisfaction on cyber university students' learning persistence in a mobile learning service environment linked with e-learning. For this purpose, the researchers examined the structural relationships between variables using the extended PAM, which was created by adding the perceived ease of use to the TAM. According to the research results, expectation-confirmation significantly affected the perceived ease of use. Second, expectation-confirmation and perceived ease of use significantly affected perceived ease of use. Third, expectation-confirmation, perceived ease of use, and perceived usefulness all significantly affected satisfaction. Fourth, perceived ease of use, perceived usefulness, and satisfaction significantly affected learning persistence. Finally, perceived ease of use, perceived usefulness, and satisfaction of three

endogenous variables took a role inter-mediator in multiple paths. This research examined the significant variables affecting learners' learning persistence in a mobile learning environment linked with e-learning. The research results will provide useful suggestions for the design of e-learning and mobile learning.

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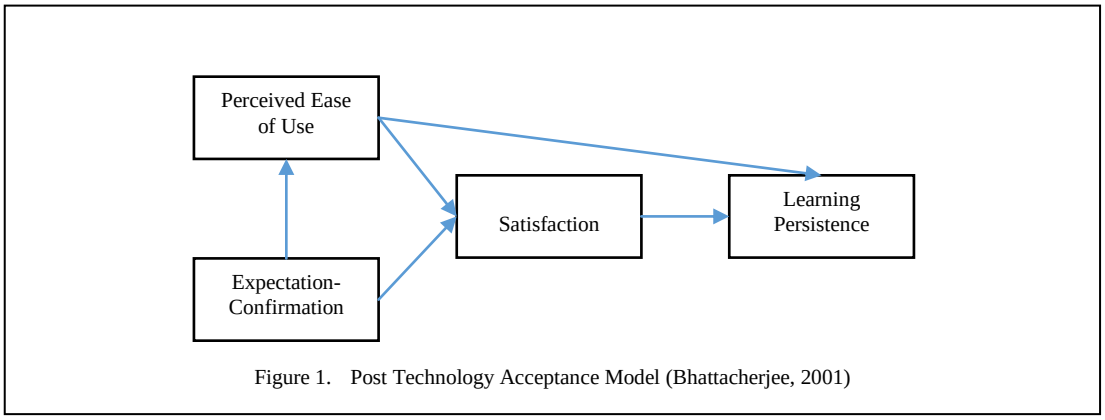

Figure 1. Post Technology Acceptance Model (Bhattacherjee, 2001)

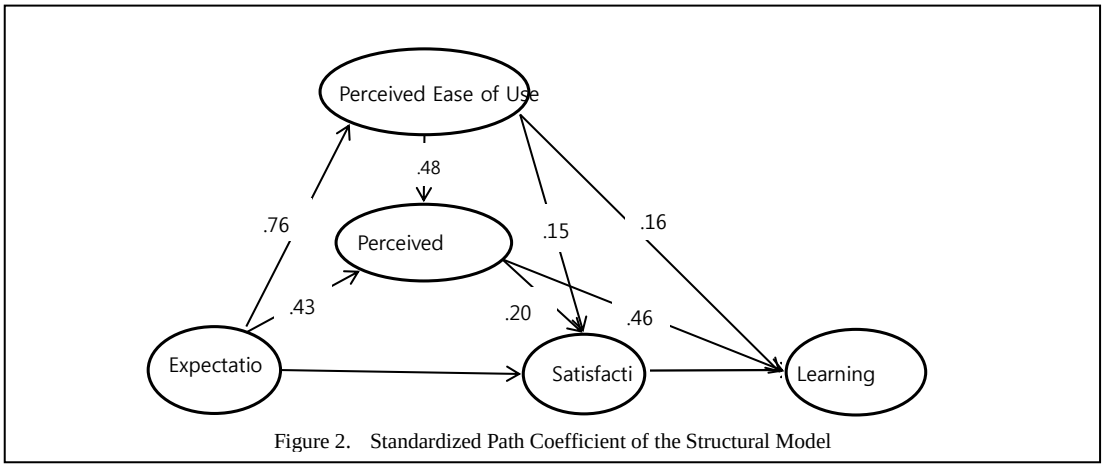

Figure 2. Standardized Path Coefficient of the Structural Model

TABLE 1. Examination Results for the Measurement Model (n = 253)

	CMIN	*P*	*Df*	TLI	CFI	RMSEA (90% Confidence Interval)
Measurement Model	45.010	.008	25	.987	.993	.056 (.028~.082)
Acceptable Criteria				> .90	> .90	< .08

TABLE 2. Examination Results of the Fitness of Structural Model (n = 253)

	CMIN	*P*	*Df*	TLI	CFI	RMSEA (90% Confidence Interval)
Structural Model	50.616	.003	26	.985	.991	.061 (.035~.086)
Acceptable Criteria				> .90	> .90	< .08

TABLE 3. Analysis of the Direct/Indirect Effects of the Structural Model *(n = 253)*

Correlation Variable			Unstandardized Coefficient (B)			Standardized Coefficient (β)		
Relevant Variables			Total	Direct	Indirect	Total	Direct	Indirect
Perceived Ease of Use	←	Expectation Confirmation	.605	.605	-	.763	.763	-
Perceived Usefulness	←	Expectation Confirmation	.714	.387	.327	.797	.432	.365
		Perceived Ease of Use	.540	.540	-	.478	.478	-
Satisfaction	←	Expectation Confirmation	.823	.570	.253	.888	.615	.273
	→	Perceived Usefulness	.207	.207	-	.200	.200	-
	→	Perceived Ease of Use	.285	.173	.112	.244	.148	.096
Learning Persistence	←	Perceived Usefulness	.544	.489	.055	.514	.461	.052
		Perceived Ease of Use	.530	.190	.340	.443	.159	.284
		Satisfaction	.268	.268	-	.261	.261	-
		Expectation Confirmation	.684	-	.684	.721	-	.721