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VALIDITY OF THE FACTORS STUDENTS' ADOPTION OF LEARNING MANAGEMENT SYSTEM (LMS): A CONFIRMATORY FACTOR ANALYSIS

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Abstract. *Although several studies have specifically been carried out on e-learning, there is still a limited amount of instruments used to measure LMS adoption. Therefore, this study validates the measurement instrument for LMS adoption in online learning using two factors, namely perceived satisfaction, and digital competence. The random sampling method was used to obtain data from 500 BINUS Online Learning students, Bina Nusantara University. The result showed that the instrument developed had satisfied the requirements of statistical goodness. Therefore, it is applicable to further research that explicitly studies the adoption of LMS in online learning.*
Keywords: Learning management system, UTAUT, Online learning, Validity, Confirmatory factor analysis

1. **Introduction.** Since 2015, several universities in Indonesia have implemented the online learning method, which supports information technology's continuous development, and considered an innovative solution to teaching and learning in higher education. However, for the successful utilization of this learning method, an integrated system between lecturers, students, and universities, known as the Learning Management System (LMS), is needed.

LMS is a virtual environment that supports distance and blended learning activities [1]. It is a medium used to ensure effective and fast communication between students and lecturers. Online learning is considered successful, assuming it has the ability to translate student experiences (onsite class) and consider their needs [2,3]. LMS has removed classroom barriers and quickened learner and instructor interactions into virtual touch [4,5]. Ramirez-Correa et al. [6] researched students' attitudes in adopting LMS through the D&M (DeLone and McLean) models found a relationship between satisfaction and the benefits students felt using LMS.

Despite the perceived benefits, LMS cannot function effectively when not used by students. Furthermore, implementing this system depends on the perception of learners to adopt its usage. However, there is a consistent increase in the number of students that drop out while taking online learning programs [7,8]. Therefore, it is essential to examine the determinants of students adopting LMS, thus providing insight to reduce dropout rates in online learning. According to studies, online learning cannot be viewed as a simple technological innovation. However, an essential prerequisite for its successful implementation is careful consideration of the underlying pedagogy [9]. Many online learning authors have confirmed that student acceptance is a significant and critical impact [10,11], thus motivating us to study the factors of student acceptance of adopting LMS in online learning programs.

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It is important to test students' behavioral intentions to use LMS as an online learning tool for their success and to ensure it is continuously used by them and lecturers. Several research models have examined the factors of customer behavioral intention to adopt specific technologies. Some of these models include TAM [12], TPB [13], TRA [14], UTAUT [15], UTAUT 2 [16] and in online learning [17-19]. UTAUT and UTAUT-2 are the numerous successful models used to evaluate user behavioral intentions in adopting information technology in different industries. Although prior research has discussed the use of LMS in distance learning, the unanswered question is how to motivate students to use LMS voluntarily to achieve academic achievement.

Therefore, based on the concept of UTAUT-2 [16] and combining the perceived satisfaction factor [6,20] and digital competence [21], this study intends to measure the validity of numerous essential factors that influence the behavioral intentions of online learning program learners in adopting LMS so that it can be generalized in online learning.

2. **Methodology.** In accordance with an empirical study in technology acceptance [16, 22] and online learning [20,21], this study applied the quantitative methods to examining the factors described by prior authors to teach students' the use of LMS in online learning. A questionnaire of 29 items from 8-factors was designed and distributed through a Google Form URL link. Furthermore, the simple random sampling method was used to obtain 500 responses from BINUS Online Learning students, Bina Nusantara University. The data consist of students from five study programs, namely Business Management, Accounting, Computer Science, Information Systems, and Industrial Engineering.

The 8-factor measures studied consisted of performance expectancy (4-question), effort expectancy (4-question), social influence (3-question), facilitating conditions (4-question), hedonic motivation (3-question), habit (3-question), perceived satisfaction (5-question), and digital competence (3-question). All questionnaire items used a Likert point scale of 5, ranging from 1 – strongly disagree to 5 – strongly agree for analysis, with SPSS 22 used to calculate descriptive analyses and test the distribution of normality. Descriptive analysis was performed to identify responses to all questionnaire statements by looking at the items' mean value. Meanwhile, the data normality test assesses the distribution of data in a group of data or variables. The data distribution is declared to be normally distributed if the ratio value of skewness and kurtosis is ± 2 [23]. Furthermore, this research used the Lisrel 8.7 to confirm the factor analysis test.

3. **Result and Discussion.** Table 1 shows that the average student responses ranged from 3.63 (SI2) to 4.52 (FC3), with a standard deviation in the range from 0.717 to 0.993. Students provided a positive response from the eight factors studied, and the authors calculated the normality distribution test using the skewness and kurtosis ratio procedure [23]. Hair et al. [24] stated that learning needs to fulfill the data normality test in multivariate analysis. The skewness and kurtosis ratios were in the range of 0.93 to 1.95 and 0.06 to 1.97, respectively. This value met the requirements for the normality distribution because it is less than ± 2 [23].

Furthermore, this study used CFA to estimate the eight factors for LMS adoption, for a priority hypothesis evaluation based on theory, and to confirm the factor structure of a series of observed variables. CFA analysis needs the author to hypothesize the number of factors, the correlation between variables, and the indicators that reflect the factor's size [25]. This study also adopted the prior theory, with the CFA used to determine the Maximum Likelihood Estimation procedure (MLE) needed to estimate the model parameters with the covariance matrix [24].

Several index measurement criteria need to be satisfied to test the goodness of the model [24]. Furthermore, in getting the best model, Lisrel 8.71 provides recommendations for model improvement by adding error covariance to the indicator [26]. We made

Table 1. Convergent validity, CR, AVE, and mean indicator

Variable	Item	Mean	Loading factor	CR	AVE
PE	PE1	3.71	0.810	0.893	0.677
	PE2	3.69	0.820		
	PE3	3.94	0.810		
	PE4	3.74	0.850		
EE	EE1	3.79	0.780	0.848	0.582
	EE2	4.11	0.730		
	EE3	4.09	0.740		
	EE4	3.88	0.800		
SI	SI1	3.86	0.860	0.901	0.751
	SI2	3.63	0.860		
	SI3	3.77	0.880		
FC	FC1	4.15	0.810	0.845	0.578
	FC2	4.30	0.830		
	FC3	4.52	0.730		
	FC4	3.95	0.660		
HM	HM1	3.78	0.810	0.839	0.635
	HM2	3.82	0.800		
	HM3	4.11	0.780		
H	H1	3.97	0.730	0.811	0.588
	H2	3.88	0.790		
	H3	3.95	0.780		
PS	PS1	3.97	0.750	0.882	0.599
	PS2	3.98	0.800		
	PS3	4.13	0.790		
	PS4	4.03	0.770		
	PS5	4.00	0.760		
DC	DC1	4.22	0.840	0.866	0.683
	DC2	3.65	0.820		
	DC3	4.34	0.820		

Note: PE = Performance Expectancy; EE = Effort Expectancy; SI = Social Influence; FC = Facilitating Conditions; HM = Hedonic Motivation; H = Habit; PS = Perceived Satisfaction; DC = Digital Competence

several modifications (see Figure 1) to get the best measurement model, such as improving the SI2 indicator value with SI3. Next, we tested several model goodness indexes using the Chi-Square test, which is susceptible to sample size [27,28], and the ratio [29]. The index tested is Root Mean Square Residuals (RMSR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Based on calculations, the Chi-Square value is 755.99, while the ratio to the degree of freedom (χ^2/df) is 2.27. This value follows the recommendation of Carmines and McIver [29], which is less than 5 or above 3. The value of RMSR ($0.031 < 0.10$), RMSEA ($0.05 < 0.07$) with CFI ($0.99 > 0.92$), and TLI ($0.99 > 0.95$) all met indices of model goodness criteria.

Convergent validity is the degree of correlation between other measurement instruments used to measure the same construct [30]. Its purpose is to ensure some construct items' dimensions and help eliminate bad indicators [31]. The recommended value is bigger than 0.5 [24] or 0.7 [32]. Meanwhile, discriminant validity refers to the degree of mismatch between attributes that do not need to be measured using these variables' instruments and theoretical concepts [30]. Furthermore, Hair et al. [24] recommended the use of

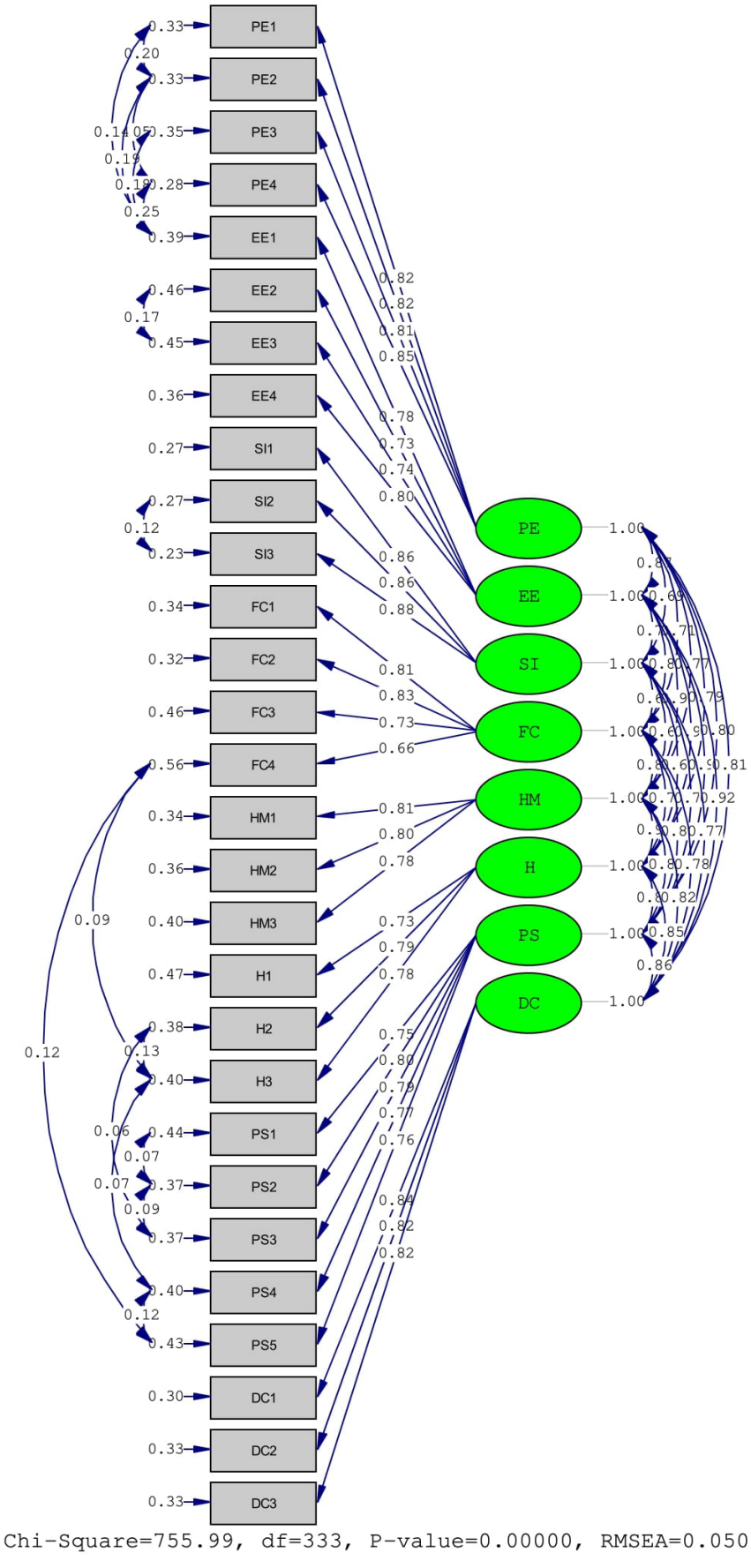

FIGURE 1. Confirmatory factor analysis

Composite Reliability (CR) and Average Variance Extracted (AVE) to assess reliability, convergent validity, and discriminant validity. They suggest that CR needs to be greater than 0.7 to establish good reliability, while AVE must be greater than 0.5.

Table 1 shows that all items of the eight factors studied had a standardized loading factor value higher above 0.5. Out of all indicators, FC4 has a value of 0.660, which is less than 0.7, and above 0.5. In conclusion, convergent validity is satisfactory, while the CR value for each factor is higher than 0.7. Similarly, with the AVE, each factor has a value of over 0.5.

The results of the discriminant validity are shown in Table 2. The correlation value between factors met the discriminant validity requirements because the correlation is less than 1 [33]. Overall, the authors firmly conclude that all indicators for measuring LMS adoption in online learning are satisfactory and implementable.

Table 2. Correlation matrix of 8-factors

	PE	EE	SI	FC	HM	H	PS	DC
PE	1.00							
EE	0.87	1.00						
SI	0.69	0.77	1.00					
FC	0.71	0.83	0.61	1.00				
HM	0.77	0.90	0.69	0.81	1.00			
H	0.79	0.92	0.68	0.79	0.93	1.00		
PS	0.80	0.92	0.73	0.81	0.81	0.85	1.00	
DC	0.81	0.92	0.77	0.78	0.82	0.85	0.86	1.00

4. **Conclusion.** In conclusion, this study was carried out to verify the LMS adoption factor in online learning using students, in the BINUS Online Learning Faculty, Bina Nusantara University. The LMS adoption factor studied in this research extends from technology adoption by adding two additional factors, namely perceived satisfaction and digital competence. These two factors are considered significant when students use LMS for the online learning process. Perceived satisfaction with the LMS and digital capabilities are used to determine how students act during online learning. This study proves that the 8-factor of LMS adoption is acceptable because it has satisfied all statistical measurements.

To produce a more comprehensive generalization of the LMS adoption factor's validity in the context of online learning, it becomes a guideline for future researchers and us to expand the study in mobile-LMS. The aim is to produce broader information about how students adopt technology in distance learning. Besides, efforts to explore the validity of non-educational organizations, such as when firms provide training to employees with LMS and mobile-LMS tools, also need to be studied in the future.

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Appendix.

Table 3. Questioners

Factor	Code	Item
Performance Expectancy	PE1	The use of LMS is beneficial to support all my academic activities.
	PE2	The use of an LMS can fulfil my expectations in achieving essential attributes during the lecturing process.
	PE3	LMS helps me to complete all academic activities.
	PE4	The use of LMS improves academic performance.
Effort Expectancy	EE1	Knowing how to use LMS is easy.
	EE2	My interplay with the LMS is evident and comprehensible.
	EE3	The LMS is easy to use.
	EE4	It is simple for me to grow an expert in using an LMS.
Social Influence	SI1	Somebody vital to me suggested studying online because they use LMS.
	SI2	Those that positively influence my behavior suggested I study online because it uses LMS.
	SI3	People whose opinions I respect suggested I study online due to the use of LMS.
Facilitating Conditions	FC1	I have the resources needed to use an LMS in my studies.
	FC2	I have the knowledge essential to use an LMS.
	FC3	My LMS is fit with separate technologies.
	FC4	I can get help from other people when I have difficulty using the LMS.
Hedonic Motivation	HM1	I am happy whenever I use LMS to study.
	HM2	Using an LMS in my studies is cosy.
	HM3	Using LMS to study is very impressive.
Habit	H1	The use of LMS has become my habit.
	H2	I must use an LMS.
	H3	Using an LMS has become a natural thing for me.

(*Continued*)

(*Continued*)

Perceived Satisfaction	PS1	I am usually satisfied with my decision to use an LMS.
	PS2	If I had the opportunity to study online again with an LMS, I would be happy to do it.
	PS3	I will be very satisfied with the LMS.
	PS4	I feel the LMS fits my needs.
	PS5	I will do as much learning with LMS as I can.
Digital Competence	DC1	I can solve problems related to using LMS.
	DC2	I know how to maximize the LMS to support my studies.
	DC3	I have the awareness to maintain LMS privacy.