Learning management system acceptance scale (LMSAS): A validity and reliability study

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The present study aimed to develop a measurement tool that will enable a valid and reliable measurement of students' acceptance levels within the framework of the unified theory of acceptance and use of technology model regarding learning management systems. This study was conducted in the 2016-2017 academic year with three groups of participants, making 515 medical students in all. Expert opinion was obtained to examine the content validity and face validity of the scale, and exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to examine the construct validity of the conclusions based on measurements. A construct with four factors and 21 items was obtained at the end of the EFA, which explained 64.39% of the total variance. CFA results showed that the construct with four factors and 21 items had a good fit with the data. The reliability of the measurements based on the scale was examined using Cronbach's alpha and test-retest methods. To examine the discriminatory power of the items, adjusted item-total correlations and comparison of the top and bottom 27% of participants were used. Findings showed that the scale developed in the study can be used as a tool that generates valid and reliable measurements of students' acceptance of learning management systems.

Introduction

The use of technology in educational environments facilitates every step of the education process from course planning to conducting classes and assessment (Ashrafzadeh & Sayadian, 2015; Masud, 2016). A learning management system (LMS) is one such technology (Islam, 2014; Navimipour & Zareie, 2015; Stantchev, Colomo-Palacios, Soto-Acosta, & Misra, 2014). As its name implies, an LMS is a management tool and integrated system for managing educational material, monitoring learners and teachers, and customising learning and teaching processes. In other words, an LMS is a software application for managing learning activities. LMSs come in many formats; some of them are open source (e.g., Sakai, Moodle, Dokeos) and some of them are commercial (e.g., eFront, Blackboard, Brightspace). All of them, however, aim to facilitate learning activities and enable them to be conducted in a more systematic and planned manner. The learning process can be continually improved thanks to these systems given that they enable monitoring and evaluating of education activities (Zhang, de-Pablos, & Zhou, 2013).

Malikowski, Thompson, and Theis (2007) used a three-level construct to group user-system interaction on the basis of the frequency of LMS use. They found out that the LMS was used most frequently to convey content to learners. In this context, files were uploaded to the learning environment, learning content was transferred to the system, announcements were made, and achievement levels of learners were monitored. At the medium level of frequency, an LMS was used to assess learners and create in-class interaction. Instant messaging and discussion environments were used to create in-class interaction, and quizzes and assignments were used to assess learners. An LMS was used least frequently to assess the course and the teacher. For example, questionnaires or scales to measure course satisfaction or teacher performance were used.

LMSs have undeniably made an important contribution to education (Cigdem & Topcu, 2015). To make the best use of these technologies in educational environments, students need to have positive attitudes, beliefs and intentions towards their use. The relevant literature shows that the use of technology is related to the beliefs, attitudes and intentions of potential users (Horzum & Canan Güngören, 2012). In this context, technology acceptance, which refers to attitudes, beliefs and intentions concerning technology, is an important factor.

Technology acceptance model

Technology acceptance is a construct that consists of cognitive and psychological elements regarding the use of technology (Venkatesh, Morris, Davis, & Davis 2003). This construct aims to explain the acceptance of a given technology by individuals, and the factors that affect acceptance. Many models (such as technology acceptance model, technology acceptance model 2, the unified theory of acceptance and use of technology, the unified theory of acceptance and use of technology 2) have been proposed in studies on technology acceptance (Schepers & Wetzels, 2007). All of these models aim to understand the factors that affect effective use of technology. Of these models, technology acceptance model (TAM) is the most popular and the most frequently used in the studies on computer and Internet technologies (Kourakos, 2006; Moon & Kim, 2001; Yuen & Ma, 2002). Developed by Davis (1989), TAM measures individuals' willingness and intention to use technology on the basis of three elements: perceived usefulness, perceived ease of use, and behavioural intention to use.

TAM was criticised for its limitations, and proposals were put forward to improve the explanatory power of the model by adding various elements. Venkatesh and Davis (2000) improved it by adding new dimensions (image, output quality, subjective norm, job relevance, result demonstrability, voluntariness) to TAM. This new model was called technology acceptance model 2 (TAM2). According to this new model, the behaviour of using a new technology is affected by additional factors, including whether the technology is seen to be useful by significant people in one's social environment, adds to the social status of the user, is directly relevant to the professional life of the user, allows completing one's tasks successfully, and is easy to use (Venkatesh & Davis, 2000).

Venkatesh et al. (2003), who thought a single model would be insufficient to explain technology use and that the topic needed to be examined in a multidimensional manner, developed the unified theory of acceptance and use of technology (UTAUT) model. This model, which combines similar elements included in eight different models (social cognitive theory, innovation diffusion theory, technology acceptance model, theory of planned behaviour, combined technology acceptance model and theory of planned behaviour, motivational model, model of PC utilization, theory of reasoned action), identifies "performance expectancy, effort expectancy, facilitating conditions and social influence" as the four basic elements that determine behavioural intention to use (Venkatesh et al., 2003, p. 456).

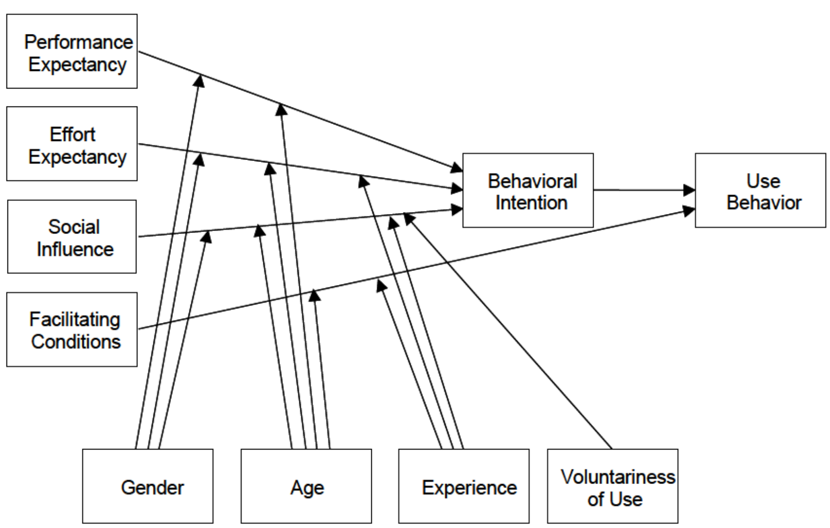

Figure 1. UTAUT (Venkatesh et al., 2003, p. 447)

Performance expectancy (PE) refers to the belief that performance will improve with the use of technology, *effort expectancy* (EE) refers to the belief that the technology will be easy to use, *social influence* (SI) refers to the belief held by significant people in the social environment that the technology in question should be used, and *facilitating conditions* (FC) refers to the belief that various elements that support the use of the technology exist. UTAUT accounted for 70% of the intention of using a technological innovation (Venkatesh, et al., 2003).

The UTAUT model developed by Venkatesh et al. (2003) includes intermediary variables that indirectly affect intention or use, such as gender, age, experience and volunteering, in addition to determining factors with direct effects, reported above (Figure 1). A literature review on UTAUT shows that, in addition to the determining variables, a study conducted by Magsamen-Conrad, Upahdyaya, Joa, and Dowd 2015 included intermediary variables, whereas other studies (see Carlsson, Carlsson, Hyvonen, Puhakainen, & Walden, 2006; Escobar-Rodriguez, Carvajal-Trujillo, & Monge-Lozano, 2014; Nicholas, Azeta, Chiazor, & Omoregbe, 2017; Oktal, 2013; Sedana & Wijaya, 2010; Thomas, Singh, & Gaffar, 2013; Zhou, Lu, & Wang, 2010) did not. Thus, the present study does not include the intermediary variables that have been reported; instead, it focused on the determining factors that affect the acceptance of the system by users.

The UTAUT framework has been revised to more accurately predict information and communication technology usage within the consumer context, which resulted in the extended UTAUT2 (Venkatesh, Thong, & Xu, 2012). UTAUT2 includes three new explanatory variables in addition to the four constructs included in the original model (Venkatesh et al., 2012): hedonic motivation, price value, and habit. Although the original UTAUT was designed mainly for organisational contexts, UTAUT2 is primarily focused on consumers and the factors that determine their intentions to use (and their actual use of) new technologies (Venkatesh et al., 2012). UTAUT2 is not appropriate for technologies or applications with no economic cost to users (Herrero, San Martin, & de Mar Garcia-De los Salmones, 2017; Macedo, 2017).

UTAUT is one of the most frequently used models found in the literature and has been used to examine many different technologies. It has been used with different technologies, such as social media (Escobar-Rodríguez et al., 2014), homecare technologies (Kutlay, 2015), medical devices (Kurtuluş, 2015), mobile learning (Carlsson et al., 2006; Thomas, Singh, & Gaffar, 2013), online family dispute resolution systems (Casey & Wilson-Evered, 2012), tablet devices (Magsamen-Conrad et al., 2015), information systems (Oktal, 2013), and LMSs (Jong, 2009; Maina & Nzuki, 2015; Nicholas et al., 2017; Raman, Don, Khalid, & Rizuan, 2014; Sedana & Wijaya, 2010). Among these technologies, the LMS has a prominent place as a frequently used educational material or resource. For these systems to provide the maximum possible benefit, the technology needs to be accepted by users in their daily life and educational contexts (Davis, 1989; Venkatesh et al., 2003).

LMSs and technology acceptance

An LMS has many functions, such as sharing learning materials, conducting discussions, managing classes, assigning homework or tasks, holding exams, receiving feedback, arranging learning materials, keeping student, teacher and system records, and creating reports. With those advantages, LMSs are potential tools for use in education. LMSs improve the effectiveness of instruction (Aydın & Tirkeş, 2010; Lonn & Teasley, 2009), student learning (Raman et al., 2014), interaction (Özgür, 2015), student performance (MacFadyen & Dawson, 2010; Cleary & Zimmerman, 2012), motivation (Erdoğan, 2013) and communication (Lonn, Teasley, & Krumm, 2009), contributing to their more widespread use.

Studies on the acceptance of LMSs have examined the acceptance of these technologies at the college level, using various technology acceptance models. Some of the studies (see Jong, 2009; Maina & Nzuki, 2015; Nicholas et al., 2017; Raman et al., 2014; Sedana & Wijaya, 2010) have used the UTAUT model. Measurement tools used in all of these studies, conducted on the basis of different acceptance models, have serious validity and reliability problems. These studies have created new scales by adapting items of the relevant TAM to an LMS. Typically, they have not examined the construct validity of the measurement tools they used, and reported reliability evidence based on Cronbach's alpha values only.

The aim of the present research

The general aim of this study, which was carried out to consider studies on the acceptance and use of LMSs, and also the limitations of the studies reported above, was to develop a valid and reliable measurement tool for the determination of LMS acceptance and usage among users. The intention in this regard was to identify the factors that affect users' LMS acceptance and use within the framework of the UTAUT model so as to reveal the relationships of the factors, both among themselves and with the LMS acceptance of users in general. In this way, to make more effective use of LMSs, which see frequent use in educational environments, the study was intended to predetermine the perceptions of acceptance of the learners towards these systems.

Method

The present study was conducted to develop a Likert-type scale to measure college students' LMS acceptance within the framework of the UTAUT model. Likert-type scales are based on self-reporting (Tezbaşaran, 1997). The study followed the standard steps to develop a Likert-type scale to measure the degree to which students accept the LMSs they use for various tasks.

Participants

Within the scope of this research, we aimed to develop a tool to determine the level of LMS acceptance and LMS usage among users. In this context, when selecting the participants for the study, the researchers prioritised students with previous experience with LMSs. The study was conducted with three groups of participants, a total of 515 first-year, second-year and third-year students who attended Hacettepe University Medical School in the 2016-2017 academic year. Of the 515 participants, 51.5% were male (n = 265) and 48.5% were female (n = 250). All data collection procedures were conducted in accordance with accepted ethical and professional standards. Active informed consent was provided by all of the participants.

Many factors were considered in the selection of participants, with the aim of including students with different levels of experience in LMSs, usage in a variety of courses and learning activities, as including different experiences from different courses, as well as with different LMSs, would contribute to a better determination of the general acceptance and use of LMSs, as well as ensuring the diversity, reliability and validity of the results of the measurement. The students of Hacettepe University Medical School had previously used different LMSs (Moodle and Blackboard) within different courses. Thus, in the context of a purposive sampling approach, they were identified as participants for this research. When technology acceptance and usage models are considered, the duration of the user experience is quite important in ensuring a realistic measurement of user acceptance and usage. In the case of short-term use, user acceptance may appear too high or too low due to the novelty effect of technology. To prevent this, and to ensure that the measurement results are valid and reliable, it was aimed to keep the duration of the user experience longer, which is another reason why a purposive sampling method was preferred in this research. The first group of participants consisted of 235 third-year students: 113 females (48.0%) and 122 males (52.0%). Exploratory factor analysis (EFA) was conducted on data from this group. The second group comprised 214 second-year students: 106 females (49.6%) and 108 males (50.4%). Confirmatory factor analysis (CFA) was conducted on data from this group. In addition, Cronbach's alpha reliability coefficients were calculated, and item analyses were conducted using the entire data from the first and second groups (N = 449). The literature recommends conducting EFA and CFA using different samples (Ilhan & Cetin, 2014). Therefore, EFA and CFA were conducted on data from different groups of participants.

Because administering the learning management system acceptance scale (LMSAS) we developed to the same group of participants twice is a costly process, test-retest reliability was examined using data from the third group of students, which was smaller than the other groups. The third group of participants comprised 75 third-year students: 35 females (46.6%) and 40 males (53.4%). Test-retest reliability was examined using the data from this group of participants. For test-retest reliability, the test was administered twice, with a three-week gap in between. There were three students who failed to participate in both sessions, and their data were removed from the data set. Table 1 provides a summary of the information on the scale administered to the groups of participants and the statistical analyses conducted on data from these groups.

Table 1
Groups of participants in the study

Group	Statistical analyses conducted	
First group of participants	EFA for construct validity	Cronbach's alpha reliability coefficient was calculated and item analyses were conducted using the combined data set with data from the first and second groups of participants
Second group of participants	CFA for construct validity	
Third group of participants	Calculation of the correlation between the first and the second administration of the test for test-retest reliability of the measurements	

Scale

The researchers developed the LMSAS on the basis of the UTAUT model. The model has four main dimensions: performance expectancy (PE), effort expectancy (EE), facilitating conditions (FC) and social influence (SI). To develop the scale, first, the literature was reviewed to identify the items that would be appropriate for each dimension, and these items were modified for use with the LMS. The pool of items created had 8 items appropriate for the first factor (PE), 5 items each for the second (EE) and third (FC) factors, and 3 items for the last factor (SI). The 5-point Likert scale ranged from *strongly disagree* to *strongly agree* chosen as the response format.

Procedure

Content validity, face validity and construct validity of the scale were examined. Expert opinion (on educational technologies, measurement and assessment) was obtained for content validity and face validity. One item was removed from each of the PE and SI dimensions on the basis of expert opinion. In addition, one item was updated in each of the EE and SI dimensions. Then, for linguistic assessment, a Turkish language expert and an English language expert reviewed the scale. Following revisions, a pilot was conducted with 18 second-term students (8 females and 10 males) to obtain feedback about the items and the time taken to administer the scale. Afterwards, a meeting was held with participants in the pilot group to learn about their views on the clarity of the items and instructions, and revisions were made accordingly. The time to administer the scale was calculated by averaging the times of the students who were the first and the last to complete the questionnaire. Data from this group of students were not included in the main data set. The 21-item scale was then finalised for administering to the main participants.

Data analysis

Once the LMSAS was applied to the main participants, statistical analyses were conducted to examine the psychometric qualities of the scale. First, EFA was conducted on data from the first group of participants. The literature recommends checking the data set before conducting the EFA to see if the data set meets the requirements for this type of analysis. The most important requirement concerns sample size. The first group of 235 participants meets the sample size requirement for EFA (Cattell, 1978; Comrey & Lee, 1992; Çokluk, Şekercioğlu, & Büyüköztürk, 2012; Hair, Anderson, Tatham, & Grablowsky, 1979; Kline, 1994). Another procedure to check whether the data set is appropriate for factor analysis is to examine the Kaiser-Mayer-Olkin (KMO) value and to conduct Bartlett's test. KMO values above .60 and statistical significance of Bartlett's test indicate that the data set is appropriate for factor analysis (Büyüköztürk, 2010).

EFA can be conducted using multiple factorisation techniques (image factor analysis, principal component analysis, weighted least squares analysis, maximum likelihood factor analysis) (Tabachnick & Fidell, 2007). Of these, the principal component analysis is more powerful in psychometric terms (Stevens, 1996). Therefore, the principal component analysis should be the first choice when deciding which factorisation technique to use (Akbulut, 2010). The present study thus used principal component analysis for factorisation.

For individual items to be retained in the scale, the rule of thumb that they have a minimum factor loading of .30 on the relevant factor was followed (Pallant, 2005). Communality values (h^2) for the variable measured were also taken into account in addition to factor loadings of the items. Low common variance values indicate that the item in question should be removed from the measurement tool. Tabachnick and Fidell (2007) recommend that a cut-off value of .20 be used for communality. The present study thus used the cut-off value of .20.

CFA was conducted to confirm the results of the EFA carried out with data from the first group, and to test the theoretically constructed measurement model. Significant χ^2 values from the CFA indicate that the theoretically constructed model is not confirmed by data. In addition, standardised values and other fit indexes were examined as recommended in the literature (Byrne, 2010; Hu & Bentler, 1999; Kline, 2011). In this study, goodness of fit index (GFI), incremental fit index (IFI), standardized root mean square residual (SRMR), parsimony goodness of fit index (PGFI), adjustment goodness of fit index (AGFI), normed fit index (NFI), root mean square error of approximation (RMSEA), non-normed fit index (NNFI), parsimony normed fit index (PNFI) and comparative fit index (CFI) and chi-square goodness of fit test were examined for CFA.

Reliability of the measurements made using LMSAS was examined using Cronbach's alpha and test-retest methods. To examine the discriminatory power of the items, adjusted item-total correlations were calculated and the top 27% and bottom 27% of participants were compared. SPSS 18.0 software package was used for EFA, fit validity, Cronbach's alpha, test-retest reliability and item analysis. CFA-related calculations were made using the software package LISREL 8.54.

Findings

Construct validity

EFA and CFA were conducted to test the construct validity of the LMSAS measurements. Procedures for these two analyses are presented under separate headings.

EFA

EFA was conducted using data from the first group of participants. First, KMO was used to check whether the sample size requirement was met, and Bartlett's sphericity test was used to see whether the data set was appropriate for factor analysis. The KMO value of the scale was 0.782, and Bartlett's test of sphericity was significant (χ^2 = 4665.925 p = .000). These results indicate that the data set is appropriate for EFA. Principal component analysis with varimax (25) rotation was conducted on the 21 items, with the number of components set at 4. Table 2 reports the results of the EFA.

Table 2
LMSAS' factor structure and factor loads

Item	Factor load				
	PE	EE	FC	SI	h^2
1. Using an LMS in my courses enables me to accomplish tasks more quickly.	.491				.32
2. Using an LMS in my courses improves my performance.	.469				.36
3. Using an LMS in my courses improves my productivity.	.581				.28
4. Using an LMS in my courses improves my motivation.	.580				.22
5. Using an LMS in my courses makes it easier to do my homework.	.672				.27
6. Using an LMS in my courses improves the quality of the work I do.	.650				.41
7. I find using an LMS in my courses useful.	.742				.38
8. Using an LMS in my courses enhances the effectiveness of the learning process.	.723				.37
9. I find learning how to use an LMS is easy.		.688			.37
10. I can easily use an LMS.		.439			.18
11. I can accomplish tasks more quickly when I use an LMS.		.530			.26
12. I feel comfortable when using an LMS.		.730			.33
13. I can do anything I want using an LMS.		.785			.36
14. I have the required information to make effective use of an LMS.			.589		.40
15. There are people I can turn to for support when I have difficulty using an LMS.			.749		.30
16. Using an LMS is similar to using other computer systems.			.689		.26
17. When using an LMS I know who to ask for help to solve problems I encounter.			.590		.23
18. The help function of an LMS is sufficient to solve the problems I encounter.			.772		.36
19. People around me think that it is important for me to make effective use of an LMS.				.721	.31
20. My effective use of an LMS increases my prestige among fellow students.				.590	.23
21. Friends of mine who make effective use of an LMS have more prestige.				.772	.28
% eigenvalue (total = 10.70)	6.19	2.10	1.29	1.12	
% variance explained (total = 64.39)	28.76	13.84	11.96	9.83	

Table 2 shows that each of the 21 items had a factor loading above .30. All items except item 10 met the criterion of .20 for common variance explained. Item 10 was retained in the scale because it had sufficient factor loadings in both the EFA and the CFA, and because it is an important item for content validity of the scale. The first dimension of the scale was PE, which explained 28.76% of the variance and consisted of 8 items with factor loadings that varied between .46 and .74. The second dimension of the scale was EE, which explained 13.84% of the variance and consisted of 5 items with factor loadings varying between .43 and .78. The third dimension of EE explained 11.96% of the variance and had 5 items with factor loadings varying between .58 and .77. The fourth dimension was SI, which explained 9.83% of the variance and consisted of 3 items with factor loadings varying between .59 and .77. The total variance explained by the scale was 64.39%, indicating that the scale is successful in explaining the quality being measured. The EFA thus resulted in a four-factor structure with 21 items.

CFA

Data from the second group were used to confirm the four-factor, 21-item structure that resulted from the EFA. The CFA result fit indexes for the LMSAS provided the following values: χ^2/sd = 1.87, SRMR =. 03, AGFI = .91, CFI = .92, NNFI = 93, RMSEA = .06 and GFI =. 93. Table 3 reports values of acceptable fit and an excellent fit for the fit indexes (Ilhan & Cetin, 2014) used to decide whether the model being tested has sufficient fit with the data. The results show that the four-factor model from the CFA has sufficient fit.

Table 3

Fit indexes calculated by CFA

Fit indexes	**Criteria for excellent fit**	**Criteria for acceptable fit**	**Fit indexes obtained**	**Result**
χ^2/sd	$0 \leq \chi^2/sd \leq 2$	$2 \leq \chi^2/sd \leq 3$	1.87	Perfect fit
SRMR	.00 ≤ RMSR ≤ .05	.05 ≤ RMSR ≤ .10	0.03	Perfect fit
AGFI	.90 ≤ AGFI ≤ 1.00	.85 ≤ AGFI ≤ .90	0.91	Perfect fit
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI ≤ .95	0.92	Acceptable fit
NNFI	.95 ≤ NNFI ≤ 1.00	.90 ≤ NNFI ≤ .95	0.93	Acceptable fit
RMSEA	.00 ≤ RMSEA ≤. 05	.05 ≤ RMSEA ≤ .08	0.06	Acceptable fit
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI ≤ .95	0.93	Acceptable fit

χ^2 = 201.96, *sd* = 108

Table 4 reports *t*-test values for the four-factor model that resulted from the CFA. When *t* values calculated are above 2.58, they are significant at the .01 level (Jöreskog & Sörbom, 2000; Kline, 2011). All *t* values were thus found to be significant at the .01 level. This finding confirms that the number of participants in this study is sufficient for factor analysis, and there are no items that need to be removed from the model.

Table 4

The t-test values for LMSAS

Item no. (PE)	***t***	**Item no. (EE)**	***t***	**Item no. (FC)**	***t***	**Item no. (SI)**	***t***
1	11.08*	9	9.88*	14	8.56*	19	7.11*
2	8.87*	10	8.84*	15	11.53*	20	11.38*
3	10.07*	11	7.98*	16	10.91*	21	10.05*
4	12.43*	12	10.25*	17	8.87*		
5	10.98*	13	9.76*	18	9.02*		
6	9.07*						
7	11.22*						
8	12.77*						

*$p < .01$

Factor loadings for the four-factor model obtained from the CFA are shown in Figure 2. As Figure 2 shows, factor loadings vary between .43 and .64 for the PE dimension, .41 and .63 for the EE dimension, .53 and .62 for the FC dimension and .43 and .57 for the SI dimension.

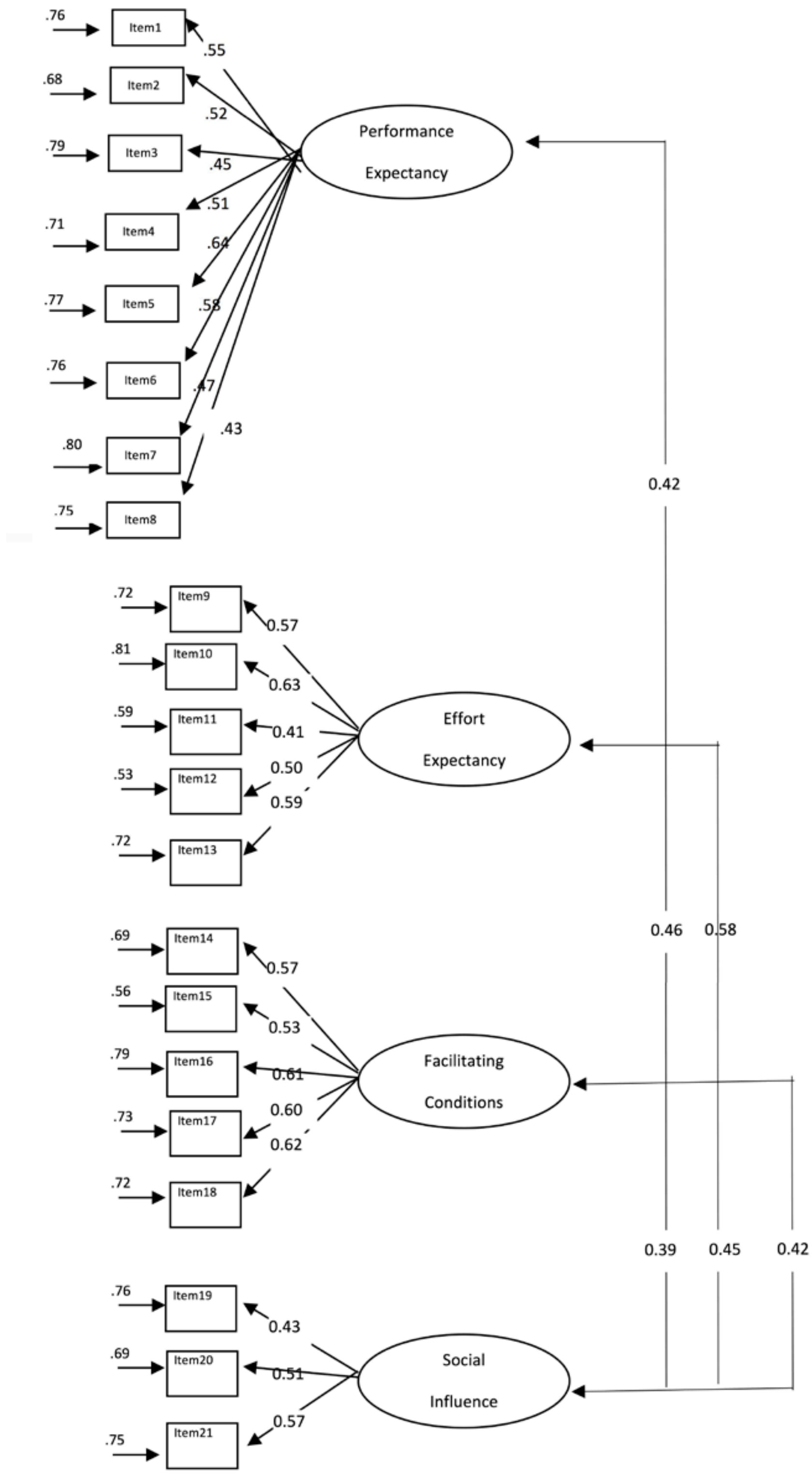

Figure 2. Standardised solutions for the four-factor model of the LMSAS

Reliability

Cronbach's alpha and test-retest methods were analysed to determine the reliability of the LMSAS. Given that reliability coefficients of .70 and above indicate reliable measurements (Fraenkel, Wallen, & Hyun, 2012), the reliability coefficients calculated were at sufficient levels. Table 5 shows the results.

Table 5
Reliability coefficients of the LMSAS

Sub-dimensions	Cronbach's alpha	Test-retest
PE	.772	.924
EE	.813	.892
FC	.780	.911
SI	.824	.882

Item analysis

To examine the discriminatory power of the items on the scale and their power to predict the total score, adjusted item-total correlations were calculated and the top 27% and bottom 27% of participants were compared. Findings from the item analysis are reported in Table 6.

Table 6
LMSAS item analysis results

Item no.	Cronbach's alpha if item deleted	Adjusted item – total correlation	Mean	Std. dev.	Skewness	*t*
			Performance expectancy			
Item1	.758	.46	3.28	1.22	-.27	13.31*
Item2	.743	.43	3.12	1.18	-.31	12.21*
Item3	.752	.36	2.85	1.11	-.08	10.78*
Item4	.743	.41	3.19	1.21	-.11	11.02*
Item5	.762	.55	3.07	1.11	-.45	11.98*
Item6	.749	.47	2.99	1.02	-.29	13.82*
Item7	.752	.38	3.11	1.04	-.51	14.02*
Item8	.748	.33	2.97	1.16	-.40	9.12*
			Effort expectancy			
Item9	.810	.48	3.16	1.31	-.11	11.37*
Item10	.796	.54	2.89	1.26	-.23	12.28*
Item11	.799	.32	3.05	1.11	-.42	10.11*
Item12	.802	.40	3.25	1.09	-.35	13.42*
Item13	.808	.48	3.22	1.18	-.33	14.57*
			Facilitating conditions			
Item14	.760	.47	3.33	1.12	-.13	14.71*
Item15	.762	.45	3.16	1.15	-.23	12.29*
Item16	.770	.50	2.91	1.11	-.31	11.26*
Item17	.759	.50	3.20	1.05	-.45	13.13*
Item18	.772	.52	2.97	1.09	-.34	11.24*
			Social influence			
Item19	.800	.34	3.17	1.14	-.23	12.18*
Item20	.803	.41	3.11	1.09	-.42	10.34*
Item21	.812	.53	3.12	1.12	-.39	11.72*

$^{*}p < .0011$

Table 6 shows that the *t* values for the difference between the top 27% and bottom 27% of participants varied between 9.12 and 14.02 for the PE dimension, 10.11 and 14.57 for the EE dimension, 11.24 and 14.71 for the FC dimension and 10.34 and 12.18 for the SI dimension.

Table 6 shows that item total correlations varied between .33 and .55 for the PE dimension, .32 and .54 for the EE dimension, .45 and .52 for the FC dimension and .34 and .53 for the SI dimension. In the interpretation of item total correlations, items with values .30 and above are considered to have a sufficient level of discriminatory power (Büyüköztürk, 2010; Erkuş, 2012). All items were found to meet this requirement. In addition, *t* values for the comparison of the top and bottom 27% of participants were significant for all items. Significant *t* values for comparisons between top and bottom groups are considered as evidence for the discriminatory power of the items (Erkuş, 2012). These findings indicate that all items on the LMSAS have discriminatory power.

Interpreting LMSAS scores

The LMSAS consists of 21 items. The scale ranging from *strongly disagree* to *strongly agree* chosen as the response format. The total score on the scale varies between 21 and 105. Higher scores on the scale indicate higher levels of LMS acceptance among students.

Discussion and conclusion

Contemporary higher education institutions need LMSs for learning and teaching activities (Almarashdeh, 2016; Ateş, 2010; Grob, Bensberg, & Dewanto, 2004). LMSs are used as distance education tools in higher education institutions, or as e-learning tools to support conventional education (Dutta, Roy, & Seetharaman, 2013). The literature shows that use of LMSs in higher education improves student motivation and attention, provides a more flexible learning environment and enables better management of the learning/teaching time (Corbeil & Valdes-Corbeil, 2007, Findik-Coskuncay & Ozkan, 2013; Jacob & Issac, 2008; Abas, Peng, & Mansor, 2009). The prerequisite for obtaining all these benefits is that students should be ready to use the LMS; in other words, they should accept this technology.

As stated above, there are many technology acceptance models. Studies so far have failed to show that any one of these models is better than others in explaining technology acceptance and use behaviour (Taylor & Todd, 1995; Venkatesh et al., 2003). However, the UTAUT model, used in many studies on the acceptance of different technologies, was preferred in this study as a powerful model (Magsamen-Conrad et al., 2015; Venkatesh et al., 2012) for explaining user behaviours and technology use. The model has four main dimensions: PE, EE, FC and SI.

A review of the literature shows that there are no valid and reliable measurement tools that can be used to measure students' acceptance of an LMS. The present study is therefore important, in that it fills this gap in the literature by developing the LMSAS. One of the strengths of this study is that it presents manifold evidence for the validity, reliability and discriminatory power of the measurements made using LMSAS.

Construct validity was examined using both EFA and CFA. A four-factor 21-item construct was obtained at the end of the EFA, which explained 64.39% of the total variance. CFA was used to see if this measurement model would be confirmed. Fit indexes for the CFA showed that this construct had an acceptable fit to the data. Variance ratio was above 30%, all items had factor loadings above the cut-off point of .30 and fit indexes for the CFA had acceptable levels, which indicated that measurements made using LMSAS have construct validity.

Cronbach's alpha was used to test reliability in the sense of consistency, and a test-retest reliability coefficient was used to test reliability about stability. Cronbach's alpha reliability coefficient was found to be .772 for PE, .813 for EE, .780 for FC and .824 for SI. The test-retest reliability coefficient, conversely, was found to be .924 for PE, .892 for EE, .911 for FC, and .882 for SI. Given that reliability coefficients of .70 and above are considered to indicate reliable measurements (Fornell & Larcker, 1981; Tezbaşaran, 1997), reliability coefficients calculated for LMSAS provide evidence for the reliability of the scale. On the other hand, reliability coefficients obtained using the test-retest method were higher than Cronbach's alpha coefficients, which indicated that the stability reliability of the scale is better than its consistency reliability.

Item analysis was conducted to examine the discriminatory power of the items on the scale and their power to predict the total score. As part of item analysis, adjusted item total correlations were examined, and the top and bottom 27% of participants were compared. Adjusted item total correlations were found to vary between .33 and .55 for the PE dimension, .32 and .54 for the EE dimension, .45 and .52 for the FC dimension and .34 and .53 for the SI dimension; and *t* values for the differences between the top and bottom 27% of participants were found to be significant for all items on the scale. These findings indicate that all items on the scale have discriminatory power. Findings of this study show that the scale can be used as a tool that generates valid and reliable measurements of students' acceptance of LMSs.

Limitations of this study and recommendations for further studies

In addition to the strengths stated above, this study has limitations that need to be addressed in future studies. The first limitation is that all the participants were Hacettepe University Medical School students. Another limitation is that external criterion validity and fit validity were not examined. Validity and reliability analyses should be repeated with data collected from different samples. Today, the use of LMSs is widespread at all education levels from primary school to university (Cigdem & Topcu, 2015). However, we should highlight that the problems encountered with their use is that LMS acceptance and usage levels are not the same for all levels of education. Within the context of adult education, LMSs are also used for applications such as giving in-service training to different occupational groups (Almarashdeh, 2016). In this context, examining the reliability and validity of this measurement tool with different samples would help educators and instructional designers to execute effective teaching practices. In particular, LMS usage within the context of adult education forms part of the self-directed learning skills of the users, and these are environments in which external support, such as support from the educator, is non-existent or at a minimum. Within the context of adult education, a low level of acceptance and usage of LMSs among users may even result in users leaving lifelong learning activities. Thus, examining the LMS acceptance and usage of educators and students in adult education is extremely important. Studies to be conducted using the scale are important in that they would contribute to the measurement power of the scale. This study has developed a scale to measure LMS acceptance of students. However, educators' acceptance of the LMS is also very important for successful integration of LMSs into higher education institutions (Almarashdeh, 2016; Cigdem & Topcu, 2015). In this context, future studies should develop measurement tools to measure acceptance of the LMS by educators.

In the present day, LMSs represent an important part of teaching practices both within and outside the faculty. As part of the integration of technology-based approaches into education, and as novel teaching approaches such as flipped classroom become more widely used, the acceptance and usage of LMSs have become more and more important. Thus, it is vital to determine the acceptance and usage rates of LMSs among educators and students and to identify any variables that may affect acceptance and usage. In this context, future research to determine whether personal differences, such as gender, education level, age and familiarity with technology, have an effect on the acceptance and usage of LMSs, and provisions for such personal differences by educators and instructional designers, would be helpful. Another important point regarding the acceptance and usage of LMSs relates to mobile learning. Today, the usage of mobile learning activities as part of learning activities, both within and outside the faculty, are becoming more widespread, and so LMSs are trying to adapt to this by taking advantage of improvements in mobile applications (Thomas, Singh, & Gaffar, 2013). Accordingly, future research may seek to determine the acceptance and usage of mobile LMSs among students and to identify contributing factors.

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Please cite as: Sezer, B., & Yilmaz, R. (2019). Learning management system acceptance scale (LMSAS): A validity and reliability study. *Australasian Journal of Educational Technology*, *35*(3), 15-30. https://doi.org/10.14742/ajet.3959