A MODEL FOR INSTRUCTORS' ADOPTION OF LEARNING MANAGEMENT SYSTEMS: EMPIRICAL VALIDATION IN HIGHER EDUCATION CONTEXT

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ABSTRACT
Through the rapid expansion of information technologies, Learning Management Systems have become one of the most important innovations for delivering education. However, successful implementation and management of these systems are primarily based on the instructors' adoption. In this context, this study aims to understand behavioral intentions of higher education instructors towards Learning Management Systems and further to identify the influencing factors. A multidimensional research model has been proposed based on the Belief Factors, Application Characteristics, and Individual, Social and Technological dimensions to identify the effects of key variables on behavioral intentions of users. A comprehensive survey was conducted with 224 academicians, followed by semi-structured interviews with ten of them. This paper presents evidence for the factor structure, reliability and validity of the survey. Additionally; structural equation modeling, specifically partial least square, was applied to assess the proposed multi-dimensional research model. Consequently, relationships between the influencing factors were detected and the results showed that the research model significantly predicts instructors' behavioral intention towards Learning Management System use. Findings of this research will be valuable for academicians and practitioners in implementation, management and continuous improvement of learning management systems.
Keywords: E-learning adoption, Technology adoption, Structural equation modeling, Partial least squares, Learning management systems

INTRODUCTION

Rise of computers, information and communication technologies and rapid expansion of the Internet encourage universities to transform their educational programs. Through this transformation, universities promote online courses to increase communication with students, to establish new revenue sources, and to reduce the location dependency and time constraints that are associated with traditional education. The rapid development of information technologies provides tools to expand and support e-learning applications in higher education institutes. One of the major technological innovations to support e-learning programs is Learning Management Systems (LMS). Higher education institutes implement LMS to support their course curriculum with many types of tools; such as, discussion boards, forum, chat, online grade posting, online exam, file sharing, management of assignments, syllabi, schedules, announcements and course plans. Proper implementation of these tools is important for the success of courses; however, most of the time, implementation of such systems may be problematic and even may end with a failure (Legris et al., 2003). Successful implementation of this technology partly depends on factors related to attitudes and opinions of instructors, students, information technologies and university support (Davis et al., 1989; Webster, Hackley, 1997; Selim, 2007). Although these stakeholders are primary considerations of LMS for successful implementation, instructors play a central role in the effectiveness and success of e-learning based courses (Webster, Hackley, 1997; Selim, 2007). Instructors' decision on continuing to use the system after trying is one of the success indicators of LMS implementation; therefore, determining the factors affecting users' intention to continue e-learning service use is one of the critical issues for researchers (Chiu et al., 2005). Instructors' attitudes towards a technology will affect learning outcomes (Webster & Hackley, 1997) and should be considered when technology-mediated distance learning systems are evaluated (Dillon & Gunawardena, 1995). Instructors are becoming increasingly critical determinant for implementation, management and continuous improvement of LMS. Therefore, the reasons effecting instructors' adoption towards LMS use must be revealed for the successful implementation of such systems in higher education.

E-learning revolutionizes education and makes it more accessible with the innovative use of information technologies; however it brings formidable challenges for instructors and students (Liaw, et al., 2007). Upon the knowledge we gathered so far, the studies concentrating on students' adoption (Saade' & Bahli, 2005; Pituch & Lee, 2006; Lee et al., 2009) towards e-learning system reach a certain level of maturity. However, the number of

studies examining instructors' adoption towards e-learning system is not sufficient to make a generalization. There is no single study that has examined instructors' adoption towards e-learning system considering **Belief** - *Perceived Usefulness and Perceived Ease of Use*, **Application Characteristic** – *Compatibility,* **Individual** – *Application Self Efficacy***, Technological** – *Technological Complexity* and **Social** – *Subjective Norm* dimensions all together. Among the limited number of studies that examined attitudes of instructors towards e-learning systems, Wang and Wang (2009) only concentrated on Perceived Usefulness, Perceived Ease of Use, Subjective Norm and Self-Efficacy dimensions and Sánchez-Franco (2009) only examined flow construct.
In these contexts, in order to increase the LMS use, it is essential to understand the reasons behind instructors' rejection and identify the critical success factors affecting their adoption. Therefore **the aims of this study** are as follows:

- Identifying the key factors affecting instructor adoption of LMS in higher education
- Developing a multidimensional model to reveal the main reasons behind the instructors' rejection of LMS.

This paper is organized as follows. First, the proposed research model and hypotheses are introduced. Second, information is given about preparation of the survey instrument, data collection process and participants of the research. Third, the survey instrument has been explored for validity and reliability. Exploratory factor analysis has been conducted to identify the factor structure of the survey instrument. In addition, structural model is presented considering the relations between factors and results of the analysis. Fourth, the findings of the research have been discussed in the light of literature and qualitative analyses results. Lastly, contributions of this study are summarized and potential future research topics are addressed.

RESEARCH MODEL AND HYPOTHESES

Research model

Most of the studies have examined users' e-learning acceptance or adoption either by using the original Technology Acceptance Model (TAM) (Davis, Bagozzi & Warshaw, 1989) or by extending it with different variables. They do not utilize a framework in developing their research models. This situation is a limitation because there is no clear pattern in selecting the external variables of the research models. Researchers are advised to avoid using a single linear methodology when evaluating individual attitudes toward e-learning (Liaw et al., 2007; Wang, 2003). Therefore, in this study, a multidimensional approach is considered to evaluate the behavioral intention of higher education instructors towards LMS use and the variables of the research model are selected under the control of related dimensions. The proposed research model is presented in Figure 1.

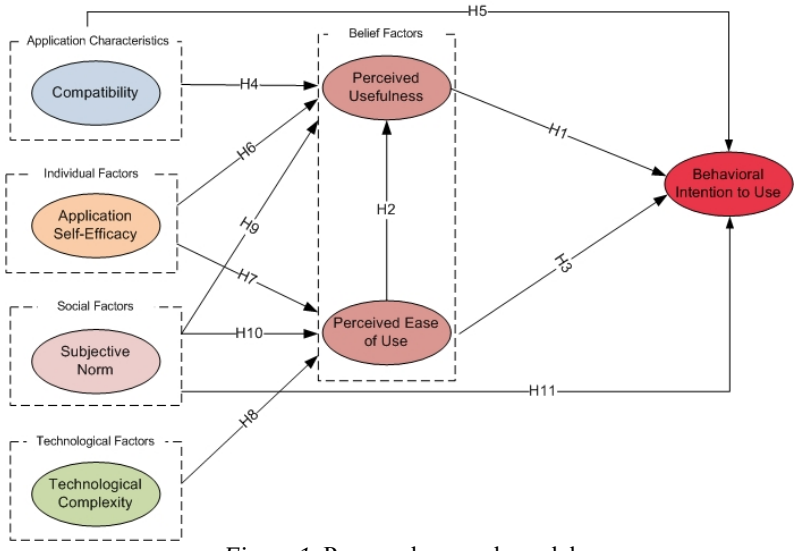

Figure 1. Proposed research model

The dimensions of the proposed research model and the related hypotheses are presented below;
Belief Factors examines individual's cognitive perception concerning the functionality of the system and his beliefs that using the system will have job related or, in general, utilitarian outcomes (Karaiskos, 2009). The factors under this dimension measure that how individual's perception is affected when they use information systems which provide utilitarian outcomes like improving effectiveness and efficiency in accomplishing tasks, fulfilling tasks without effortless and timeless (Karaiskos, 2009). In this context Perceived Usefulness (PU) and

Perceived Ease-of-Use (PEOU) are grouped under this dimension as indicative factors to evaluate that how system's utility and easiness affect users' perception and intention to system use. These two factors have become evident to have direct effects on behavioral intention to use LMS. However, too few studies (Liaw et al., 2007; Wang & Wang, 2009) verify the relationship between perception and intention from higher education instructors' perspective empirically in the context of e-learning systems. In the proposed research model, PU of LMS is defined as "the degree to which an instructor believes that using such systems will enhance his or her teaching performance" and PEOU of LMS is defined as "the degree to which an instructor believes that the system will be used easily" (Davis et al., 1989). Davis in 1989 concluded that PEOU has a significant direct effect on PU, and most of the recent studies verified the relation empirically in the context of LMS use (Lee et al., 2009; Chang & Tung, 2008), except one study, which aimed to predict university students' perception towards a web-based comprehensive class management system (Yi & Hwang, 2003). PU and PEOU are the key factors that affect the behavioral intention to use technology. Previous studies stated that both PU and PEOU directly affect the intention to use (Chang & Tung, 2008). Thus the hypotheses related with PU and PEOU are as follows:

Hypothesis-1: Perceived Usefulness will have a positive direct effect on Behavioral Intention.
Hypothesis-2: Perceived Ease of Use will have a positive direct effect on Perceived Usefulness.
Hypothesis-3: Perceived Ease of Use will have a positive direct effect on Behavioral Intention.

Also, a three-level framework developed by Cho in 2005 is used in constructing the research model. The framework includes the Technological, System and Application levels. The study indicates that Technological, System and Application characteristics, as well as Individual dimensions should be considered when evaluating technology adoption and usage (Cho, 2005; Cho et al., 2009).

Application Characteristics capture perceived innovation characteristics stating that behavioral intention and actual use are heavily depend on user perception of innovation (Conner, 2002). Under this dimension effects of the task and service characteristics of the systems on users' behavioral intention are examined. Compatibility (CMP) is explored under the Application Characteristics to reveal the effects of satisfaction between system characteristics and instructors' needs on behavioral intention to use. CMP assesses the effects of user's values, previous experiences and needs (Rogers, 1995) over the user's perception towards LMS use. Effects of CMP have not been verified from the perspective of higher education instructors in the scope of LMS. Chang and Tung (2008) examined the relations among CMP, PU and BI to examine the students' behavioral intention to use an online learning course web site and concluded that CMP has a direct effect on PU and BI. Thus the hypotheses related with CMP are as follows:

Hypothesis-4: Compatibility will have a positive direct effect on Perceived Usefulness.
Hypothesis-5: Compatibility will have a positive direct effect on Behavioral Intention.

Individual Factors refer personal traits that define the boundaries of individual's perception and assessments over the behavior (Karaiskos, 2009). Self-abilities and experiences of an actor who performs the behavior are considered with this dimension to evaluate LMS adoption and use. Effects of Application Self-Efficacy (ASE) are examined under the Individual Factors to capture that how an people's characteristics influence their intention to use a system. ASE is utilized to evaluate the effects of instructors' judgments about their LMS use capabilities. Venkatesh and Davis (1996) states that PEOU and self-efficacy are related and many studies have proved that self-efficacy has a direct relation with PEOU in the scope of web-based learning systems (Wang & Wang, 2009; Pituch & Lee, 2006). The relationship between ASE and PEOU is assessed in the proposed model. The hypotheses related with ASE are provided below:

Hypothesis-6: Application Self Efficacy will have a positive direct effect on Perceived Usefulness.
Hypothesis-7: Application Self Efficacy will have a positive direct effect on Perceived Ease of Use.

Technological Factors examine the characteristics of the technology. Complexity is included in the research model to understand the effects of technological characteristics on users' easiness perception. Technological Complexity (TC) is grouped under technological factors and considered in the research model to evaluate how perception about system complexity will affect the instructors' intention. TC is defined as "the degree to which technology is perceived as relatively difficult to understand and use" (Thompson, Higgins, & Howell, 1991). In a previous study, effect of TC on PEOU was analyzed to explain pre-service teachers' intention toward technology use (Teo, 2009). The study stated that if a technology perceived as being difficult, it is perceived as being tedious and time consuming, which results in a lot of effort to be spent to benefit from it. The hypothesis related with TC is as follow:

Hypothesis-8: Technological Complexity will have a negative direct effect on Perceived Ease of Use.

Social Factors explore effects of environmental factors like other people's attitudes and behaviors and social pressures imposed to the individuals. Social factors capture that how individuals who are important for end users have an effect on them towards using a system. Subjective Norm (SN) is grouped under environmental dimension and defined in the model to evaluate the effects of others' opinions on the instructors' decisions. Many instructors choose to use LMS upon recommendations from their colleagues or students, who are the users of the system. Previous studies indicate that SN has a direct relation with both PU (Wang & Wang, 2009; Yuen & Ma, 2008; Park, 2009) and BI (Wang & Wang, 2009; Yuen & Ma, 2008; Park, 2009) in the scope of e-learning systems. Although, Park (2009) found insignificant effects of SN on PEOU when evaluating university students' adoption of e-learning, Yuen and Ma (2008) found a significant relation between SN and PEOU in their study that concentrated on teachers' acceptance of e-learning technology. To offer a new viewpoint, relation between SN and PEOU is being analyzed in the proposed model. Thus the following hypotheses are formulated by these considerations;

Hypothesis-9: Subjective Norm will have a positive direct effect on Perceived Usefulness.
Hypothesis-10: Subjective Norm will have a positive direct effect on Perceived Ease of Use.
Hypothesis-11: Subjective Norm will have a positive direct effect on Behavioral Intention.

RESEARCH METHOD

Study Settings

In this study, METU Online learning management system was taken into consideration when evaluating users' behavioral intention towards LMS use. METU Online is a learning management system developed by Informatics Institute of Middle East Technical University (METU) and being used since 1997 to meet the e-learning needs of METU students and academicians. This LMS provides an educational environment in which instructors and students can easily communicate with each other synchronously and asynchronously. METU Online enables an instructor to share and arrange lecture notes, syllabus and course schedule, publish assignments, announcement and grades of the students, communicate with students via e-mail, chat and forum and evaluate their students with online exams.

Survey instrument and data collection

In this study, both quantitative and qualitative research methods were used to test the proposed research model. A comprehensive survey instrument was prepared after a detailed literature review to collect data from higher education instructors about their perceptions of the LMS in regards to their adoption level. **Content validity** of the survey instrument was checked, in order to evaluate whether the measurement reflects the intended domain of content specifically (Carmines & Zeller, 1994). Judgments were taken from seven experts to assess each item in the survey as 'essential', 'useful but not essential' or 'not necessary'. Four of the experts were from the Information Systems Evaluation and Integration Group (ISEing), Brunel University, London, UK; two from the Education Sciences, METU, Ankara and one from the Informatics Institute, METU, Ankara, Turkey. Then the instrument was demonstrated over a small group including ten PhD students.

Before the main survey was performed, a pilot study was applied on 86 instructors who are employed in various institutions in METU. Pilot survey included 46 items to measure the constructs of the proposed research model. The results and feedbacks from the pilot survey were taken as basis for preparing the main survey.

The resulting survey consisted of two main parts. The first part included demographic questions. The second part consisted of 27 five-point likert-type scale questions aiming to assess the seven constructs of the proposed research model. These questions are anchored from 1 to 5, where 1 indicates strong disagreement and five indicates strong agreement. All responses were guaranteed confidentiality. This measurement items are presented in Table 1. Initially, an electronic version of the survey was distributed to 1000 instructors via email. Due to low response rate (0.5%), distribution of the survey was continued by hand. Moreover, for qualitative analysis, 10 active users of the LMS were interviewed face-to-face via use of semi-structured questions (A.1). The Semi-structured interviewing method was chosen because it is useful for obtaining information to test a specific hypothesis that the researcher has in consideration (Fraenkel & Wallen, 2006).

Participants

A total of 500 questionnaires were distributed to the higher education instructors. The data used to evaluate the proposed research model was collected from full time instructors working in School of Foreign Languages, Faculty of Education, Faculty of Arts and Science and Faculty of Engineering of METU, Turkey. In total 250 surveys were retrieved. 224 respondents were active users of the METU Online. The resulting total response rate was 50%. The demographic profile of the respondents included collecting responses on LMS usage, gender, age and evaluation of computer skills and major motivation of users. The demographic results showed that while 89.6% of the participants were using the METU Online LMS, the rest had not used it before. In addition, the

participations awareness of other LMSs was asked and 20% of them were aware of Moodle, 20% of them were aware of Blackboard and 9% of them were aware of WebCT. The sample population showed diversity in gender as 62.5% of the respondents were female, and the rest of them were male. 90% of the respondents were between 20 and 39 years old and 68% evaluated their computer skills as pretty good. Also 44%, 38%, 27% and 12% of the respondents selected "Myself", "Course Content", "Students" and "Colleagues" respectively as a major motivation factor towards system use.

Data analysis and results

Data analysis and results of the research composed of preliminary data analysis, identification of factor structure, reliability assessment and assessment of the proposed research model stages. Steps of data analysis are illustrated in Figure 2.

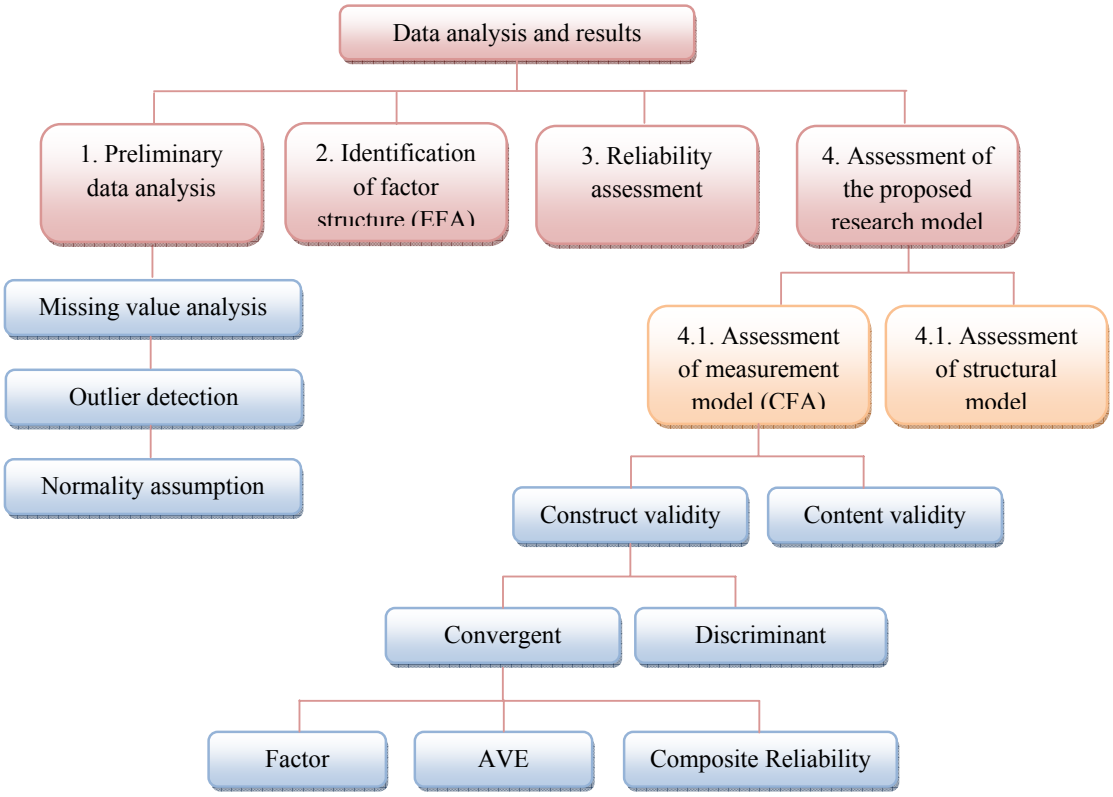

*Figure 2.*Steps of data analysis

Preliminary data analysis

Missing value analysis, outlier detection, multicollinearity analysis and normality assumption checks were performed before using the data set for further analyses (Hair, 2006). Hair (2006) indicated that missing values can be handled with any imputation method as long as missing data level is under 10%. For this reason, regression method was used to handle missing data of 224 usable questionnaires. Also, multivariate outliers were explored and none of the data appeared to be extreme. Lastly, skewness and kurtosis values were checked with Kolmogorov–Smirnov test (Field, 2009). All items were found significant ($p<0.05$) according to the result of this test. Also the skewness and kurtosis values of each item should be between -1 and +1 (Huck, 2004). In this study, the skewness and kurtosis values were between +2 and -2. According to these results, the data had non-normal distribution.

Identifying the factor structure

Explanatory Factor Analysis (EFA) was performed to show whether the related items were clustered under the same factors or not. Maximum likelihood extraction method and direct oblimin rotation were conducted on 27 items because factors in the proposed research model were related with each other. The Kaiser-Meyer-Olkin (KMO) measure equaled to .91 confirmed the sampling adequacy for the explanatory factor analysis (Field, 2009). Bartlett's test of sphericity $p < .001$, indicated that correlations between items were sufficiently large for maximum likelihood. Six components had eigenvalues over Kaiser's criterion of 1 and combination explained

67.75% of the variance. According to Hair et al. (2006), factor loadings should be between 0.3 and 0.4 to meet the minimal level. Table 1 shows the each item's factor loading after rotation. Factor 1 represents Perceived Usefulness, factor 2 represents Perceived Ease of Use, factor 3 represents Application Self-Efficacy, factor 4 represents Technological Complexity, factor 5 represents Subjective Norm and factor 6 represents Behavioral Intention.

Item 3, 5, 11, 13, 18, 19 and 21 were deleted because they did not cluster appropriately under the factors. None of the items clustered under the CMP dimension so CMP was removed from the proposed research model. As a result, the final version of the questionnaire contained 20 items.

Reliability assessment

Reliability was evaluated by considering the inter-item consistency assessed by Cronbach's Alpha value (Morgan et al, 2004). Morgan indicates that in order to provide a good support for internal consistency, the value of Cronbach's Alpha should be positive and even greater than 0.7. Additionally, Hair et al (2006) notes that a Cronbach's Alpha value ranging between 0.6 and 0.7 refers a lower level of acceptability. The 20-item instrument had a very high reliability with 0.894. Table 1 shows Cronbach's Alpha coefficients for the six constructs which were between 0.665 and 0.845. Although Cronbach's Alpha values of ASE and SN slightly lower than 0.7, the results lead to a conclusion that the reliability was assured.

Table 1. Descriptive statistics of the construct and items.

Construct / Item	Factor Loading	Cronbach's Alpha Coefficient	Reliability Result
Perceived usefulness (PU)	.490		
I1-PU1 : LMS enhances my course performance	.697		
I9-PU2 : LMS increases productivity of the course	.452	.808	Good
I17-PU3 : LMS helps me to satisfy the purpose of the course easily	.566		
I25-PU4 : LMS gives me a greater control over my course			
Perceived ease of use (PEOU)			
I2-PEOU1 : Interacting with LMS is clear and understandable	.572		
I10-PEOU2 : Interface of the LMS is clear and easy to understand	.660	.819	Good
I7-PEOU3 : Navigation among tools is not difficult	.578		
I15-PEOU4 : Interacting with LMS is not complicated	.427		
Application self-efficacy (ASE)			
I6-ASE1 : I can use LMS without support	.456		
I14-ASE2 : I can use LMS, even if there is no one for help when I get stuck	.686	.684	Acceptable
I22-ASE3 : I was able to use LMS without observing anyone use it	.336		
Technological complexity(TC)			
I26-TC1 : Interacting with LMS does not require much mental effort	.676	.845	Good
I23-TC2 : It does not take too long to learn how to use LMS	.585		
I27-TC3 : Using LMS does not take too much of my time	.654		
Subjective norm (SN)			
I8-SN1 : My colleagues encourage me to use LMS	.584	.665	Acceptable
I16-SN2 : My assistants / instructors support me to use LMS	.849		
I24-SN3 : Head of my department supports me to use LMS	.431		
Behavioral intention (BI)			
I4-BI1 : I will use LMS in the next semesters	.696	.805	Good
I12-BI2 : I plan to use LMS in all of my courses	.779		
I20-BI3 : It is worth to use LMS	.650		
Not Measured			
I3: I feel good about supporting the course with LMS			
I5: LMS is compatible to manage the course progress			
I11: LMS provides an attractive learning environment			
I13: LMS fits my teaching style			
I18: Interacting with LMS does not demand much care or attention			
I19: Supporting the course with LMS is better than the traditional methods to manage course			
I21: LMS is helpful to fulfill the needs of the course			

Ii: Number of survey items

Assessment of the proposed research model

The proposed research model was validated with structural model analysis using the partial least square (PLS) technique. In this study PLS was used to analyze data, instead of LISREL, because of the non-normal data distribution.

Assessment of the measurement model

Confirmatory Factor Analysis (CFA) was conducted to validate the correlation between items and factors before the structural model was evaluated. Additionally, CFA assessed the measurement model via convergent validity and discriminant validity that are two important components of construct validity.

Convergent Validity

Convergent validity is defined as the degree to which two variables share variance due to a given concept and correlation (Reichardt & Coleman, 1995). Convergent validity can be assessed with Factor Loadings, Composite Reliability and Average Variance Extracted methods and Hair (2006) explains these concepts as follows.

- *Factor loading* is the evidence of the variance shared between item and construct, and also its standardized value should be ideally 0.7 or higher, but 0.5 or higher is also acceptable. As shown in Table 2, standardized factor loadings ranged between 0.679 and 0.886. The values of the factor loadings validated the correlation between each item and their constructs in the data set.
- *Composite reliability (CR)* refers to internal consistency indicating that all measures consistently represent the same latent construct. A reliability value of 0.7 or higher refers good reliability. In this study, CR values were between 0.816 and 0.902; so the composite reliability of the date set was validated. CR values were shown in Table 2.
- *Average variance extracted (AVE)* value is to be computed for each latent construct of the measurement model. That value should be 0.5 or higher to provide adequate convergent validity. The AVE values ranged from 0.598 to 0.756. This indicated that each construct was strongly related to its respective indicators. AVE values were shown in Table 2.

As a result, the measurement model was evaluated to have an adequate convergent validity.

Table 2. Convergent validity

Item	Factor Loadings	Composite Reliability (CR)	Average Variance Extracted (AVE)
PU1	.782	.876	%63
PU2	.845		
PU3	.781		
PU4	.788		
PEOU1	.728	.879	%64
PEOU2	.857		
PEOU3	.824		
PEOU4	.802		
ASE1	.843	. 830	%62
ASE2	.782		
ASE3	.734		
TC1	.869	.902	%75
TC2	.852		
TC3	.886		
SN1	.812	.816	%59
SN2	.820		
SN3	.679		
BI1	.855	.892	%73
BI2	.852		
BI3	.861		

Discriminant Validity

Another important dimension of construct validity is discriminant validity which demonstrates that a measure should not correlate so highly with another measure (Peter, 1981). Fornell and Larcker (1981) indicated that square root of the average variance calculated for each construct should be greater than the correlation between a given construct and all other constructs. Table 3 shows that square root of average variance for each construct on the diagonal was greater than the other values. For this reason, Discriminant validity was reasonable to verify construct validity.

Table 3. Discriminant validity of measurement model.

Construct	BI	CSE	PEOU	PU	SN	TC
BI	**0.856**					
CSE	0.391	**0.788**				
PEOU	0.397	0.629	**0.804**			
PU	0.627	0.349	0.395	**0.799**		
SN	0.216	0.114	0.245	0.398	**0.773**	
TC	0.352	0.653	0.707	0.351	0.164	**0.869**

Assessment of structural model and hypotheses testing

SMART PLS was used to assess the statistical significance of each hypothesis considering the path coefficient values that are standardized betas. The data set composed of 224 samples was analyzed with a bootstrapping procedure to evaluate the significance level of the relations between constructs. The estimated path coefficients of the structural model are shown in Figure 3.

The summary of hypotheses tests, T values that have been considered to evaluate the significance of path coefficients and β values stating the standardized path coefficient are given in Table 4. When T and β values were considered, it was found that there were strong positive relations between PU-BI, ASE-PEOU, TC-PEOU and SN-PU at the $p<0.001$ level, therefore H1, H7, H8 and H9 accepted. Additionally, structural model analysis showed strong relation between TC and ASE at the $p<0.001$ level that was not a situation estimated before. The relation between TC and ASE was named as Additional Relation. A new constructed hypothesis had positive direct relation between TC and ASE. Also the results showed that the relations proposed in H3 and H10 were significant at the $p<0.01$ level, thus the hypotheses were accepted. The relations between PEOU-PU and ASE-PU were significant at the $p<0.05$ level, therefore H2 and H6 were accepted. There was not a significant relation between SN and BI, hence H11 was rejected. Furthermore none of the items clustered under the CMP dimension when explanatory factor analysis was performed. For this reason CMP was not included in the content of structural model and the relations between CMP and PU, CMP and BI were not analyzed. Therefore, H4 and H5 could not be measured.

The result of analyses showed that the model's predictive power (R^2) value was 0.42.

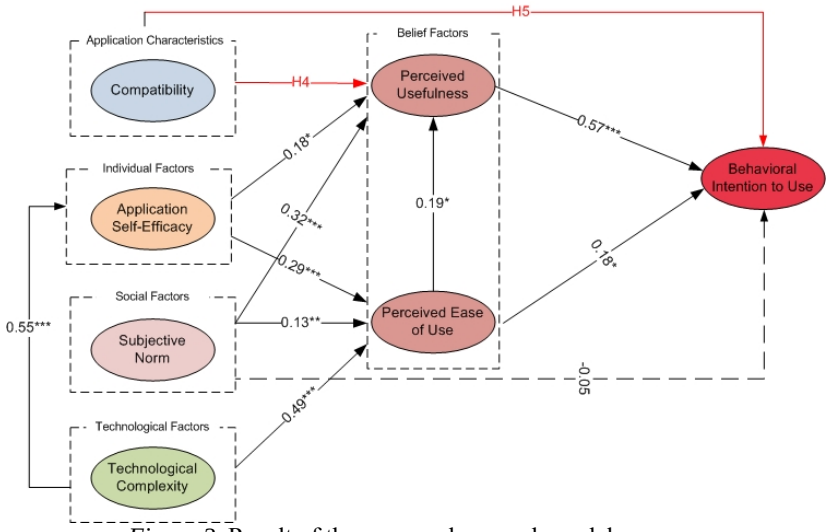

Figure 3. Result of the proposed research model

Path significance: *p<0.05; **p<0.01; ***p<0.001

Table 4. Summary of hypotheses tests.

Relationships	Hi	T-Values	β	Decision
PU -> BI	H1	9.010	0.579***	Accepted
PEOU -> PU	H2	2.382	0.197*	Accepted
PEOU -> BI	H3	2.950	0.183**	Accepted
CMP->PU	H4	-	-	Cannot be determined
CMP->BI	H5	-	-	Cannot be determined
ASE -> PU	H6	2.378	0.188*	Accepted

ASE -> PEOU	H7	4.995	0.291***	Accepted
TC -> PEOU	H8	8.294	0.497***	Accepted
SN -> PU	H9	5.207	0.328***	Accepted
SN -> PEOU	H10	2.621	0.131**	Accepted
SN -> BI	H11	0.941	-0.058	Rejected
TC -> ASE	Additional Relation	15.310	0.553***	Accepted

*p < 0.05; **p < 0.01; ***p<0.001

DISCUSSION

In this empirical study, a number of relationships were examined to reveal instructors' adoption of LMS in higher education. The relations among factors were examined under the Belief, Technological, Social, Application Characteristics and Individual Dimensions.

Belief Factors: *Perceived Usefulness and Perceived Ease of Use*

The first dimension identified the effects of Belief Factors on behavioral intention towards LMS use from the perspective of higher education instructors. The relations among PU, PEOU and BI were examined in the proposed research model.

Statistical results (in Table 4) proved that PU had a positive significant relationship with BI (i.e. hypothesis 1). This result leads to similar conclusions with some previous studies in the literature (Saade' & Bahli, 2005). Focus group interviews confirmed the significant relation between PU and BI. Qualitative findings supported that the usage of LMS reduces time and location dependency via use of forum, chat and e-mail tools and the effort spent for sharing and archiving course materials without any information loss. One of the instructors stated that "…I can manage my courses easily because I can access the system, organize course materials and communicate with my students whenever I want…" Another instructor stated that "… I can achieve my course materials easily with METU Online. The prepared lecture notes, syllabi and schedules are kept in the system, so I won't need to prepare same documents for upcoming semesters…" These two arguments support the quantitative results in a way that instructors' performance increase with LMS uses in their course organization. Also instructors' behavioral intention towards system use increase when they perform their jobs in an efficient and effective way.

In addition, statistical analyses revealed that PEOU was positively correlated with PU (i.e. hypothesis 2), which was consistent with the previous studies (Lee et al., 2009; Lee, 2009). The relation emphasized that if an instructor perceives LMS as easy to use, his/her usefulness perception will increase about supporting the course by the system. One of the instructors stated that "…I don't spend too much time when submitting grades of the students, due to user friendly interfaces; also I don't have to enter each student's grade separately, thanks to the mass grades registration…" This comment proved that when instructors perform a job in an easy way, they have pleasure and this feeling increases their usefulness perception towards system use.

The focus group discussion explored the positive relation between PEOU and BI (i.e. hypothesis 3) and the significance of the relation was lower than the relation between PU and BI. One of the instructors stated that "…although, in the first time, the relation between course and its application tools seemed a little bit confusing, learning the usage of system did not take too much time and effort…" Another instructor stated that "…despite navigation among tools is so easy, path information is needed to understand where I am at that moment…" In the first time, instructors had some difficulties to learn LMS use; however they learned thoroughly all aspects of system use after several trials. In this study, the effect of PU on BI was more influential than the effect of PEOU. Although PEOU is an important determinant of behavioral intention, instructors have adequate capability to overcome the related difficulties. So system usefulness is a more influential factor than easiness factor for instructors' decision to LMS use.

Application Characteristics: *Compatibility*

The second dimension tried to identify the effects of Application Characteristics' effect on behavioral intention. However, CMP dimension had been removed from the model because of the inconsistent explanatory factor analysis results. Therefore, the effects of CMP on PU and BI were not analyzed (i.e. hypothesis 4 and hypothesis 5). When conducting focus group interviews, it was seemed that the instructors' opinions diverse on the compatibility of the system. While a group of instructors found the system so beneficial to organize their courses, some of them thought that the system is inappropriate to support the courses. Qualitative findings supported that the main reason of the diversity emerged because of the courses' properties. An engineering science instructor stated that "…there is no tool available to support laboratory activities so I cannot use LMS to organize my laboratory sections…" The result of the interview was in parallel with the literature. Bourne et al.

(2005) states that engineering education fell behind some other education areas in the field of adoption of online methodologies, due to laboratory works, intensive mathematical computations, designing tools requiring computing power and graphics.

Individual Factors: *Application Self Efficacy*
The third dimension identified the effects of Individual Factors on behavioral intention to use LMS. This dimension examined that how users self efficacy towards an application affects their future decision to use system.

ASE significantly influenced PU (i.e. hypothesis 6), as claimed by Hsu et al. (2009) that concentrate on statistical software-self efficacy of students. Users' self-confidence towards LMS use increases their usefulness perception towards system use. As indicated in the study of Wang & Wang (2009), higher education instructors have basic computer literacy; for this reason, they have self-confidence while using web-based learning systems. Similar results were seen in this study, as 68% of the instructors evaluated their computer abilities as pretty good, which shows the instructors' self-confidence towards system use.

Moreover ASE significantly affected PEOU (i.e. hypothesis 7). Morris and Venkatesh (2000) examined age differences in a workplace to reveal their technology adoption, and they found that older workers may be less self-confident in their ability to use a new technology. In this study, 63% of the participants were young people whose ages were between 20 and 29. For this reason, most of the participants of this research had ASE when using LMS, so self-confidence positively influences their ease of use perception. Additionally, according to focus group interviews an instructor indicated that "…availability of the manual increases my self-confidence, so I don't care about the difficulty of the system. Since, I know that I will be able to use the system with the help of manual…" This comment also showed that additional supportive activities enhance users' self confidence towards system use.

Like previous studies have revealed, ASE positively affected both PU and PEOU (Hsu et al., 2009; Yi & Hwang, 2003). However, effect of ASE on PU was lower than PEOU. An instructor statement supported this argument by claiming that "…when I created lecture notes for the first time, the interface confused me. Because, the resource files of the lecture notes and the files to be shared with students are being organized in the same interface. I could not understand the difference between these two structures, so I called the help desk to for assistance in creation of the lecture notes…" This statement showed that the instructor was confused and need to take help to solve this dilemma. Although instructor had self confidence to use system and easily learned the system use, he did not find the system so useful to achieve his aim at the first time. Therefore, effects of instructors' self-efficacy towards application were lower on his usefulness perception.

Technological Factors: *Technological Complexity*
The fourth dimension identified the effects of Technological Factors on behavioral intention of instructors towards LMS use. Statistical results showed that TC had a strong and positive effect on PEOU (i.e. hypothesis 8). Although it was hypothesized that technological complexity negatively related with perceived ease of use, the statistical analysis showed that there was a positive relation between these two constructs. This positive relation was caused by the participants' capability to use computer technology and their self confidence towards LMS use. They found the system use simple; so they did not feel anxiety when using LMS and live any complexity problem when using LMS. An instructor's comment supported the strong positive relation between TC and PEOU. He said that "…the applications, such as sending announcements, posting assignments and file sharing, integrated to the system are not confusing. However, preparing an online exam with the system is a little bit confusing, so I prefer paper based exam instead of using online exam tool…" One of the instructors stated that "…technical support is so beneficial, so I don't need to spend much time to solve a problem…" These statements showed that instructors did not have difficulty in using the system. The result of this relation was parallel with the study of Teo (2009). He indicated that the perception of difficult technology discourages instructors towards LMS use, because they think that the usage of the system is so tedious and time confusing that a lot of effort is needed to benefit from the system.

Additionally, significant relation, which was not estimated before, was detected between Technological and Individual dimensions; TC had a strong positive effect on ASE (i.e. Additional Relation). This positive affect may be caused because of the instructors' self confidence. This relation showed that the complexity of the technology affects user's self-efficacy towards application use. One of the instructors stated that "…I am not so successful in computer usage, so simplicity of the system increases my self-confidence towards LMS…." This statement supports that simple systems increase users' self confidence. The relation between TC and ASE shows that although instructors have self confidence towards system use, simple systems enhance their confidence.

Social Factors: *Subjective Norm*
The fifth dimension identified the effects of Social Factors on behavioral intention of instructors towards LMS use.

Statistical results showed that SN positively and directly influenced PU (i.e. hypothesis 9). In parallel with the literature, social environments of instructors' increase their usefulness perception (Wang & Wang, 2009; Park, 2009).

Additionally, SN was positively correlated with PEOU (i.e. hypothesis 10) even if its effect was lower than the one on PU. The result of this relation was inconsistent with the study of Park (2009).

In this study, SN did not have any direct effect on BI (i.e. hypothesis 11). The study of Morris and Venkatesh (2000) indicated that age has a positive direct influence on subjective norm which means that older people may consider the opinions of friends and coworkers more. In this research, most of the respondents were young, and they did not care about what people around them believe. Additionally, a generic question was asked in the questionnaire to obtain information about the major motivation of users when deciding about system use. The results showed that, users' own decision and course content (44% and 38%, respectively) were more effective than the students and the colleagues (27% and 12% respectively) as motivation to use LMS. According to these finding, the insignificant relation between SN and BI was reasonable. Additionally, an instructor stated that "…before I used the system, my students and friends were mentioning about the LMS. After I tried it, I realized that the system could be beneficial to support my courses…" This statement supported that, although the user was influenced by the others' opinions at the beginning, the others' opinions were not as effective as at the beginning, when giving decision about continuing system use. Although usefulness and ease of use perceptions were affected from the people around the user; the final decision towards system use was given by the user him or herself.

CONCLUSION

This study aimed to propose a LMS adoption model from the perspective of higher education instructors. The model comprised of five dimensions – Belief, Application Characteristics, Individual, Social and Technological – and a scale has been developed to examine the relations among their variables. Validity tests have proved that the following variables and their corresponding dimension of the model were significant in explaining the behavioral intention of instructors towards LMS use: (1) Belief - Perceived Usefulness and Perceived Ease of Use, (2) Individual – Application Self Efficacy, (3) Social – Subjective Norm, (4) Technological – Technological Complexity. However, the fifth dimension and its variable, i.e. Application Characteristic – Compatibility, could not be incorporated within the proposed model because of the inappropriate correlation between the items and the factor. The final model explained a significant amount of the variance of behavioral intention towards LMS use ($R^2 = 0.423$). The results provide considerable insights about instructor adoption of LMS in higher educations. Moreover the findings of this study contribute to the e-learning literature by identifying the factors that influence instructor adoption of LMS for successful system use in learning and teaching in higher education.

Information systems success is based on the multidimensional approach and interdependent construct (DeLone & McLean, 2003). In that regard, different dimensions were considered to investigate external variables of the proposed research model. However, there may be other influencing factors for instructor adoption of LMS. Hence future research should be performed to explore and test the causal relationships among different factors considering the proposed dimensions within the boundary of LMS. Another future study would be to confirm the validity of the research model on different learning management systems.

The proposed adoption model is not a fixed and unchanged model and is open to continuous development. Future studies may extend or modify this adoption model through adding other dimensions or external variables valid for various educational level contexts, i.e. elementary level education, etc. For future work, the validated research model and the developed scale could be taken as a basis forming a starting point when developing other instruments for LMS evaluation with respect to other educational level instructors' perceptions.

In time, changes in e-learning technologies and their perceptions by users will inevitably raise the need for a continuous research for technology adoption in this field. The instructor adoption of LMS model presented in this study can greatly benefit those engaged in the management and development of learning management systems as a guidance to better understand how instructors' adoption can be increased and how the use of LMSs can be continuously improved.

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A.1

Qualitative questions

While you are using METU Online, how frequently do you use these tools: Lecture Notes, Online Exam, Assignment, Announcement, Grading, E-Mail, Chat, Forum, Schedule and Syllabus?
Why do you choice METU Online to support your courses?
Are you satisfied with the use of METU Online system?
Do you have any problems when using METU Online? Please give some examples.
What is your overall thought about METU Online?