Expert Systems with Applications 39 (2012) 10959–10966

Contents lists available at SciVerse ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

A model for measuring e-learning systems success in universities

Alireza Hassanzadeh *, Fatemeh Kanaani, Shában Elahi

Department of Information Technology Management, Tarbiat Modares University, Pole Nasr, Jalale Ale Ahmad, Tehran, Iran

ARTICLE INFO

Keywords:
E-learning
E-learning systems
E-learning systems success
Measuring e-learning success
User satisfaction

ABSTRACT

In the era of internet, universities and higher education institutions are increasingly tend to provide e-learning. For suitable planning and more enjoying the benefits of this educational approach, a model for measuring success of e-learning systems is essential. So in this paper, we try to survey and present a model for measuring success of e-learning systems in universities. For this purpose, at first, according to literature review, a conceptual model was designed. Then, based on opinions of 33 experts, and assessing their suggestions, research indicators were finalized. After that, to examine the relationships between components and finalize the proposed model, a case study was done in 5 universities: Amir Kabir University, Tehran University, Shahid Beheshti University, Iran University of Science & Technology and Khaje Nasir Toosi University of Technology. Finally, by analyzing questionnaires completed by 369 instructors, students and alumni, which were e-learning systems user, the final model (MELSS Model[1]).

1. Introduction

Nowadays, e-learning has caused many changes in higher education, as it emerged as a new paradigm of modern education and has changed previous learning concept (Sun, Tsai, Finger, Chen, & Yeh, 2008; Wang, Wang, & Shee, 2007). E-learning is a subset of distance education that was common since the middle of 1980s. An e-learning approach can take advantage of coaching and facilitated learning by building online knowledge repositories, such as lessons learned and best practice systems (Liebowitz & Frank, 2011). The development of e-learning offers new possibilities for learning and leads to drastic changes in education practice (Jia et al., 2011). With spread of internet usage, e-learning became vastly widespread and many universities put it in their program (Kanuka & Anderson, 2007). According to the Giga Information Group, nearly 75% of the 129 top US universities use e-learning systems (Wang & Wang, 2009). In Iran, many applicants do not have access to higher education in face-to-face classes. E-learning systems can compensate the weakness of traditional learning methods. So, if we can use features of modern technology well, a golden opportunity will provide for youth and knowledge seekers.

But what makes importance of the matter clearer, is an attempt to gain success in use of e-learning systems. Also, measuring the success of systems is critical to understand the value, effect of management operations and investment on them (DeLone & McLean, 2003). Therefore, since 1992, several researches have been examined the success of different information systems and measured it experimentally (Lee & Lee, 2008; Lin & Shao, 2000; Muylle, Moenaert, & Despontin, 2004; Wang et al., 2007). So, various factors have been identified for the success of information systems because success of e-learning systems is not measurable with a single factor such as user satisfaction (Shee & Wang, 2008). In this paper, a comprehensive model is presented for measuring the success of e-learning systems.

2. Literature review

2.1. E-learning and e-learning systems

There are different technologies that instructor can use them as a tool for electronic learning e.g. Internet, intranet, extranet, satellite broadcast, audio/video tape, interactive TV, CD–ROM and many others (SØrebØ, Halvari, Gulli, & Kristiansen, 2009). But with the increasing development of internet, concept of e-learning has been completed and generally refers to cases which learning is done through the internet and online courses are offered (Monahan, McArdle, & Bertolotto, 2008; Wang et al., 2007). Base on Technology Standard Committee's definition, e-learning system is a learning technology that uses web browsers as a tool for interaction with learners and other systems. This system works as a platform to facilitate teaching and learning (Ferdousi, 2009). In fact, e-learning system is an information system based on the World Wide Web that provides training of learner in a flexible way (Lee & Lee, 2008).

* Corresponding author. Tel./fax: +98 2182883637.
E-mail addresses: ar_hassanzadeh@modares.ac.ir, hasanzadeh.alireza@gmail.com (A. Hassanzadeh), ftmh_kanani@yahoo.com (F. Kanaani), elahi@modares.ac.ir (S. Elahi).

[1] Measuring e-learning systems success.

0957-4174/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.eswa.2012.03.028

2.2. E-learning in Iran

In 2001, virtual education site of Tehran University launched with 9 courses. Based on latest available statistics, currently 26 governmental and nongovernmental universities present electronic education.

2.3. Success of e-learning systems

Undoubtedly, the emergence of modern technologies have promised to provide equal educational opportunities everywhere for everyone and also, diverse courses continuously. In fact, without considering the main components of learning, application of the most advanced and latest technology is in vain, and will have merely advertising aspect rather than educational.

On the other hand, since unsuccessful effort in implementing e-Learning is reflected in terms of return on investment, the success of e-learning is one of the important issues (Govindasamy, 2002). In an e-learning system, not only the learner, but also all stakeholders are important. It is no doubt that internet and other digital technologies are able to support e-learning in an open, flexible and distributed environment. But how? Due to the differences between e-learning and traditional learning in some aspects, effective and successful conversion of traditional courses to e-learning may need a complex attempt and requires accurate planning, monitoring and control (Cantoni, Cellario, & Porta, 2004). In fact, continuity of global demand growth for e-learning and acceptance of virtual communities needs to measure their effectiveness and usefulness in education (Stalling, 2002).

3. Methodology

In order to present a model for measuring e-learning systems success, we use D&M model of information systems success measurement. Because e-learning systems are kinds of information systems and learners use systems for learning (Lee, 2010; McGill & Klobas, 2009). But the revised D&M model, in spite of all its strengths, still has defects. In this paper, to eliminate the defects of D&M model, and to customize it for e-learning area, 10 components -based on previous researches- have been considered for measuring e-learning system success.

3.1. Conceptual model

D&M model of information systems success measurement, for the first time presented by Delone and McLean, in 1992, to examine IS success and was used by nearly 300 papers (DeLone & McLean, 2003). Based on 2002 estimation, 38% of articles have used this model (Despont-Gros, Mueller, & Lovis, 2005). The model, in 2003, due to the changing role of information systems over time, was revised and developed by Delone & McLean. The revised D&M model includes six dimensions: (1) information quality, (2) system quality, (3) service quality, (4) use/intention to use, (5) user satisfaction and (6) net benefits (DeLone & McLean, 2003; Wang et al., 2007; Wu & Wang, 2006). The revised D&M model is one of the most widely used models of information systems success and has been used for various information systems. Since e-learning systems are specific type of IS (Lee & Lee, 2008; Wang et al., 2007), the revised model of Delone and McLean can be used for measuring success of e-learning systems. However, defining and measuring the success factors of IS, particularly for e-learning systems, is still a problem, and regarding the international aspects such as culture, the problem is broader. In this regard, Wang et al. used the components of D&M model for the first time, for e-learning systems in organizations (without considering the relationship between the components of the model) (Wang et al., 2007). Then,

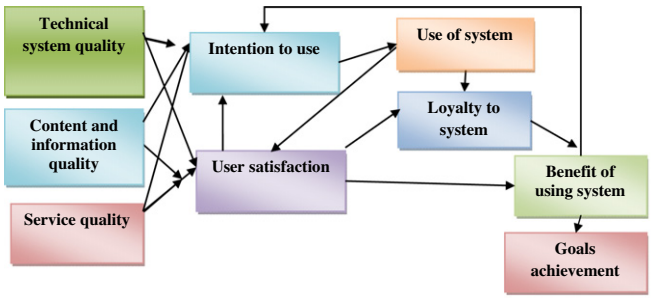

Fig. 1. Conceptual model.

Lin used this model for e-learning systems without considering net benefits component and neglecting all relationships between components of the model, despite their importance (Lin, 2007; Petter & McLean, 2009). It should be noted in both these cases, the success of e-learning systems has been studied only from learner's perspective. Considering that an instructor also has a vital and important role in e-learning, for proper application of this model, in addition to considering all the components and relationships between them, the instructor view must be examined. In addition, goals achievement (Beldagli & Adiguzel, 2010) and loyalty to system (Lin & Lee, 2006) are other important components that need to be included in the model.

In this paper, we tried to use concepts and models mentioned in the same researches, taking into account the views of instructors, students and alumni and provide a model for measuring success of e-learning systems, add to the richness of previous researches. Therefore, by reviewing previous researches, the initial conceptual model is presented in Fig. 1.

According to the Fig. 1, all components of the widely used model D&M, are included in this conceptual model to measure the success of e-learning systems. Also, a new relationship between intention to use and system use components is added to the previous D&M model. In addition, loyalty to system and goals achievement has been added to the model, determining the possible relationship between them.

3.2. Components and indicators

In this paper, according to previous researches on e-learning, components and indicators of the proposed model has determined (see Tables 1–10).

The indicators measuring the technical system quality are presented in Table 1.

Table 2 refers to the indicators measuring educational system quality.

In Table 3, the indicators measuring content and information quality are presented.

Indicators which are measuring service quality are shown in Table 4.

Table 5 shows the indicators measuring user satisfaction.

The indicators measuring benefits are presented in Table 6.

Table 7 refers to the indicators measuring intention to use.

Table 8 refers to the indicators measuring system use.

The indicators measuring loyalty to system are shown in Table 9.

Table 10 shows the indicators measuring goal achievement.

And now, we mention some brief definitions and explanation of each component.

- **Technical system quality:** Technical system quality is performance of the system in term of reliability, ease of use and other indicators of systems (Petter & McLean, 2009; Wang & Wang,

Table 1
Indicators measuring the technical system quality.

References	Indicators
(Ho & Dzeng, 2010)	Aesthetic
(DeLone & McLean, 2003; Ozkan & Koseler, 2009; Oztekin, Kong, & Uysal, 2010; Wang et al., 2007)	Ease of access
(Ozkan & Koseler, 2009; Shee & Wang, 2008; Sun et al., 2008; Wang & Liao, 2008; Wang et al., 2007)	Ease of use
(Au, Ngai, & Cheng, 2008; Ozkan & Koseler, 2009; Parker & Martin, 2010; Wang & Liao, 2008; Wang et al., 2007)	User friendly
(Chen, Lambert, & Guidry, 2010; Ozkan & Koseler, 2009; Oztekin et al., 2010; Wang et al., 2007)	Interactivity
(DeLone & McLean, 2003; Ozkan & Koseler, 2009; Piccoli, Ahmad, & Ives, 2001; Wang et al., 2007)	Personalization
(Wang et al., 2007; Garrity, Glassberg, Kim, Sanders, & Shin, 2005; Lee, Yoon, & Lee, 2009; Shih, 2008; Wrzesien & Raya, 2010)	Attractiveness
(Wang et al., 2007; Holsapple & Lee-Post, 2006; Lin, 2007)	System speed
(DeLone & McLean, 2003; Graft, 2002; Holsapple & Lee-Post, 2006; Ozkan & Koseler, 2009)	Security
(DeLone & McLean, 2003; Lin & Lee, 2006; Ozkan & Koseler, 2009; Shee & Wang, 2008; Volery & Lord, 2000; Webster & Hackley, 1997)	Reliability
(Cantoni et al., 2004; Cukusic, Alfirevic, Granic, & Garaca, 2010; Ho & Dzeng, 2010; Ozkan & Koseler, 2009)	Structured design
(Chou & Hsiao, 2007; DeLone & McLean, 2003; Holsapple & Lee-Post, 2006; Ozkan & Koseler, 2009)	Usability
(Ozkan & Koseler, 2009; Wu et al., 2008; Cukusic et al., 2010; Shee & Wang, 2008)	Maintenance
(Au et al., 2008; Cukusic et al., 2010; Johnston, Killion, & Oomen, 2005; Lin & Lee, 2006)	Flexibility
(Au et al., 2008)	Ease of integration
(Ho & Dzeng, 2010; Wang & Wang, 2009)	Having the required functions through appropriate menus

Table 2
Indicators measuring educational system quality.

References	Indicators
(Lee, 2010)	Existence of facilities such as chat, forum, and others in the system
(Fang, 2007; Fardoun, Montero, & Jaquero, 2009; Lee, 2010; Lim, Lee, & Kichan, 2007; Lonn & Teasley, 2009; Pituch & Lee, 2006)	Facilities for communicating with other students and doing class discussion
(Kerr, Rynearson, & Kerr, 2006; Vernadakis, Antoniou, Giannousi, Zetou, & Kioumourtzoglou, 2011)	Appropriateness of the system with students' learning styles
Researchers' experience	Make it possible to ensure the presence of the students in the class
(Artut, 2009; Chang & Chen, 2009; EL-Deghaidy & Nouby, 2008)	Providing collaborative and active Learning
(Zaïane, 2002)	Possibility of evaluation of learning and performance

Table 3
Indicators measuring content and information quality.

References	Indicators
(Lin, 2007; Wang & Liao, 2008; Wang et al., 2007)	Required Information and content
(Au et al., 2008; Wang et al., 2007)	Timely content and information
(Au et al., 2008; Avison & Fitzgerald, 2006; Wang et al., 2007)	Related content and information
(Lin, 2007; O'Dell, 2009; Wang et al., 2007)	Useful content and information
(Bolliger et al., 2010; DeLone & McLean, 2003; Ho & Dzeng, 2010; Lin, 2007; Ozkan & Koseler, 2009; Oztekin et al., 2010; Wang et al., 2007)	Comprehensive content and information
(DeLone & McLean, 2003; Kember, McNaught, Chong, Lam, & Cheng, 2010; Ozkan & Koseler, 2009; Oztekin et al., 2010; Wang et al., 2007)	Intelligible content and information
(Lin, 2007; Ozkan & Koseler, 2009; Shee & Wang, 2008; Wang & Liao, 2008; Wang et al., 2007)	Up to date content and information
(Au et al., 2008; Avison & Fitzgerald, 2006; Lin, 2007; Wang & Wang, 2009)	Accurate content and information
(Wang & Wang, 2009)	Precise content and information
(Holsapple & Lee-Post, 2006; Ozkan & Koseler, 2009)	Organized content and information

Table 4
Indicators measuring service quality.

References	Indicators
(Ozkan & Koseler, 2009; Wang & Wang, 2009; Wang et al., 2007)	Provide guidance services
(Au et al., 2008; DeLone & McLean, 2003; Holsapple & Lee-Post, 2006)	Responsiveness
(Andrade & Bunker, 2009; Wang et al., 2007)	Reflecting user views in system design and development
(Au et al., 2008; Khan, 2005; Ozkan & Koseler, 2009; Oztekin et al., 2010; Sun et al., 2008)	Courses management
(Lin, 2007)	Speed of provided service

2009). Technical system quality is related to presence and absence of a bug in system (Rabaa'i, 2009). In fact, technical system quality measures technical success (DeLone & McLean, 2003).

- **Educational system quality:** In this paper, the aim of educational system quality is system quality according to the features and capabilities that facilitate and improve teaching and learning.

Table 5
Indicators measuring user satisfaction.

References	Indicators
(Sun et al., 2008; Wang et al., 2007; Wu et al., 2010; Abdous & Yoshimura, 2010; Parker & Martin, 2010)	Perceived usefulness
(Wang et al., 2007; Wu et al., 2010; Bolliger et al., 2010; Chen & Jang, 2010; Oztekin et al., 2010)	Satisfaction with system performance
(Holsapple & Lee-Post, 2006; Lee, 2010)	Keeping users pleased with the system
(Duan, He, Feng, Li, & Fu, 2010; Henley, 2009; lee et al., 2009; Sheng, Jue, & Weiwei, 2008)	Providing educational needs of users
(Díez & McIntosh, 2009; Hutchins & Hutchison, 2008; Molla & Licker, 2001)	To gain user confidence

Table 6
Indicators measuring benefits.

References	Indicators
(Duan et al., 2010; Gonzalez, Jover, Cobo, & Munoz, 2010; Holsapple & Lee-Post, 2006; Parker & Martin, 2010; Wang et al., 2007)	Improving performance/effective learning
(Ssemugabi, 2006)	Increased knowledge
(Chiu & Wang, 2008; Piccoli et al., 2001; Ssemugabi, 2006)	Self-reliance
(Ho & Dzeng, 2010; Parker & Martin, 2010; Wang et al., 2007)	Cost savings
(DeLone & McLean, 2003; Ho & Dzeng, 2010; Holsapple & Lee-Post, 2006; Parker & Martin, 2010; Wang & Liao, 2008; Wang et al. 2007)	Time savings

Table 7
Indicators measuring intention to use.

References	Indicators
(Lin, 2007; Selim, 2007)	Believed that use of the system is valuable
(Lin, 2007; Naveh, Tubin, & Pliskin, 2010; Wang & Wang, 2009)	Tendency to use the system

Table 8
Indicators measuring system use.

References	Indicators
(Chen & Jang, 2010; Wang & Liao, 2008; Wang et al., 2007; Ngai, Poon, & Chan, 2007; Kember et al., 2010)	Frequency of system use
(Ozkan & Koseler, 2009)	Duration of system use

Table 9
Indicators measuring loyalty to system.

References	Indicators
(Wang & Liao, 2008; Wang et al., 2007)	Dependance on system
(Duan et al., 2010; Holsapple & Lee-Post, 2006; Lee, 2010; Lin, 2007)	Suggest to others to use the system

Table 10
Indicators measuring goals achievement.

References	Indicators
(Beldagli & Adiguzel, 2010)	Achieving educational goals
(Beldagli & Adiguzel, 2010; Sun, Cheng, & Finger, 2009; Law, Lee, & Yu, 2010)	Achieving personal goals

- **Content and Information quality:** In fact, content and Information quality is the quality of system output (Petter & McLean, 2009; Wang & Wang, 2009) and measures semantic success (DeLone & McLean, 2003).
- **Service quality:** This is user support by training unit (Petter & McLean, 2009) and it is effective support for system users to use the system (Wang & Wang, 2009). Although some researches claim that service quality is subset of system quality in model, but changing role of information systems in recent years, has made it an independent component (Wang & Liao, 2008).
- **User satisfaction:** User satisfaction is users' general idea about system (Wang & Wang, 2009) and it is often used to measure learner's attitude (Wu, Tennyson, & Hsia, 2010). This component, evaluates interaction between user and e-learning system (Rabaa'I, 2009). User satisfaction is recognized as one of the five main pillars of online education quality (Bolliger, Supanakorn, & Boggs, 2010).
- **Intention to use:** Intention to use is the decision to use a system before you actually do it and it is predicted to happen in future (Petter & McLean, 2009). Intention to use is an attitude (DeLone & McLean, 2003).
- **Use of system:** This is the actual use of the system or its outputs (Petter & McLean, 2009). Against intention to use that is related to user's attitude, system use is relates to users' behavior (DeLone & McLean, 2003).
- **Loyalty to system:** Loyalty to system is involvement and participation rate of users in e-learning activities (Lin & Lee, 2006).
- **Benefits of using e-learning system:** Benefit of using e-learning system is the impact of an e-learning system on one person, group, organization, industry or community. With time passing, benefits of using system becomes out of monopoly of one person and increasingly expanding to organizations and communities (DeLone & McLean, 2003).
- **Goals achievement** in this paper, indicators of educational and personal goals achievement of user are considered for goals achievement component.

3.3. Population and sample

In this paper, two categories of population are considered: (1) e-learning experts that have knowledge and experience in the subject (Turban, 1993), (2) e-learning system users (including students, alumni and instructors). In the first category, 80 experts in the field of e-learning in Iran were identified and a questionnaire was given to them. 33 of them completed it. In the second category, the total volume of the sample was 3598 users which among them, 2858 persons were students, 470 persons were alumni and 270 persons were instructors.

3.4. Reliability of measurement tool

In order to measure the components of the model and model testing, a questionnaire was designed. In this paper, Cronbach's

alpha coefficient is utilized to determine reliability of the questionnaire. Based on the results of this test, Cronbach's alpha coefficient for the experts' questionnaire is 0.955. Also, Cronbach's alpha coefficient value for the instructors' questionnaire is 0.95. Students and alumni questionnaires (353 persons) have very high reliability of 0.968. Details about Cronbach's alpha are in Table 11.

4. Statistical analysis

4.1. Data analysis method in first stage: results of experts' opinion

In order to test the conceptual model, we use the structural equation modeling technique. Results show that at 0.95 confidence levels, components and indicators are confirmed by experts.

4.2. Data analysis of case study (second stage)

The final model was obtained by analyzing the opinions of the e-learning systems users in the sample (including students, alumni and instructors). The model is represented in Fig. 2. The Figure shows the path coefficients of SEM analysis and their *t*-value.

In order to evaluate the fitness of the MELSS model based on previous studies, eight main criteria in the previous studies, have been considered. The criteria and their acceptable limits are shown in Table 12.

According to the Table 12, all values are in the acceptable range indicating a good fit of the model. Based on the structural equation analysis, the structural equations of the model are as follows:

$$V1 = 0.74*V2 + 0.21*V3 + 0.28*V4,\ \text{Errorvar.} = 0.27,\ R^2 = 0.65$$
(0.067) (0.052) (0.064) (0.020)
11.01 4.02 4.30 13.49

$$V5 = 0.92*V1 + 0.19*V6 - 0.20*V7,\ \text{Errorvar.} = 0.37,\ R^2 = 0.67$$
(0.068) (0.068) (0.052) (0.028)
13.50 2.84 -3.85 13.43

$$V8 = 0.24*V5 + 0.23*V6,\ \text{Errorvar.} = 0.64,\ R^2 = 0.23$$
(0.057) (0.073) (0.047)
4.27 3.21 13.48

$$V9 = 0.56*V1 + 0.35*V5 + 0.18*V8,\ \text{Errorvar.} = 0.31,\ R^2 = 0.73$$
(0.056) (0.048) (0.036) (0.023)
10.01 7.36 4.87 13.48

$$V10 = 0.53*V1 + 0.13*V9 + 0.43*V6,\ \text{Errorvar.} = 0.28,\ R^2 = 0.74$$
(0.061) (0.045) (0.056) (0.021)
8.62 2.92 7.71 13.49

$$V6 = 0.62*V1 + 0.13*V9,\ \text{Errorvar.} = 0.25,\ R^2 = 0.65$$
(0.053) (0.046) (0.019)
11.70 2.80 13.34

V1:	user satisfaction
V2:	technical quality of the system
V3:	educational quality of the system
V4:	content and information quality
V5:	intention to use
V6:	benefits of using system
V7:	service quality
V8:	use of system
V9:	loyalty to system
V10:	Goals achievement

Based on MELSS model and its structural equations, it can be said that technical system quality is one component of measuring the success of e-learning system and through a direct effect on user satisfaction can also affect the success of these systems. So, whatever the technical quality of e-learning systems is more, user satisfaction is higher. More user satisfaction leads to increase the success of e-learning systems. The results show that technical systems quality influences intention to use through indirect effect on user satisfaction. Also, educational system quality influences user satisfaction. Although according to the path coefficients in Fig. 2, effect of educational system quality on user satisfaction is less than technical system quality, but it indicates that facilities like forum, chat, collaborative learning tools, possibility of class discussions and etc. in e-learning systems can result in user satisfaction. Also, educational system quality and service quality are interrelated with each other. So, service quality through educational system quality can influence on user satisfaction and intention to use. Namely, when better support for users of e-learning system takes place, we have more possibility of creating collaborative learning through relevant features in the system and it leads to higher user satisfaction. Also, results indicate that content and information quality has the most direct effect on user satisfaction. So, whatever quality of content and information is more, users are more satisfied with the use of information systems. User satisfaction, leads to achieve personal and educational goals of users. Because of direct impact of user satisfaction on benefits of using system, benefits of using system and their knowledge will be higher. On the other hand, it encourages users to reuse the systems. So, content and information quality through impact on user satisfaction can influence intention to use of the e-learning systems indirectly.

When a user of e-learning system is more satisfied, the loyalty to system will increase (direct effect). In addition to the possibility of him/her intention to use the system for the future periods, he/she might suggest the system to others. Based on MELSS model, intention to use the system has direct effect on system usage. Moreover, even when the user is going to use system and still this intention has not actualized, the user will be loyal to the system

Table 11
Cronbach's alpha coefficient of the questionnaire.

Cronbach's alpha coefficient	Component
0.899	Technical quality of the system
0.736	Educational quality of the system
0.907	Content and Information quality
0.815	Service quality
0889	User satisfaction
0.897	Intention to use
0.882	Use
0.746	Loyalty to system
0.807	Intention to use
0.881	Goals achievement

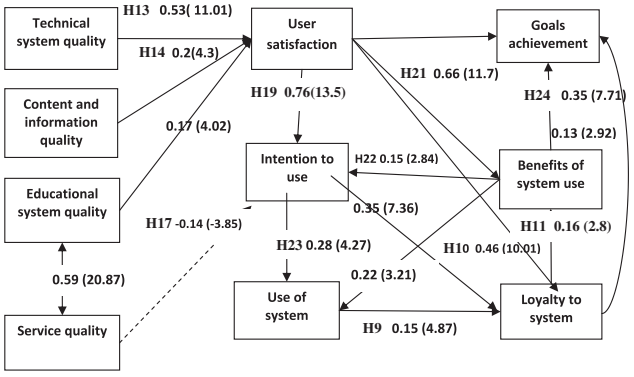

Fig. 2. Results of SEM analysis in the case study (MELSS model).

Table 12
Criteria and acceptable amounts and values in model fit test.

Value	Source	Acceptable level	Criteria
0.851	(Choudhury & Karahanna, 2008; Hwang & Kim, 2007)	Less than 5	Amount X^2 on free degree
0.99	(Choudhury & Karahanna, 2008; Hwang & Kim, 2007)	Equal or more than 0.9	GFI
097	(Choudhury & Karahanna, 2008; Hwang & Kim, 2007)	Equal or more than 0.8	AGFI
0.99	(Choudhury & Karahanna, 2008; Hwang & Kim, 2007)	Equal or more than 0.9	NFI
1	(Oztekin et al., 2010)	Equal or more than 0.9	IFI
1	(Choudhury & Karahanna, 2008; Hwang & Kim, 2007)	Equal or more than 0.9	CFI
0	(Hwang & Kim, 2007)	Less than 0.06	RMSEA
0.6903	(Choi, Kim, & Kim, 2007)	More than 0.05	P-Value

Table 13
Comparison of MELSS model with similar previous models.

Evaluation criteria	D&M IS Success Model. 1992	D&M IS Success Model.2003	The E-Learning Success Model- *Holsapple and Lee-Post 2006*	Online communities Success model. Lin & Lee, 2006	Measuring Online Learning Systems Success, Lin, 2007	MELSS model, current research
Technical quality of the system	■	■	■	■	■	■
Educational quality of the system						■
Content and information quality	■	■	■	■	■	■
Service quality		■	■	■	■	■
User satisfaction	■	■	■	■	■	■
Intention to use		■		■	■	■
Use	■		■		■	
User loyalty				■		■
Benefits of using system[2]		■	■			■
goals achievement[3]						■
Considering relationships between components	■			■	■	■
Considering intention to use and use as two separate components					■	■

[2]In other researches, this component is referred as "net benefit". Since this name may cause confusion, in this paper, it replaced with "Benefits of using system"; [3] goals achievement means achieving educational goals and/or personal goals.

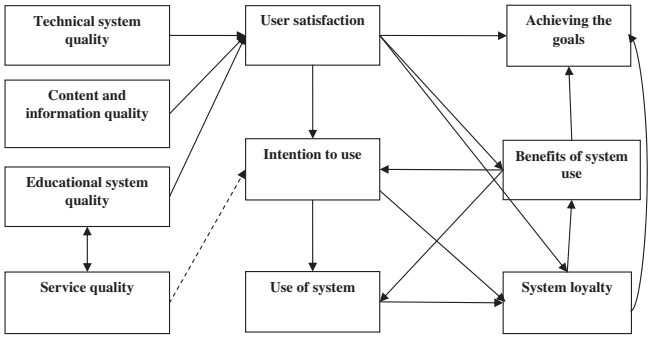

Fig. 3. The final model (MELSS).

and suggests it to others. On the other hand, the greater use of e-learning system leads to the more loyalty to the system, and also benefits of using system will be added. Results of the case study suggest that more interests of using e-learning systems itself will cause the user goals achievement (direct effect). Also, user satisfaction has effect on his/her goals achievement; this means that the more e-learning systems user satisfaction, the more achievement of personal and educational goals for him/her.

5. Comparison of the MELSS model with other similar models

In any scientific research, there are weaknesses and strengths. Comparing weaknesses and strengths of similar studies can be

helpful for future researches. In this section, current study is compared with other similar studies. Results of the comparison are presented in Table 13.

Table 13 shows that the MELSS model has comprehensive components. Furthermore, this research is the first one to consider the opinions of students, alumni and instructors together.

6. Conclusion

In this paper, by combining models and previous studies, a model for measuring e-learning systems success entitled "MELSS" is presented. In this model, we have tried to resolve the weaknesses of previous models and to reinforce the strength of them. Based on the results of experts questionnaire, components such as technical system quality, educational system quality, content and information quality, service quality, user satisfaction, intention to use, user loyalty to system, benefits of using system and goals achievement, are suitable for measuring e-learning systems success. After finalizing the indicators of conceptual model, based on students, alumni and instructors' opinions in universities, MELSS model was designed and its fitness was confirmed. The final model is shown in Fig. 3.

Future studies can be done to compare the resulted models from the opinions of students, alumni and instructors, individually and collectively.

References

Abdous, M., & Yoshimura, M. (2010). Learner outcomes and satisfaction: A comparison of live video-streamed instruction, satellite broadcast instruction, and face-to-face instruction. *Computers & Education, 55*, 733–741.

Andrade, M. S., & Bunker, E. (2009). A model for self-regulated distance language learning, Distance Education. Melbourne 30(1) 47–62.

Artut, P. D. (2009). Experimental evaluation of the effects of cooperative learning on kindergarten children's mathematics ability. *International Journal of Educational Research, 48*, 370–380.

Au, N., Ngai, E. W. T., & Cheng, T. C. E. (2008). Extending the understanding of end user information systems satisfaction formation: An equitable needs fulfillment model approach. *MIS Quarterly, 32*(1), 43–66.

Avison, D., & Fitzgerald, G. (2006). Information system development; Methodologies, techniques & tools (4th ed.). Mc Graw-Hill Education, p. 483.

Beldagli, B., & Adiguzel, T. (2010). Illustrating an ideal adaptive e-learning: A conceptual framework. *Procedia Social and Behavioral Sciences, 2*, 5755–5761.

Bolliger, D. U., Supanakorn, S., & Boggs, C. (2010). Impact of podcasting on student motivation in the online learning environment. *Computers & Education, 55*, 714–722.

Cantoni, V., Cellario, M., & Porta, M. (2004). Perspectives and challenges in e-learning: Towards natural interaction paradigms. *Journal of Visual Languages and Computing, 15*, 333–345.

Chang, T-Y., & Chen, Y-T. (2009). Cooperative learning in e-learning: A peer assessment of student-centered using consistent fuzzy preference. *Expert Systems with Applications, 36*, 8342–8349.

Chen, K. C., & Jang, S. J. (2010). Motivation in online learning: Testing a model of self-determination theory. *Computers in Human Behavior, 26*, 741–752.

Chen, P. S. D., Lambert, A. D., & Guidry, K. R. (2010). Engaging online learners: The impact of Web-based learning technology on college student engagement. *Computers & Education, 54*, 1222–1232.

Chiu, C. M., & Wang, E. T. G. (2008). Understanding Web-based learning continuance intention: The role of subjective task value. *Information & Management, 45*, 194–201.

Choi, D. H., Kim, J., & Kim, S. H. (2007). ERP training with a web-based electronic learning system: The flow theory perspective. *International Journal of Human–Computer Studies, 65*, 223–243.

Chou, J. R., & Hsiao, S. W. (2007). A usability study on human–computer interface for middle-aged learners. *Computers in Human Behavior, 23*, 2040–2063.

Choudhury, V., & Karahanna, E. (2008). The relative advantage of electronic channels: A multidimensional view. *MIS Quarterly, 32*(1), 179–200.

Cukusic, M., Alfirevic, N., Granic, A., & Garaca, Z. (2010). E-Learning process management and the e-learning performance: Results of a European empirical study. *Computers & Education, 55*, 554–565.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9–30.

Despont-Gros, C., Mueller, H., & Lovis, C. (2005). Evaluating user interactions with clinical information systems: A model based on human–computer interaction models. *Journal of Biomedical Informatics, 38*, 244–255.

Díez, E., & McIntosh, B. S. (2009). A review of the factors which influence the use and usefulness of information systems. *Environmental Modelling & Software, 24*, 588–602.

Duan, Y., He, Q., Feng, W., Li, D., & Fu, Z. (2010). A study on e-learning take-up intention from an innovation adoption perspective: A case in China. *Computers & Education, 3*, 1–10.

EL-Deghaidy, H., & Nouby, A. (2008). Effectiveness of a blended e-learning cooperative approach in an Egyptian instructor education programme. *Computers & Education, 51*, 988–1006.

Fang, L. (2007). Perceiving the Useful, Enjoyable and Effective: A case study of the e-learning experience of tertiary students in Singapore. *Educational Media International, 44*(3), 237–253.

Fardoun, H., Montero, F., & Jaquero, V. L. (2009). eLearniXML: Towards a model-based approach for the development of e-Learning systems considering quality. *Advances in Engineering Software, 40*, 1297–1305.

Ferdousi, B. J. (2009), A Study of Factors that Affect Instructors' Intention to Use E-Learning Systems in Two-Year Colleges, PhD. Thesis, Nova Southeastern University.

Garrity, E. J., Glassberg, B., Kim, Y. J., Sanders, G. L., & Shin, S. K. (2005). An experimental investigation of Web-based information systems success in the context of electronic commerce. *Decision Support Systems, 39*, 485–503.

Gonzalez, J. A., Jover, L., Cobo, E., & Munoz, P. (2010). A web-based learning tool improves student performance in statistics: A randomized masked trial. *Computers & Education, 55*, 704–713.

Govindasamy, T. (2002). Successful implementation of e-learning pedagogical considerations. *Internet and Higher Education, 4*, 287–299.

Graft, F. (2002). Providing security for e-learning. *Computers & Graphics, 26*, 355–365.

Henley, B. F. (2009), Developing eLearning: A Case Study of Tennessee High School, PhD. Thesis. East Tennessee State University.

Hwang, Y., & Kim, D. J. (2007). Customer self-service systems: The effects of perceived Web quality with service contents on enjoyment, anxiety, and e-trust. *Decision Support Systems, 43*, 746–760.

Ho, C. L., & Dzeng, R. J. (2010). Construction safety training via e-Learning: Learning effectiveness and user satisfaction. *Computers & Education, 55*, 858–867.

Holsapple, C. W., & Lee-Post, A. (2006). Defining, assessing, and promoting e-learning success: An information systems perspective. *Decision Sciences Journal of Innovative Education, 4*(1), 67–85.

Hutchins, H. M., & Hutchison, D. (2008). Cross-disciplinary contributions to e-learning design: A tripartite design model. *Journal of Workplace Learning, 20*(5), 364–380.

Jia, Haiyang., Wang, Minhong., Ran, Weijia., Yang, Stephen J. H., Liao, Jian., & Chiu, Dickson K. W. (2011). A model for measuring e-learning systems success in universities. *Expert Systems with Applications, 38*, 3372–3382.

Johnston, J., Killion, J., & Oomen, J. (2005). Student satisfaction in the virtual classroom. *The international journal of Allied Health Sciences and Practice, 3*(2), 1–7.

Kanuka, H., & Anderson, T. (2007). Ethical issues in qualitative e-learning research. *International Journal of Qualitative Methods, 6*(2), 1–14.

Kember, D., McNaught, C., Chong, F. C. Y., Lam, P., & Cheng, K. F. (2010). Understanding the ways in which design features of educational websites impact upon student learning outcomes in blended learning environments. *Computers & Education, 55*, 1183–1192.

Kerr, M. S., Rynearson, K., & Kerr, M. C. (2006). Student characteristics for online learning success. *Internet and Higher Education, 9*, 91–105.

Khan, B. H. (2005). Learning features in an open, flexible, and distributed environment. *AACE Journal, 13*(2), 137–153.

Law, K. M. Y., Lee, V. C. S., & Yu, Y. T. (2010). Learning motivation in e-learning facilitated computer programming courses. *Computers & Education, 55*, 218–228.

Lee, B. C., Yoon, J. O., & Lee, I. (2009). Learners' acceptance of e-learning in South Korea: Theories and results. *Computers & Education, 53*, 1320–1329.

Lee, J. K., & Lee, W. K. (2008). The relationship of e-Learner's self-regulatory efficacy and perception of e-Learning environmental quality. *Computers in Human Behavior, 24*, 32–47.

Lee, M. C. (2010). Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model. *Computers & Education, 54*, 506–516.

Liebowitz, Jay., & Frank, Michael. S. (2011). The synergy between knowledge management and e-learning. In: Jay Liebowitz & Michael S. Frank (Eds.), *Knowledge Management and e-Learning*. CRC Press.

Lim, H., Lee, S-G., & Kichan, N. (2007). Validating e-learning factors affecting training effectiveness. *International Journal of Information Management, 27*, 22–35.

Lin, H. F. (2007). Measuring Online Learning Systems Success: Applying the Updated DeLone and McLean Model. *Cyberpsychology & Behavior, 10*(6), 817–820.

Lin, H. F., & Lee, G. G. (2006). Determinants of success for online communities: An empirical study. *Behaviour & Information Technology, 25*(6), 479–488.

Lin, W. T., & Shao, B. B. M. (2000). The relationship between user participation and system success: A simultaneous contingency approach. *Information & Management, 37*, 283–295.

Lonn, S., & Teasley, S. D. (2009). Saving time or innovating practice: Investigating perceptions and uses of learning management systems. *Computers & Education, 53*, 686–694.

McGill, T. J., & Klobas, J. E. (2009). A task–technology fit view of learning management system impact. *Computers & Education, 52*, 496–508.

Molla, A., & Licker, P. S. (2001). E-commerce systems success: An attempt to extend and respecify the DeLone and McLean model of IS success. *Journal of Electronic Commerce Success, 2*(4), 1–11.

Monahan, T., McArdle, G., & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education, 50*, 1339–1353.

Muylle, S., Moenaert, R., & Despontin, M. (2004). The conceptualization and empirical validation of web site user satisfaction. *Information & Management, 41*, 543–560.

Naveh, G., Tubin, D., & Pliskin, N. (2010). Student LMS use and satisfaction in academic institutions: The organizational perspective. *Internet and Higher Education, 13*, 127–133.

Ngai, E. W. T., Poon, J. K. L., & Chan, Y. H. C. (2007). Empirical examination of the adoption of WebCT using TAM. *Computers and Education, 48*(2), 250–267.

O'Dell, T. (2009), generational differences in satisfaction with e-learning environment, PhD. Thesis. College of Education University of Houston.

Ozkan, S., & Koseler, R. (2009). Multi-dimensional students' evaluation of e-learning systems in the higher education context: An empirical investigation. *Computers & Education, 53*, 1285–1296.

Oztekin, A., Kong, Z. J., & Uysal, O. (2010). UseLearn: A novel checklist and usability evaluation method for eLearning systems by criticality metric analysis. *International Journal of Industrial Ergonomics, 40*, 455–469.

Parker, M. A., & Martin, F. (2010). Using virtual classrooms: Student perceptions of features and characteristics in an online and a blended course. *MERLOT Journal of Online Learning and Teaching, 6*(1), 135–147.

Petter, S., & McLean, E. R. (2009). A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level. *Information & Management, 46*, 159–166.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly, 25*(4), 401–426.

Pituch, K. A., & Lee, Y. K. (2006). The influence of system characteristics on e-learning use. *Computers & Education, 47*, 222–244.

Rabaa'i, A. A. (2009). Assessing information systems success models: Empirical comparison (Research in Progress). In *20th Australian Conference on Information Systems, 2–4 Dec 2009, Melbourne*. Available from: <http://www.infotech.monash.edu/about/news/conferences/acis09/Proceedings/pdf/044.pdf>, [retrieved Oct. 2010].

Selim, H. M. (2007). Critical success factors for e-learning acceptance: Confirmatory factor models. *Computer & Education, 49*, 396–413.

Shee, D. Y., & Wang, Y. S. (2008). Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its applications. *Computers & Education, 50*, 894–905.

Sheng, Z., Jue, Z., & Weiwei, T. (2008). Extending TAM for Online Learning Systems: An Intrinsic Motivation Perspective. *Tsinghua science and technology, 13*(3), 312–317.

Shih, H. (2008). Using a cognitive-motivation-control view to assess the adoption intention for Web-based learning. *Computer & Education, 50*, 327–337.

SØrebØ, Ø., Halvari, H., Gulli, V. F., & Kristiansen, R. (2009). The role of self determination theory in explaining instructors' motivation to continue to use e-learning technology. *Computers & Education, 53*, 1177–1187.

Ssemugabi, S. (2006), Usability evaluation of a web-based e-learning application: a study of two evaluation methods, thesis of Master. University Of South Africa.

Stalling, D. (2002). Measuring success in the virtual university. *The Journal of Academic Librarianship, 28*(1), 47–53.

Sun, P.-C., Cheng, H. K., & Finger, G. (2009). Critical functionalities of a successful e-learning system–An analysis from instructors' cognitive structure toward system usage. *Decision Support Systems, 48*, 293–302.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). what drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education, 50*, 1183–1202.

Turban, E. (1993). *Decision support and expert systems: Management support systems*. Macmillan Publishing Company.

Vernadakis, N., Antoniou, P., Giannousi, M., Zetou, E., & Kioumourtzoglou, E. (2011). Comparing hybrid learning with traditional approaches on learning the Microsoft Office Power Point 2003 program in tertiary education. *Computers & Education, 56*, 188–199.

Volery, Th., & Lord, D. (2000). Critical success factors in online education. *The International Journal of, Educational Management* (14/5), 216–223.

Wang, W. T., & Wang, C. C. (2009). An empirical study of instructor adoption of web-based learning systems. *Computers & Education, 53*, 761–774.

Wang, Y. S., & Liao, Y.-W. (2008). Assessing e-Government systems success: A validation of the Delone and Mclean model of information systems success. *Government Information Quarterly, 25*(4), 717–733.

Wang, Y. S., Wang, H. Y., & Shee, D. Y. (2007). Measuring e-learning systems success in an organizational context: Scale development and validation. *Computers in Human Behavior, 23*(1), 1792–1808.

Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. *Academy of Management Journal, 40*(6), 1282–1309.

Wrzesien, M., & Raya, M. A. (2010). Learning in serious virtual worlds: Evaluation of learning effectiveness and appeal to students in the e-junior project. *Computers & Education, 55*, 178–187.

Wu, J. H., Tennyson, R. D., & Hsia, T. L. (2010). A study of student satisfaction in a blended e-learning system environment. *Computers & Education, 55*, 155–164.

Wu, J. H., & Wang, Y. M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. *Information & Management, 43*, 728–739.

Zaïane, O. R. (2002). Building a recommender agent for e-learning systems. In *Proceedings of the International Conference on Computers in Education (ICCE'02), IEEE*.