Developing a new framework for evaluating e-learning systems: integrating BSC and FAHP

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Abstract
Purpose – E-learning is one area of strategic application of information technology (IT) in the educational field. In the past, massive investments in e-learning systems have neither been necessarily effective nor created value for e-learners. As a result, e-learning systems’ evaluation has become critical. Although many researchers have studied e-learning’s performance evaluation, there is little research on e-learning assessment, which uses pedagogical principles and organizational issues along with information systems (ISs) assessment measures. Thus, the purpose of this study is to consolidate multi-dimensional aspects of e-learning evaluation by applying balanced scorecard (BSC) as a strategic performance measurement method. This study further seeks a solution for designing a systematic approach, in which three equally important considerations must be balanced: organization, pedagogy and technology.

Design/methodology/approach – This paper introduces a framework for assessing e-learning systems by using fuzzy analytic hierarchy process (FAHP) and BSC. Owing to the growing use of BSC in strategic management, this study applies its four perspectives as a base for performance evaluation. To identify measures of each perspective, a comprehensive literature review has been conducted. Modifying the list of measures is completed in two phases: first by using a focus group consisting of six e-learning experts, and second, by using a survey analysis conducted among 256 Iranian e-learners. FAHP is applied to weigh and determine the rank-order of the measures.

Findings – The results propose integrating pedagogical, organizational and technical measures based on the BSC framework for evaluating e-learning systems. In the proposed framework, effective BSC perspectives and their rank-orders and weights are presented as a guideline for assessing e-learning systems in Iran.

Research implications – In e-learning initiatives, organizational issues must be considered along with technological and pedagogical factors simultaneously. The proposed framework can assist educational institutions and organizations to identify weaknesses and strengths of e-learning projects and guide them to select appropriate strategies for progress.

Originality/value – A review of the e-learning literature shows that there are few substantive theoretical accounts, which adequately integrate multiple dimensions of e-learning evaluation; yet, most researchers view e-learning evaluation as the most difficult part in the e-learning implementation process. This study proposes a new conceptual framework to evaluate e-learning initiatives systematically. The main contribution of this study is to develop a new systematic approach for e-learning systems’ evaluation that integrates two well-established managerial methodologies (BSC and FAHP), and considers pedagogical, organizational and technological aspects synchronously.

Keywords E-learning, Information systems’ evaluation, Pedagogical principles, Balanced scorecard (BSC), Fuzzy analytic hierarchy process (FAHP)

Paper type Research paper
1. Introduction

E-learning systems are viewed as enablers in learning processes and as facilitators of educational strategy achievements (Jafari Navimipour and Zareie, 2015; Sun et al., 2008). Academics and practitioners consider e-learning systems to be a valuable knowledge-sharing and transfer tool (Loureiro and Bettencourt, 2014; Wang et al., 2007) which enhances organizational performance and innovation capabilities (Jafari Navimipour and Charband, 2016). E-learning has been viewed synonymous with Web-based learning, online learning, advanced distributed learning, open/flexible learning, internet-based learning, e-training or Web-based instruction (Jafari Navimipour and Zareie, 2015; Mosakhani and Jamporazmey, 2010). Using electronically based approaches, learning and training can be conducted anywhere, anytime and at any pace (Baylari and Montazer, 2009; Chang, 2016). Organizations and educational institutions worldwide prefer e-learning systems because they offer cost-effective and valuable learning approach to enhance and deliver more flexible learning (Chang, 2016; Mosakhani and Jamporazmey, 2010; Singh and Hardaker, 2014).

The learning management systems’ (LMSs) market was worth $2.55bn in 2013 with an estimated compound annual growth rate of approximately 25.2 per cent, and it is expected to rise to approximately $7bn in 2018 (e-learning industry, 2015). Despite huge investment in these systems, failures still exist (Sun et al., 2008). So, the contribution of e-learning systems in enhancing the productivity and improving educational achievements is questionable. One major reason for the productivity paradox of e-learning systems may be the inadequate methods applied in measuring the e-learning systems’ value and performance. Wang et al. (2007) assert that for e-learning applications to be used effectively, we need reliable methods to evaluate the performance of e-learning systems (Wang et al., 2007). On the other hand, e-learning evaluation is complex because it must integrate four distinct domains: learning evaluation, IT improvement, project management and organizational management (Chiu and Sheng, 2008).

In another view, evaluation of e-learning implementations is always a difficult activity (Dittler et al., 2005) owing to the various stockholders to deal with in such systems, and few studies consider multi-dimensional aspects of e-learning, such as different views like those of students and instructors, as well as institutional benefits and management support in evaluation. This study attempts to partially fill the above gap by reducing such complexity.

Reviewing the e-learning system assessment studies reveals that there are not many multidisciplinary e-learning systems studies (Ozkan and Koseler, 2009). The factors affecting e-learning performance presented by previous researchers are basically around certain dimensions (Ozkan and Koseler, 2009; Sun et al., 2008). Although many studies have discussed learning systems, most of them have focused on the learning emotion, learning style, educational content and technology (Jafari Navimipour and Zareie, 2015). Therefore, there is limited research exploring significant factors related to the e-learning systems’ assessment that incorporates technological, pedagogical and institutional aspects simultaneously. Consequently, there is a need for a systematic and logical scientific evaluation framework to assist decision-makers in e-learning initiatives to identify critical aspects and achieve the optimum outputs. Such a framework helps managers to:

- evaluate e-learning systems’ success and identify their weakness aspects;
- encourage project team to focus on the most important issues; and
- justify making more investment on e-learning projects.
So, the primary objective of this paper is to introduce a systematic and comprehensive assessment framework for e-learning systems. The balanced scorecard (BSC) is a hybrid performance measurement framework that provides an integrated look at the performance by a set of financial and non-financial measures; considers internal and external, as well as quantitative and qualitative measures, as it seems to be a good solution (Lee et al., 2008). Four perspectives of BSC that need to be balanced in evaluation are: financial perspective as a lagging indicator and customer, internal business process and learning and growth perspectives as leading indicators (Varmazyar et al., 2016). Possibly, the BSC is a suitable approach to assess e-learning systems, and consequently, overcome the problem of productivity paradox. Although multiple perspectives and measures may better represent the multifaceted nature of the phenomenon, they pose several difficulties:

- possible need to assign non-equal priorities to perspectives and to performance indicators within each perspective;
- need to account for mutually inconsistent results; and
- need to design an aggregated metric that would somehow summarize the whole story of success (or failure thereof) (Bentes et al., 2012).

One method that can address the complex issues of a balanced system of performance assessment is the analytic hierarchy process (AHP) developed by Saaty. Fuzziness and vagueness are common characteristics in many decision-making problems, and a fuzzy AHP (FAHP) method is capable to tolerate vagueness and ambiguity (Patil and Kant, 2016). The widespread applications of FAHP in the literature prove the capability of the method (Abdullah and Zulkifli, 2015; Akkaya et al., 2015; Keprate and Ratnayake, 2016). Besides, the successful integration of BSC-AHP or FAHP is seen in many fields (Bentes et al., 2012; Galankashi et al., 2016; Lee et al., 2008); however, the gap is notable in the e-learning evaluation studies.

The contribution of this paper rests on the attempt to address the main indicators of evaluating e-learning systems based on technical, pedagogical and organizational criteria and weighting them— in particular, how to:

- make sense of multiple (and often mutually conflicting) perspectives and measures of the e-learning systems;
- prioritize those perspectives;
- reach some synthesized assessment; and
- rank the performance level of alternative e-learning systems under comparative evaluation.

The remainder of this paper is organized as follows: in Section 2, related studies about e-learning, e-learning systems’ evaluation, BSC, fuzzy set theory (FST) and FAHP are reviewed. Also some related literatures of pedagogical and organizational issues are mentioned in this Section. In Section 3, research methodology is discussed. The proposed model is presented in Section 4. Conclusion and suggestions are declared in Section 5. Finally, practical and theoretical implications are discussed in Section 6.

2. Literature review
The aim of the literature review is to identify the knowledge gap and the appropriate measures needed to develop the e-learning BSC framework. In this Section, first the
concepts of e-learning and e-learning systems as well as BSC are discussed. Three different areas are explored to exploit a comprehensive BSC measures covering technological, pedagogical and institutional aspects. Figure 1 shows the areas where the review has been conducted. The related references to indicate the reason of investigating the area are also shown in this figure.

2.1 E-learning and e-learning systems
In the past, the use of online resources has successfully facilitated learning and training activities in the field of education (Chang, 2016; Mohammadi, 2015). Learning is no longer restricted to traditional classrooms with limited time and space (Jafari Navimipour and Zareie, 2015; Wang et al., 2007). E-learning can be defined as an application of technology as a mediating tool for learning, which enables students to readily access information and interact with others online (Mohammadi, 2015; Singh and Hardaker, 2014). Grubisic et al. (2009) regard e-learning systems as a type of information system (IS) that provides access to electronically based learning resources anywhere and at any time for anyone (Grubisic et al., 2009). E-learning systems are IT-based systems, which allow students to not only download materials but also share relevant experiences and knowledge with other colleagues (Jafari Navimipour and Zareie, 2015). Chang (2016) identifies some advantages and disadvantages of the e-learning systems (Table I).

Owing to budget-constrained and competitive environment of educational institutions, IS practitioners are under pressure to show the business value of e-learning systems for learning processes. E-learning evaluation assists educational institutions and organizations to identify areas that need to be changed, improved or adapted.

2.2 Balanced scorecard
Among the most important frameworks in the management science, BSC merits intense research attentions (Hoque, 2014). Increasing the use of the BSC framework in many recent studies in various management and the IS fields such as supply chain management (SCM) (Bhagwat and Sharma, 2007), IT project selection (Asosheh et al., 2010) and implementation of city development strategy (Rasoolimanesh et al., 2015) has some reasons.

![Figure 1. Research literature review domains for developing BSC](image-url)
Compared with traditional measurement systems that only include financial measures, BSC is designed to improve managers’ decisions by guiding their attention to a broader vision of the company’s operations (Jam porazmey and Mehrafrouz, 2012). Furthermore, as a holistic performance measurement system, BSC provides causal links that connect the multiple classes of non-financial measures to the financial measures (Bhagwat and Sharma, 2007; Wong-On-Wing et al., 2007). In this paper, considering the mass application of BSC for strategic management issues, we have applied it as a base for evaluating e-learning systems.

2.3 IS evaluation and e-learning evaluation

As e-learning systems are a type of ISs, e-learning evaluating models have been developed based on IS success along with pedagogical and institutional studies (Islam, 2012; Mohammadi, 2015).

Owing to the complicated, interrelated and multi-faceted nature of IS success (Mohammadi, 2015), numerous IS success/evaluation models have been introduced; some of them are presented in Table II.

The need for measuring an e-learning system’s achievement of its objectives has derived many studies to exploit appropriate evaluation factors. Table III shows some studies related to the recognition of e-learning evaluation measures.

Most of the studies presented in Table III have focused on the technological aspects of the system quality, and just a few of them have considered pedagogical and institutional issues in developing e-learning evaluation models. In addition, to the best of our knowledge, only a limited number of published works have applied the BSC framework. Finally, earlier studies of e-learning have not considered e-learning systems’ consequences for educational institutions and business. However, until now, there is no study in e-learning evaluation, which uses technical, pedagogical and institutional measures in the four BSC dimensions in an integrated manner. The four BSC dimensions include financial, e-learner, internal process and learning and growth. This research attempts to fill this theoretical gap.

2.4 Pedagogical and organizational dimensions

Granic et al. (2009) clarified that the contribution of information and communication technology (ICT) needs to be mediated by educational and organizational issues. The organizational dimension relates to not only the e-learning strategy formulation, selection of

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>E-learning saves costs</td>
<td>More instructor effort is required</td>
</tr>
<tr>
<td>E-learning improves learning</td>
<td>Online courses take 20-40% more time and effort than traditional courses</td>
</tr>
<tr>
<td>Learners can get the best instruction available</td>
<td>Converting existing classrooms to online courses has proven harder than many designers expected</td>
</tr>
<tr>
<td>Learners set the pace and schedule</td>
<td>E-learning is often used as a type of distance learning and distance learning is “impersonal” due to the lack of face-to-face contact</td>
</tr>
<tr>
<td>Training adapts to the learning styles</td>
<td>Fear of the technology</td>
</tr>
<tr>
<td>Instructors can teach from different locations</td>
<td></td>
</tr>
<tr>
<td>Instructors travel less</td>
<td></td>
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<tr>
<td>Course content can be dynamic</td>
<td></td>
</tr>
<tr>
<td>E-learning delivers high-quality training, including training around the globe without travel</td>
<td></td>
</tr>
<tr>
<td>E-learning creates valuable learning resources</td>
<td></td>
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</tbody>
</table>

Source: Adapted from Chang (2016)
trainees and instructors, extracting their knowledge requirements and issuing evaluations and so on, but also provide support by creating space and time for learning (Welle-Strand and Thune, 2003). In this study, we consider return on investment and reducing cost as organizational concerns.

From a pedagogical perspective, an e-learning system development, which addresses some important pedagogical principles, will enable instructors to apply the learning resources in a way suited to learning objectives and special learning style of the learners (Granic et al., 2009). There is a serious mismatch between the enormous features available in the e-learning systems and the lack of pedagogy required to be integrated with these systems. This omission, if not resolved, may ultimately lead to putting away e-learning from the educational world. One of the most crucial prerequisites for successful implementation of e-learning is the need for careful consideration of the underlying pedagogy or how learning takes place online (Govindasamy, 2002; Welle-Strand and Thune, 2003; Littig, 2006). Rubens et al. (2005) recognize several pedagogical principles to be considered in e-learning development such as designing for flexibility and modularity, facilitating knowledge building, progressive inquiry, tutoring in progressive inquiry, providing tools for structuring and coordinating activity, designing tools for process analysis and providing support for community building (Rubens et al., 2005). Some of the adverse effects of not considering pedagogical principles are resistance by universities toward change, learners staying away from the e-learning courses, poor performance of trainees, poor quality of content and so on (Govindasamy, 2002). Littig (2006) states that e-learning vendors often ignore fundamental pedagogical issues such as:

- learning is a social process;
- learning is basically a self-guided process;
- learning is an individual process; and
- adult learners have clear goals in mind.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Factors</th>
<th>Research method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbaugh (2000)</td>
<td>Perceived usefulness, perceived ease of use, flexibility of e-learning, interaction with class participants, student usage, and gender</td>
<td>Survey</td>
</tr>
<tr>
<td>Piccoli et al. (2001)</td>
<td>Design dimensions: learning model, technology, learner control, content, and interaction&lt;br&gt;Human dimensions: students and instructors</td>
<td>Longitudinal field experiment</td>
</tr>
<tr>
<td>Arbaugh and Duray (2002)</td>
<td>Perceived usefulness, perceived ease of use, and perceived flexibility</td>
<td>Multi case study</td>
</tr>
<tr>
<td>Wang et al. (2007)</td>
<td>System quality, information quality, service quality, system use, user satisfaction, net benefits</td>
<td>Survey</td>
</tr>
<tr>
<td>Sun et al. (2008)</td>
<td>Learner's attitude toward computers, learner computer anxiety, learner's internet self-efficacy, instructor's response timeliness, instructor's attitude toward e-learning, E-learning course flexibility, e-learning course quality, technology quality, internet quality, perceived usefulness, perceived ease of use, diversity in assessment, and learner's perceived interaction with others</td>
<td>Survey</td>
</tr>
<tr>
<td>Shee and Wang (2008)</td>
<td>Ease of use, user-friendliness, ease of understanding, operational stability, Ease of discussion with other learners, ease of discussion with teachers, ease of accessing shared data, ease of exchanging learning with the others, up-to-date content, sufficient content, useful content, capability of controlling the learning progress, capability of recording learning performance</td>
<td>Empirical study by AHP</td>
</tr>
<tr>
<td>Ozkan and Koseler (2009)</td>
<td>System quality, service quality, content quality, learner's perspective, instructor's attitudes, and supportive issues</td>
<td>Survey</td>
</tr>
<tr>
<td>Ireland et al. (2009)</td>
<td>Site design driven by learner-centered pedagogy, assessment activities and feedback processes, student interaction and engagement, quality of online resources and supports, and academic management of site of a high standard that benefits student learning</td>
<td>Literature review</td>
</tr>
<tr>
<td>Mosakhani and Jamporazmey (2010)</td>
<td>Instructor’s attitude to student, instructor’s attitude to e-learning, instructor’s computer skill, student’s computer skill, student’s motivation, commitment, and learning speed, updated content, sufficient content, understandable content, Reliability, accessibility, degree of guidance, design of user interface, network security, timeliness, learning community, ease of interaction with together, providing financial support, proper feedback, diversity evaluation methods, and degree of applying knowledge management tools</td>
<td>Survey</td>
</tr>
<tr>
<td>Undo et al. (2011)</td>
<td>Assurance, empathy, responsiveness, reliability and website content</td>
<td>Survey</td>
</tr>
<tr>
<td>Islam (2012)</td>
<td>Perceived usefulness, confirmation of initial expectation, and system quality</td>
<td>Survey</td>
</tr>
<tr>
<td>Mohammadi (2015)</td>
<td>Educational quality, service quality, technical system quality, information quality, perceived ease usefulness, and perceived ease of use</td>
<td>Survey</td>
</tr>
<tr>
<td>Jafari Navimipour and Zareie (2015)</td>
<td>Educational technology: Learning system quality, availability of systems, knowledge use of the system, technical support system, easy to use system, user friendliness&lt;br&gt;Educational content: Content quality, content quantity of learning, spatial and temporal flexibility, effectiveness of content, working group&lt;br&gt;Motivation: Organizational promote, internal knowledge promotion, financial motives&lt;br&gt;Attitude: Internet use skills, personal experience, self-confidence and anxiety</td>
<td>Survey</td>
</tr>
</tbody>
</table>

Table III. Related e-learning evaluation studies
Based on the above-mentioned pedagogical principles, e-learning must make learners curious, motivate learners and provide for challenging the learning environment (Littig, 2006). What this study seeks to achieve is creating an integrated balance among the interacting organizational, technological and pedagogical considerations.

2.5 Fuzzy analytic hierarchy process

Being one of the multi-criteria decision-making methods, AHP enables the decision-maker to regard a certain hierarchy, make association between options and then make a choice. AHP has a mechanism that makes paired comparison of objective and nonobjective criteria, identifies the priorities among the criteria and consists of the significance of the criteria (Akkaya et al., 2015). Despite its widespread and successful application, AHP has always been criticized for its inability in managing uncertainty resulting from relating whole numbers to DM understandings. To resolve the issues, it is proposed to use the FST with AHP (Mangla et al., 2016). FAHP has been successfully applied in diverse applications (Abdullah and Zulkifli, 2015), and several FAHP approaches have been carried out in the past (Chou, et al., 2012; Csutora and Buckley, 2001; Laarhoveen and Pedrycz, 1983), but the one used in this manuscript is the extent analysis approach proposed by Chang in 1996 (Keprate and Ratnayake, 2016). The steps of Chang’s approach to handling fuzzy AHP are explained below (Besikci et al., 2016).

Let \( X = \{x_1, x_2, \ldots, x_n\} \) be an object set, and \( U = \{u_1, u_2, \ldots, u_n\} \) be a goal set. According to the method of Chang’s extent analysis, each object is taken, and extent analysis for each goal, \( g_i \), is performed. Therefore, \( M \) extent analysis values for each object can be obtained, with the following signs:

\[
M^1_{g_i}, M^2_{g_i}, \ldots, M^m_{g_i} \quad i = 1, 2, \ldots, n
\]

Where, all \( M^j_{g_i}, j = 1, \ldots, m \) are fuzzy triangular numbers.

**Step 1:** The value of fuzzy synthetic extent with respect to the \( i \)th object is defined as:

\[
s_i = \sum_{j=1}^{m} M^j_{g_i} \otimes \left[ \sum_{i=1}^{n} \sum_{j=1}^{m} M^j_{g_i} \right]^{-1}
\]

where:

\[
\sum_{j=1}^{m} M^j_{g_i} = \left( \sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right)
\]

\[
\sum_{i=1}^{n} \sum_{j=1}^{m} M^j_{g_i} = \left( \sum_{i=1}^{n} \sum_{j=1}^{m} l_i, \sum_{i=1}^{n} \sum_{j=1}^{m} m_i, \sum_{i=1}^{n} \sum_{j=1}^{m} u_i \right)
\]
and:

\[
\left( \sum_{i=1}^{n} \sum_{j=1}^{m} M_{ij} \right)^{-1} = \left( \sum_{i=1}^{n} \frac{1}{\sum_{j=1}^{m} M_{ij}} \right) \left( \sum_{i=1}^{n} \frac{1}{\sum_{j=1}^{m} M_{ij}} \right) \left( \sum_{i=1}^{n} \frac{1}{\sum_{j=1}^{m} M_{ij}} \right)
\]

(4)

**Step 2:** The degree of possibility of \( M_1 \geq M_2 \) is defined as:

\[
V(M_1 \geq M_2) = \sup_{x \geq y} \left[ \min \left( \mu_{M_1}(x), \mu_{M_2}(y) \right) \right]
\]

(5)

Because \( M_1 \) and \( M_2 \) are convex fuzzy numbers, then:

\[
V(M_1 \geq M_2) = 1 \text{ if } m_1 \geq m_2
\]

(6)

\[
V(M_2 \geq M_1) = \text{hgt}(M_1 \cap M_2) = \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}
\]

(7)

To compare \( M_1 \) and \( M_2 \), we need the values of both \( V(M_1 \geq M_2) \) and \( V(M_2 \geq M_1) \).

**Step 3:** The degree possibility for a convex fuzzy number to be greater than \( k \) convex fuzzy numbers \( M_i \) \((i = 1, 2, \ldots, k)\) can be defined as:

\[
V(M \geq M_{i_1}, M_{i_2}, \ldots, M_{i_k}) = V(M \geq M_{i_1}) \text{ and } (M \geq M_{i_2}) \text{ and } \ldots (M \geq M_{i_k}) = \min V(M \geq M_i)
\]

\( i = 1, 2, \ldots, k \)

(8)

Assume that \( d(A_i) = \min(S_i \geq S_k) \)

For \( k = 1, \ldots, n; k \neq i \), the weight vector is given by:

\[
W' = \left( d'(A_1), d'(A_2), \ldots, d'(A_n) \right)^T
\]

(9)

where, \( A_i \) \((i = 1, 2, \ldots, n)\) are \( n \) elements.

Via normalization, we get the normalized weight vectors as:

\[
W = \left( d(A_1), d(A_2), \ldots, d(A_n) \right)^T
\]

(10)

where, \( W \) is a no fuzzy number.

**3. Research methodology**

Instrument construction, data collection and sampling and reliability and validity of instrument are described in this section.

**3.1 Instrument construction**

The primary objective of this study was to develop a systematic novel framework for evaluating the performance of e-learning systems by integrating BSC and FAHP. For developing the proposed framework, four perspectives of BSC were applied, and then a list of performance evaluation indicators for each perspective was extracted from the related previous studies in the domain of IS evaluation, e-learning evaluation and pedagogical principles and organizational issues of e-learning. So, we tried to use different references for
developing the proposed framework and, in some cases, we used different aspects of e-learning initiatives from different references to create a comprehensive measurement instrument, which had the most fitness with our purpose.

As stated by Keramati et al. (2011), case studies and empirical researches are appropriate ways for IT research works. Therefore, this empirical research was done by means of questionnaires. Two different questionnaires were designed: one for evaluating the proposed framework from Iranian e-learners’ viewpoints and the second for weighting the BSC perspectives and indicators.

The first questionnaire that was developed based on the four perspectives of BSC and their extracted indicators was reviewed by six e-learning experts to be validated. Expert recommendations were incorporated into the list. The proposed BSC framework consisted of four perspectives: financial perspective, user perspective, internal process perspective and learning and growth perspective. The developed questionnaire included multi-item Likert scales, which had been widely used in the questionnaire-based perception studies. All variables were subjectively measured using the five-point Likert scale, with 5 being “Strongly agree” and 1 being “Strongly disagree”.

To obtain the relative importance of the four perspectives and the relative importance of the key performance indicators under each perspective, the second questionnaire was designed with a conventional FAHP questionnaire format based on the Chang’s pairwise comparison scale and hierarchy.

3.2 Data collection and sampling
Being aware of the importance and advantages of e-learning initiatives, many universities and firms have extensively invested on these projects and developed e-learning systems. Accordingly, this study initiated a survey to develop a novel comprehensive framework to evaluate e-learning systems. The survey was conducted in the four master universities of Iran, which had offered e-learning courses for more than eight years. The questionnaire was distributed among 256 e-learners via e-mail, and after continuous contacts with them, we eventually received 193 completed questionnaires after 6 weeks (respond rate of 75 per cent).

All the survey participants majored in one of the five disciplines (business management, management IS, financial management, law and engineering) offered by these four universities. In total, 74 per cent of the survey participants were in the age range of 17-30 years, 20 per cent of them were in the range of 30-40 years and 6 per cent of them were over 40 years. All of participants were enrolled in MA degree. Further, 83 per cent of the respondents had more than 1 year of Web-based education background. Feedbacks were analyzed through $t$-test to decide which indicators to keep for the next stage.

In the next step, to obtain the relative importance of the BSC perspectives and their indicators, a brainstorm session consisting of 12 e-learning experts was conducted. All suggested indicators were posted on a board. After two additional sessions, the participants reached a consensus as to the pairwise comparisons of perspectives and indicators. An FAHP program was developed to simplify the calculations of weights for each perspective and its performance indicators based on pairwise comparison matrix.

The rationale for choosing FAHP was that it is suitable for dealing with complex systems related to making a choice among several alternatives and provides a comparison of the considered options. Its fuzzy aspect deals with the uncertainty and vagueness as well as imprecision of human decision-making in daily life. This approach is well suited to group decision-making, and it offers numerous benefits as a synthesizing mechanism with other methodologies such as BSC.
3.3 Validity and reliability of scale

To analyze the content validity of the current research, six academic experts viewed all items separately on the questionnaire for their content, scope and purpose. These experts had either possessed practical experiences in learning systems development or have had theoretical contribution to this field, or both. This pre-test led to some modifications in the survey questionnaire.

Reliability of each variable was evaluated by assessing the internal consistency of the items representing each construct using Cronbach’s alpha. The reliability of all perspectives exceeded 0.7, above the conventional acceptable level. The total reliability was 0.87.

So, the required data were gathered from different sources including different stakeholders involved with the e-learning system of Iran such as e-learning experts and e-learners. Therefore, the use of triangulation in terms of data is seen in the process of the research.

4. Findings

The data collected from different stakeholders were analyzed using different methods such as focus group, t-test and FAHP. So, we had triangulation in terms of methods too. The findings are presented in the following sections. The preliminary list of BSC perspectives and indicators according to the literature review and the focus group of experts is presented in Section 4.1. Section 4.2 represents the modified list of perspectives using e-learners’ viewpoints. The final ranking of the perspectives and indicators using the FAHP method and according to the experts’ opinion is discussed in Section 4.3.

4.1 Preliminary BSC for e-learning

Steps 1-2: Based on the concept of BSC, and by reviewing the e-learning evaluation literature and contacting with the experts, an e-learning performance evaluation hierarchy was constructed. To determine the related area of each indicator, a focus group of six e-learning experts was formed. The hierarchy, the related areas and the most important sources are presented in Table IV.

4.2 Modified BSC for e-learning

Step 3: After survey analysis and application of t-test, two indicators including “coordination” and “enhancing learner autonomy” were not confirmed and were eliminated from the list. So, the final framework, based on BSC, and related metrics extracted from IS/IT, e-learning and pedagogical field are discussed in detail.

4.2.1 Financial perspective. In this perspective, financial outputs that the e-learning system brings to the organization are measured. Financial performance measures indicate whether the implementation of IS (or the e-learning system) improves operational-level effectively. Financial metrics include profitability, revenue growth, cash flow, return on investment (ROI) and maximizing the stakeholders’ wealth. This perspective measures the financial success of learning centers related to applying e-learning systems. Metrics used in this perspective are revenue growth and reducing the cost of learning.

4.2.2 E-learner perspective. This perspective is concerned about the value offered to the e-learning users. User perspective refers to the degree by which the users’ needs are met. It focuses on the satisfaction of e-learners and teachers. When the users of a specific system are determined, its owners can specify objects and metrics for creating value to the users. Value offering to the users determines the e-learning system’s strategies related to the e-learners by describing services, communication of the users with the system and benefits are provided to the user groups. Some measures in these perspectives include: self-
<table>
<thead>
<tr>
<th>Perspective</th>
<th>Criteria</th>
<th>Related area</th>
<th>Pedagogical</th>
<th>Organizational</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial perspective</strong></td>
<td>Revenue growth</td>
<td>*</td>
<td></td>
<td></td>
<td>Kaplan and Norton (2004); Jafari Navimipour and Zareie (2015); Wu &amp; Chen (2014)</td>
</tr>
<tr>
<td></td>
<td>Reducing the cost of learning</td>
<td>*</td>
<td></td>
<td></td>
<td>Seddon et al. (1999); Marakas (2004); Wang et al. (2007); Jafari Navimipour &amp; Zareie (2015); Zareie &amp; Jafari Navimipour (2016)</td>
</tr>
<tr>
<td><strong>E-learner perspective</strong></td>
<td>self-evaluation tools</td>
<td>*</td>
<td></td>
<td></td>
<td>Ireland et al. (2009); Beetham and Sharpe (2007); Granic et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>E-learner motivation</td>
<td>*</td>
<td></td>
<td></td>
<td>Littig (2006); Muilenburg and Berge (2005); Ozkan and Koseler (2009); Jafari Navimipour &amp; Zareie (2015); Granic et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>Content quality</td>
<td>*</td>
<td>*</td>
<td></td>
<td>Ozkan and Koseler (2009); Wang et al. (2007); Shee &amp; Wang (2008); Jafari Navimipour and Zareie (2015); Ireland et al. (2009); Zareie &amp; Jafari Navimipour (2016)</td>
</tr>
<tr>
<td></td>
<td>Degree of e-learners' interactions (with instructors and other student)</td>
<td>*</td>
<td>*</td>
<td></td>
<td>Arbaugh (2000); Shee and Wang (2008); Ireland et al. (2009); Govindasamy (2002); Ozkan &amp; Koseler (2009); Sun et al. (2008)</td>
</tr>
<tr>
<td></td>
<td>User-friendliness</td>
<td>*</td>
<td></td>
<td></td>
<td>Shee and Wang (2008); Arbaugh (2000); Arbaugh and Duray (2002); Jafari Navimipour and Zareie (2015); Wang et al. (2007); Holsapple and Lee-Post (2006)</td>
</tr>
<tr>
<td></td>
<td>Promote educational institution's image and reputation</td>
<td></td>
<td></td>
<td>*</td>
<td>Wu and Chen (2014); Wang et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>Personalized learning</td>
<td>*</td>
<td></td>
<td></td>
<td>Wang et al. (2007); Baylari and Montazer (2009); Mohammadi (2015); Lee et al. (2009); Ozkan and Koseler (2009); Zareie and Jafari Navimipour (2016)</td>
</tr>
<tr>
<td><strong>Internal process perspective</strong></td>
<td>Defect ratio</td>
<td>*</td>
<td></td>
<td></td>
<td>Pietrantonio (2007); Kan (2002)</td>
</tr>
<tr>
<td></td>
<td>Degree of downtime</td>
<td>*</td>
<td></td>
<td></td>
<td>Marakas (2004); Sun et al. (2008); Piccoli et al. (2001); Mohammadi (2015); Johnson et al. (2009); Kan (2002)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
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<th>Criteria</th>
<th>Related area</th>
<th>Sources</th>
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<tr>
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<tr>
<td></td>
<td></td>
<td>Pedagogical</td>
<td>Holsapple and Lee-Post (2006); Sun et al. (2008)</td>
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<tr>
<td></td>
<td></td>
<td>Organizational</td>
<td>Ireland et al. (2009); Mosakhani and Jamporazmey (2010); Wang et al.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sources</td>
<td>(2007); Ozkan and Koseler (2009)</td>
</tr>
<tr>
<td></td>
<td>Security</td>
<td>*</td>
<td>Piccoli et al. (2001); Marakas (2004); Mohammadi, (2015); Selim (2007);</td>
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<td></td>
<td></td>
<td></td>
<td>Holsapple and Lee-Post (2006); Sun et al. (2008)</td>
</tr>
<tr>
<td>Learning and growth</td>
<td>Online technical assistance/guidance</td>
<td>*</td>
<td>Pietrantonio (2007); Kan (2002)</td>
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<tr>
<td>perspective</td>
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<td></td>
<td>Rubens et al. (2005); Beetham and Sharpe (2007)</td>
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<tr>
<td></td>
<td>Accessibility</td>
<td>*</td>
<td>Hwang and Xu (2007); Obrien (2013)</td>
</tr>
<tr>
<td></td>
<td>Degree of app support</td>
<td>*</td>
<td>Mosakhani and Jamporazmey (2010); Jafari Navimipour and Zareie (2015);</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td></td>
<td>Kaplan and Norton (2004); Wu and Chen (2014); Holsapple and Lee-Post</td>
</tr>
<tr>
<td></td>
<td>Scalability</td>
<td>*</td>
<td>(2006)</td>
</tr>
<tr>
<td></td>
<td>Improving the capabilities of</td>
<td>*</td>
<td>Pietrantonio (2007); Wang et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>knowledge management</td>
<td></td>
<td>Wu and Chen (2014), Wang et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>Degree of offering new services to</td>
<td>*</td>
<td>Granic et al. (2009); Littig (2006); Sun et al. (2008); Lee et al.</td>
</tr>
<tr>
<td></td>
<td>learners</td>
<td></td>
<td>(2008)</td>
</tr>
<tr>
<td></td>
<td>Increasing market share</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Enhancing learner autonomy</td>
<td>*</td>
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</table>
evaluation tools, e-learner motivation, content quality, degree of e-learners’ interactions (with instructors, other students and system), user friendliness, promotion of the educational institutions’ image and reputation and personalized learning.

These measures are related to the following question:

Q1. Does the selected e-learning approach actually ensure a higher motivation to learn as compared with traditional learning approaches?

The satisfied user usually uses the system intentionally owing to the beneficial outputs and enjoyable features of e-learning (Granic et al., 2009).

4.2.3 Internal process perspective. Metrics based on user perspective are important but must be translated into metrics representing functions that the system must perform to meet the users’ expectations. The main question in this respect is “What processes and competencies must the system excel at?” Internal measures of BSC stem from the process that has the greatest impact on the e-learners’ motivation factors and evaluates the effectiveness of learning process. This BSC perspective consists of the following measures: defect ratio, degree of downtime, security, online technical assistance/guidance, accessibility and degree of application support.

4.2.4 Learning and growth perspective The system’s ability to innovate, improve and develop directly relates to its success and value. Innovation and continuous learning process cause efficiency in the operational aspect of the system. Furthermore, learning and growth bring about cost reduction and outputs’ differentiation, which ultimately satisfy various user needs, and enhance the financial ability of educational centers. This perspective contains such measures as: scalability, improving the capabilities of knowledge management, degree of offering new services to the learners and increasing the market share (Table IV).

4.3 Rank-order of the BSC perspectives and indicators for e-learning systems in Iran

Step 4: In the fourth step, FAHP was used to establish the relative importance of each indicator and of each BSC perspective versus the others. Pairwise comparisons were imported into the FAHP program, and the results were analyzed. Table V presents the weight of each BSC perspective.

For the e-learners of Iranian universities, the learning and growth perspective with the weight of 0.42505 is more important than the other perspectives. The next is financial perspective with the weight of 0.28834, and then the internal process with the weight of 0.16728. The last one is e-learner perspective with the weight of 0.11933.

The results obtained from the pairwise comparisons of indicators under each perspective are represented in Tables VI-IX.

Between the two financial criteria, revenue growth is more important than reducing cost.

<table>
<thead>
<tr>
<th>Items</th>
<th>Perspectives</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Financial</td>
<td>0.28834</td>
</tr>
<tr>
<td>C2</td>
<td>Internal process</td>
<td>0.11933</td>
</tr>
<tr>
<td>C3</td>
<td>E-learner</td>
<td>0.16728</td>
</tr>
<tr>
<td>C4</td>
<td>Learning and growth</td>
<td>0.42505</td>
</tr>
</tbody>
</table>

For the e-learners of Iranian universities, the learning and growth perspective with the weight of 0.42505 is more important than the other perspectives. The next is financial perspective with the weight of 0.28834, and then the internal process with the weight of 0.16728. The last one is e-learner perspective with the weight of 0.11933.

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<td>Financial</td>
<td>0.28834</td>
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<tr>
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<td>Internal process</td>
<td>0.11933</td>
</tr>
<tr>
<td>C3</td>
<td>E-learner</td>
<td>0.16728</td>
</tr>
<tr>
<td>C4</td>
<td>Learning and growth</td>
<td>0.42505</td>
</tr>
</tbody>
</table>
E-learner motivation is the most important, whereas content quality, self-evaluation tools, user friendliness, degree of e-learners’ interactions, promoting educational institution’s image and reputation, personalized learning respectively are considered as important.

In this perspective, degree of downtime, security, degree of application support, defect ratio, accessibility and online technical assistance/guidance are orderly important. Scalability, improving the capabilities of knowledge management, degree of offering new services to learners and increasing the market share are prioritized. The final priority weights of perspectives and related criteria considering the main goal are calculated and shown in Figure 2.

5. Conclusions
The recent applications of ITs have had a strong social impact on the society (Chang, 2016). One of the aspects of society that has been transforming is the way of learning and teaching.

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Table VI. Weights of the indicators under financial perspective

<table>
<thead>
<tr>
<th>Items</th>
<th>Criteria</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Revenue growth</td>
<td>0.68421</td>
</tr>
<tr>
<td>C2</td>
<td>Reducing cost</td>
<td>0.31579</td>
</tr>
</tbody>
</table>

Table VII. Weights of the indicators under e-learner perspective

<table>
<thead>
<tr>
<th>Items</th>
<th>Criteria</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Self-evaluation tools</td>
<td>0.15114</td>
</tr>
<tr>
<td>C2</td>
<td>E-learner’s motivation</td>
<td>0.15360</td>
</tr>
<tr>
<td>C3</td>
<td>Content quality</td>
<td>0.15138</td>
</tr>
<tr>
<td>C4</td>
<td>Degree of e-learners’ interactions (with instructors and other student)</td>
<td>0.13616</td>
</tr>
<tr>
<td>C5</td>
<td>User-friendliness</td>
<td>0.14421</td>
</tr>
<tr>
<td>C6</td>
<td>Promoting the educational institution’s image and reputation</td>
<td>0.13209</td>
</tr>
<tr>
<td>C7</td>
<td>Personalized learning</td>
<td>0.13141</td>
</tr>
</tbody>
</table>

Table VIII. Weights of the indicators under internal process perspective

<table>
<thead>
<tr>
<th>Items</th>
<th>Criteria</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Defect ratio</td>
<td>0.14648</td>
</tr>
<tr>
<td>C2</td>
<td>Degree of downtime</td>
<td>0.24160</td>
</tr>
<tr>
<td>C3</td>
<td>Security</td>
<td>0.19793</td>
</tr>
<tr>
<td>C4</td>
<td>Online technical assistance/guidance</td>
<td>0.10461</td>
</tr>
<tr>
<td>C5</td>
<td>Accessibility</td>
<td>0.11759</td>
</tr>
<tr>
<td>C6</td>
<td>Degree of application support</td>
<td>0.19178</td>
</tr>
</tbody>
</table>

Table IX. Weights of the indicators under learning and growth perspective

<table>
<thead>
<tr>
<th>Items</th>
<th>Criteria</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Scalability</td>
<td>0.41405</td>
</tr>
<tr>
<td>C2</td>
<td>Improving the capabilities of knowledge management</td>
<td>0.24244</td>
</tr>
<tr>
<td>C3</td>
<td>Degree of offering new services to learners</td>
<td>0.18246</td>
</tr>
<tr>
<td>C4</td>
<td>Increasing market share</td>
<td>0.16105</td>
</tr>
</tbody>
</table>
In today’s dynamic and changing environments, successful educational organizations and institutes are those that are able to manage and integrate learning systems to achieve learning objectives and superior performance.

Many learning centers that use e-learning, have recently confronted challenges associated with evaluating e-learning systems, and are not able to recognize weaknesses and strengths of the system correctly. With the increase of investment in e-learning systems, it is essential to design a comprehensive framework for evaluating these systems (Keramati et al., 2011; Mohammadi, 2015; Sun et al., 2008).

Figure 2. Priority weights of e-learning systems in Iran universities.
These issues encourage us to develop a new framework for evaluating e-learning systems by integrating BSC and FAHP. This approach has a systematic view to e-learning systems, and can help e-learning centers identify where making changes or reforms is needed. This also will help educational centers to gain a clear picture of how e-learning systems work and identify their weaknesses and challenges. Our proposed BSC has four perspectives, namely, financial, e-learner, internal process and learning and growth perspectives represented by 19 measures.

Learning and growth perspective by the weight of 0.42505 has been considered as the most significant perspective in the users’ standpoint. The result of ranking this perspective indicates recommends the educational institutions to pay more attention to scalability. Scalability of a system is the degree to which it can be expanded or scaled up to accommodate an increase in processing requirements owing to bottlenecks throughout the system (Hwang and Xu, 2007; O’brien, 2013). Improving the capabilities of knowledge management is the second measure of learning and growth perspective. A successful e-learning system stores, organizes and disseminates the knowledge of experts and professors. This finding is consistent with those of Jafari Navimipour and Zareie (2015), Kaplan and Norton (2004), Mosakhani and Jamporazmey (2010) and Wu and Chen (2014). The degree of offering new services to a learner is the third measure, and market share is the fourth important measure of learning and growth perspective. Qualified systems have the ability to attract more online students and increase their institute market share.

Financial perspective (weight = 0.28834), with two measures, namely, revenue growth and reducing cost, is the second priority. Financial measures have been considered in previous works such as Jafari Navimipour and Zareie (2015), Wu and Chen (2014) and also Wang et al. (2007).

Internal process (weight = 0.16728) is the third important perspective with measures like degree of downtime, security, degree of application support, defect ratio, accessibility and online technical assistance/guidance. In a world where reliability is a key concept (Marakas, 2004; Mosakhani and Jamporazmey, 2010), unplanned downtime can cause dissatisfaction of learners, and consequently, unpleasant results for institutions. Security, as emphasized by Mohammadi (2015) and Chang (2016), is another important measure of e-learning success. It means that proper material must be accessible for authorized users in appropriate time and place. According to Pietrantonio (2007), defect ratio and degree of application support are other important factors for evaluating e-learning systems. Online technical assistance/guidance refers to the degree to which e-learning systems show how to use the system and interact with it on time. This measure is emphasized in pedagogical principles to enable the participants to engage in learning activities and show them how to work with e-learning systems (Ireland et al., 2009; Mosakhani and Jamporazmey, 2010). Support for teachers has to include the use of new technologies as well as the pedagogical aspects of teaching, training, coaching, moderating, etc.

Finally, user perspective (weight = 0.11933) is prioritized as the fourth perspective. E-learner motivation, content quality, self-evaluation tools, user-friendliness, degree of e-learners’ interactions, promoting the educational institution’s image and reputation and personalized learning are considered important respectively. ICT has been shown to have an impact on both the attainment and motivation of learners (Granic et al., 2009). User motivation is usually used to represent the degree to which users persuade and inspire to use the system.

Degree of e-learners’ interactions refers to what extent the system provides facilitation for the e-participants’ interactions. One of the effective pedagogical principles which must be integrated to e-learning systems is integration and communication (Govindasamy, 2002).
Standard communication formats must be included to supplement the communication tools that are currently included in most of e-learning solutions. This measure focuses on interaction between students, between students and teacher and between students and system (Muilenburg and Berge, 2005). Govindasamy (2002) asserted that to develop content by considering pedagogical concerns, minimum standards must be stipulated, and all e-learning content must meet the minimum standards that are established. Quality content has been considered as assurance of representation of convenient and sufficient material for proper user in a proper time. Our findings’ like those of Ireland et al. (2009) consider self-evaluation to be an important aspect of the e-learning quality framework. User-friendly system is compatible with its intended users’ ability to use it easily and successfully, which has been emphasized in the works of Shee and Wang (2008); Arbaugh (2000); Arbaugh and Duray (2002); Wang et al. (2007) too. Promoting educational institutions’ image and reputation is one of the institutional measures. Personalized learning can ensure that the system will take into account the particular strengths and weaknesses of each individual who is using the system (Baylari and Montazer, 2009).

6. Practical and theoretical implications
This study provides insights for institutions and organizations to strengthen their e-learning system implementations and also improve the e-learners’ satisfaction. To assist the design and implementation of a successful e-learning system, our study identifies the main strategic factors described in the literature that influence the usage of an e-learning system, and the relative importance of them. Thus, the results suggest e-learning system designers to use the four perspectives including financial, user, internal and learning and growth to meet both institutional and e-learning system users’ objectives. An unsatisfactory perception will hamper the students’ motivation to continue their e-learning courses.

While an overwhelming majority of IS researches on e-learning have focused largely on technology and mostly the student level (Sun et al., 2008), the current research provides a fresh complementary perspective from different stakeholders’ views, and considers the organizational and pedagogical aspects of e-learning initiatives. Our results showed that organizational and pedagogical aspects are important along with technological considerations.

Summarily, the proposed approach for evaluating e-learning systems makes three main contributions as following:

1. First, it combines two well-established managerial methodologies, BSC and FAHP, and proposes a new approach for evaluation of e-learning systems to reveal their weaknesses and to improve their performance.
2. Second, it provides a comprehensive evolution tool selection of for e-learning vendors.
3. Third, it has a generic nature and is applicable for any university, institution and organization, which applies e-learning.

Some recommendations, which could be valuable for e-learning developers, universities and educational institutes, are:

- In implementing e-learning systems, universities and educational institutes must consider pedagogical principles such as user motivation, providing personalized learning, providing user-friendly technology, providing qualified content regarding specific learner skills, increasing e-learners’ interactions and so on.
- In the development of e-learning strategies, organizational issues as well as technological and pedagogical factors must be considered. In this paper, two
important factors related to profitability and cost (revenue growth and reducing cost) were embedded to the proposed framework. The results showed that finance measures are in the lowest priority of importance but both of the measures are considered as important in e-learning systems evaluation.

- To design a successful e-learning system, technological considerations which are viewed as essential, are security, defect ratio, degree of downtime, scalability, use of new technology, knowledge management and tools.

Although this research represents a systemic effort to incorporate the evaluation indicators of e-learning, it is not without limitations. First, this framework was based on Iranian e-learners’ and experts’ viewpoints. The importance of perspectives and their indicators might show different results in other populations and other countries.

Second, the research proposes an integrated model including a variety of factors influencing e-learning success; it might not be comprehensive owing to the limitations of time and resources used. It is recommended to apply systematic research methods such as meta synthesis and literature review. Third, certainly these factors influence each other; so, it is recommended to analyze the relationship between these four perspectives by statistical methods like structural equation modeling (SEM).

References


Further reading


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