# *AN EXTENDED METHODOLOGY FOR E-LEARNING EVALUATION BASED ON THE ACCOMPLISHMENT OF EDUCATIONAL OBJECTIVES*

*Konstantinos Pazalos, Euripidis Loukis, University of the Aegean, Greece*

## 1. Introduction

The emergence of e-learning has brought up big changes in the way courses are taught, the role of the teacher and the interaction between teachers and learners. The structure of knowledge transfer to the learners has been totally altered: it is based on various electronic channels (such as Internet, intranets, satellites, interactive TV, CDs, etc.), and therefore has become more impersonal than in the past. The role of the teacher has dramatically changed: since the e-learning system is delivering the course, the role of the teacher now is to guide, support and motivate the learners via a non face-to-face interaction with them through electronic channels, which demands considerable effort and necessitates the use of new techniques that did not exist in the past and for which teachers are not sufficiently trained. At the same time huge investments for the development of e-learning are taking place. So, as it happens with all investments, there is a growing need for methods to evaluate e-learning, both at the formative level, in order to diagnose weaknesses and make improvements, and at the summative level, in order to measure the value these investments create and conclude whether they have fulfilled the objectives they have been created for.

However, due to the above radical differences between the e-learning and the 'traditional' education, the evaluation of e-learning cannot be performed using the methods that have been developed for the evaluation of the traditional education (e.g. [1], [2], [3]). For this reason an on-going debate has been started concerning e-learning evaluation methods and many researchers coming from different scientific domains (e.g. education, management, technology, marketing, etc.) have conveyed their thoughts about this issue. A considerable stream of the research conducted in this area focuses mainly on the extent of use of e-learning by the learners and on their continuance intentions (user acceptance) as the central dependent variables and basic surrogate measure of the value that e-learning generates, attempting to explain and understand them, based mainly on models from the IS domain, such as the Technology Acceptance Model (TAM) [4]. On the contrary, the basic measure of educational effectiveness, which is the extent of accomplishment of the educational objectives, has been ignored by this research stream.

In this paper, after a short literature review, we propose an extended methodology for evaluating e-learning, which focuses both on the extent of use of the e-learning system by the learners and the extent of accomplishment of the educational objectives as central dependent variables. It is based on four pillars: i) Information Systems (IS) success research, ii)traditional education evaluation research, iii)TAM-related research and iv)e-learning evaluation and critical success factors research. This methodology has been initially created for the evaluation of e-RMIONE (e-Learning Resource Management Service for InterOperability Networks in the European Cultural Heritage Domain) project (www.ermione-edu.org), which is part of the eTEN Program of the European Union, but it is intended to be applied for the evaluation of various other e-learning systems as well. Finally an insight on the next steps of our research is given.

## 2. Background

A significant part of the research that has been conducted in the area of e-learning evaluation concerns mainly the formative level, and aims at the identification of the factors affecting either the extent of use of e-learning by learners (user acceptance), or the learners' intention to use e-learning, which are regarded as the basic surrogate measure of the value that e-learning generates, In this direction Selim [5] used the Technology Acceptance Model (TAM) [4] in order to investigate empirically the acceptance of course web-sites by students and identify its main determinants. For this purpose he developed "the Course Website Acceptance Model" (CWAM) consisting of the three constructs of the TAM (Perceived Usefulness, Perceived Ease of Use, and Use). By creating a questionnaire based on literature review, he validated the above model (using structural equation modelling techniques) and revealed the most important critical success factors of web-site acceptance. Saade and Bahli [6] conducted an empirical study aiming at understanding and explaining the acceptance (intention to use) of Internet-based learning systems. They have based on an extension of the TAM, which includes the concept of Cognitive Absorption as antecedent of Perceived Usefulness and Perceived Ease of Use. The results of this study, stemming from data collected from students, provided support for this model as explaining the acceptance of the Internet-based learning system and for Cognitive Absorption as an important variable affecting the TAM variables. In the same direction other researchers focus on the e-learning continuance decision, regarding it as being strongly associated with the value created by e-learning. Chiu et al [7], aiming at supporting the formative evaluation of e-learning, examine the factors affecting the e-learning continuance decision, using a research model combining the Expectancy Disconfirmation Theory (EDT) with conclusions of studies on customer satisfaction and IS quality; their results suggest that continuance intention is determined by satisfaction, which in turn is jointly determined by perceived usability, perceived quality, perceived value and usability disconfirmation.

Wang [8] has a totally different approach: in order to support (mainly) summative evaluation of e-learning and -to a lower extent- formative evaluation, he developed a global instrument for measuring the total e-learner satisfaction with asynchronous e-learning systems (i.e. a global satisfaction index). This index was calculated as the sum of 17 relevant variables, which have been determined through a review of the literature, and then on data analysis of a sample of e-learners. His final model theorizes that e-learner satisfaction is determined by four major constructs: content, learner interface, learning community, and personalization.

The conclusion drawn from reviewing the e-learning evaluation literature is that this area is characterized by 'absence of widely established and practiced methodology by which rigorously to evaluate e-learning, and through which to develop the secure body of knowledge on which to build learning technology as a discipline' [18], however there are only some general 'e-learning evaluation frameworks' reported in the relevant literature. Moreover, most of the empirical studies that have been conducted in this area focus on the formative level and aim at explaining and identifying the main factors affecting either the extent of use or the continuance intention, regarding these two constructs as main surrogate measures of e-learning value, clearly influenced by a marketing or product placement perspective. However, the use of e-learning is often just better than the other existing options, or even in some cases mandatory (i.e. there are no other options), so it does not always reflect the magnitude of the value created by e-learning (we can have e-learning systems with equal use by the learners but offering very different levels of value). For this reason a much better direct measure of the value created by e-learning is the extent of accomplishment of the various kinds of educational objectives. Therefore further research work is required in this area in order i) to develop a complete methodology, which supports both the summative and the formative level, and includes appropriate measures of the impact of e-learning

(i.e. the value it creates) and of the capabilities and resources offered to the e-learners (e.g. content, support by instructor, etc), and ii) to validate it empirically in 'real-life' conditions.

A complete e-learning evaluation methodology should consider and exploit the extensive previous research and the existing methodologies in the area of traditional education evaluation and especially in the area of students' evaluation of (traditional) teaching effectiveness (SETE) (e.g. [1], [2], [3]). Wang [8] mentions six SETE instruments: Endeavor Instrument, Student Instructional Rating System (SIRS), Instructor and Course Evaluation System (ICES), Student Description of Teaching (SDT) Questionnaire, Students' Evaluations of Educational Quality (SEEQ) Instrument, and Instructional Development and Effectiveness Assessment (IDEA). These SETE instruments provide useful information about the dimensions of teaching that should be evaluated e-learning.

The theories and models developed from the extensive research concerning the measures and determinants of IS success ([13], [14], [15]) can also be useful for the development of an e-learning evaluation methodology, since they offer a good background concerning the meaning, the dimensions and the underlying relationships of the terms IS success, impact, quality, use and satisfaction. According to DeLone and McLean models ([13], [14]) information quality, system quality and service quality affect user satisfaction and use, which in turn determine the impact at the individual and organizational level. Seddon [15] propose a respecification of the DeLone and McLean model, in which user satisfaction is determined by system quality, information quality and perceived usefulness. Another view of IS quality is offered by the ISO/IEC 9126 Software Quality Model [16], which defines software quality to be based on the following six characteristics: functionality, reliability, usability, efficiency, maintainability and portability. Finally, an e-learning evaluation methodology should also take into account the findings of the e-learning critical success factors (CSFs) research ([10], [11], [12]).

## 3. An e-learning evaluation framework

Based on the above conclusions and constructs from: i) the Information Systems (IS) success research, ii) the traditional education evaluation research, iii) the TAM-related research and iv) the e-learning evaluation and critical success factors research, we have developed an extended methodology for the evaluation of e-learning, which is shown in Figure 1.

We can see in the left column of Figure 1 that it includes at first level an evaluation of the basic e-learning capabilities and resources offered to the user: content, electronic support by the instructor, learning community, technical quality, customization and perceived ease of use. For each of these 'latent variables' a measurement instrument has been designed consisting of a number of relevant questions, based on the literature; from the variables corresponding to these questions one (or more if required) factor will be synthesized using exploratory factor analysis. 'Content' measures the quality of the course content and is based on the notion of information quality greatly emphasized in the IS success research ([13], [14], [15]). 'Electronic Support by the Instructor' measures all aspects of instructor activities in asynchronous e-learning (effort, skills, methods, motivation of e-learners and final contribution to the learning process). It has been influenced by the 'instructor methods' dimension the IDEA instrument ([2], [3]), although significant modifications were necessary so as to be adapted to the role and functions of the instructor in asynchronous e-learning environments (which are quite different than in the 'traditional education' for which the IDEA has been developed), and by the relevant conclusions of the e-learning CSF research ([10], [11], [12]). 'Learning Community' measures all the

dimensions of the capabilities offered to e-learners for communication with the instructor(s) and with their colleagues, which is a basic CSF of e-learning ([10], [11], [12]). 'Technical quality stems mainly from both the IS success literature, where it is mentioned as 'system quality' ([13], [14], [15]), and the e-learning CSF research ([11], [12]), measuring variables such as system availability, accessibility, problems with bugs and technical support. Useful information about technical quality has also been retrieved from IST/IEC 9126 [16]. 'Customization Capabilities' concerns one of the greatest advantages of asynchronous e-learning [17], the flexibility offered to the student to adjust the learning process to his/her own wishes (according to his/her learning style, interests, lifestyle, etc.). Finally 'Perceived Ease of Use' is based on the corresponding TAM construct [4], and the conclusions of the e-learning CSF research ([10], [11], [12]), measuring how easy do users perceive the system to be (e.g. how easy it was to learn it, to find the content they need, to communicate with the instructor and the other e-learners via e-mail/chat/forum, and also how flexible it is, how clear and understandable are the screens and the messages, etc.).

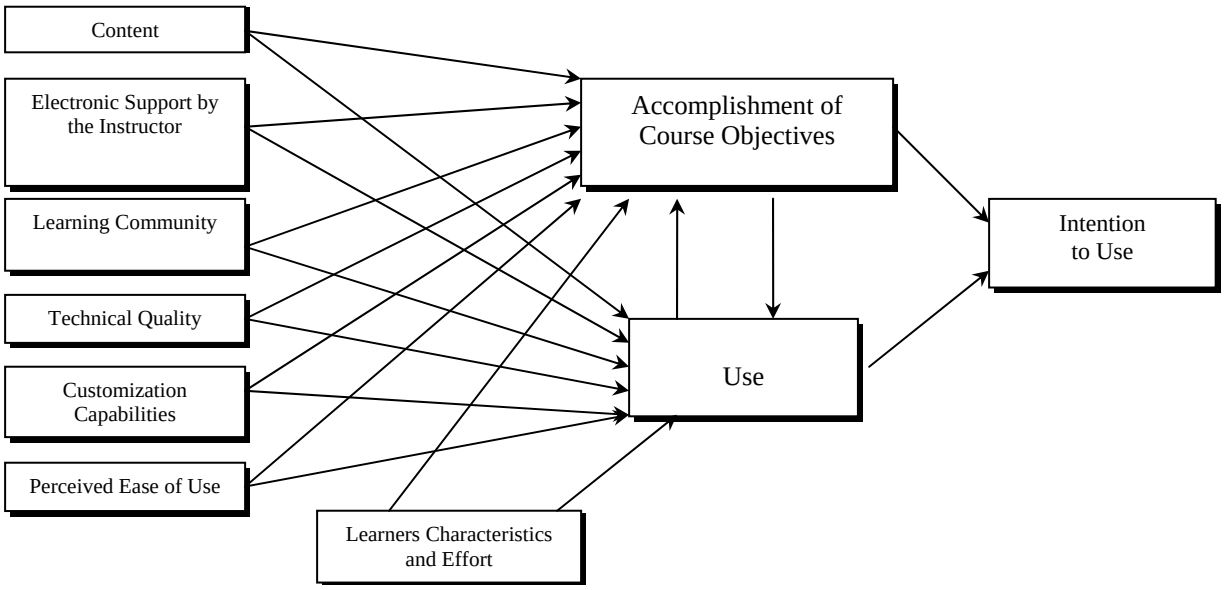


**Figure 1. An extended methodology for e-learning evaluation.**

The proposed e-learning evaluation methodology, as we can see in Figure 1, includes also (at a second level) an evaluation of the two basic e-learning outcomes: the extent of accomplishment of the educational objectives (ACEO) and the Use of the e-learning system. ACEO is a primary measure of instructional effectiveness of the IDEA instrument (named 'students' progress ratings on course objectives') ([2], [3]), and is a basic determinant of e-learners' satisfaction. Use has been extensively utilized in the relevant literature as a 'surrogate measure' of e-learning value (mainly in cases where the use of an e-learning system is not mandatory), despite its limitations mentioned previously in section 2. For each of these two 'latent outcome variables' a measurement instrument has been designed consisting of a number of relevant questions. From the variables corresponding to these questions one (or more if required) factor will be synthesized using exploratory factor analysis. In the Appendix the reader can see the measuring instrument (i.e. set of questions) for the ACEO, created by combining elements of the IDEA model and Bloom's taxonomy of educational objectives [9].

## 5. Conclusions and Further Research

In this paper we have presented a methodology of e-learning evaluation both at a summative and formative level, which includes the evaluation of e-learning capabilities and resources (content, electronic support by the instructor, learning community, technical quality, customization capabilities and perceived ease of use) and e-learning outcomes (ACEO and Use). The structural model of our methodology, which is shown in figure 1, includes, the characteristics and the effort of the student (which according to the relevant literature contribute to ACEO), and his/her intention to use it in the future, and the initially hypothesized relations among all these variables. As next steps of our research we are planning to collect evaluation data from the users of an e-learning system as part of the e-RMIONE project using a questionnaire based on the above model. Elaborating these data, we will test the validity of the above model using confirmatory factor analysis methods (LISREL), so as to determine which of the relations of the model are statistically significant and to calculate their strength. The findings of this analysis will offer to us a complete picture of e-learning value and its generation mechanisms, which is quite useful at the formative level of evaluation. Moreover, from the variables measuring the e-learning resources, capabilities and outcomes, we are going to synthesize a complete e-learning satisfaction index using methods of exploratory factor analysis, which will be useful for summative evaluation.

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**APPENDIX.**

**ACCOMPLISHMENT OF COURSE OBJECTIVES**
**State the extent to which you Agree/Disagree on the following statements:**
**1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly Agree**

1. I have learnt new concepts/terms/ideas.
2. I have learnt new methods and technologies as well as capabilities/opportunities offered by them.
3. I learned fundamental principles generalizations or theories concerning the course subject.
4. I have learnt to apply the course material in practical situations in order to improve rational thinking, problem-solving and decision-making.
5. I have learnt how to analyze situations and problems concerning the course subject into smaller elements in order to examine and understand them better.
6. I have learnt how to evaluate situations and actions concerning the course subject.
7. I have developed creative capacities (e.g. how to put together or combine pieces of knowledge I have gained from the course).
8. I have developed specific skills, competencies and points of view required by professionals in the area of the course subject.
9. My awareness on the course subject has been enhanced.
10. I have developed positive attitude towards the field of the course subject.