

Developing General View of Quality Models for E-learning from Developers Perspective

Majdi Abdellatief, Abu Bakar Md Sultan, Marzanah A.Jabar, Rusli Abdullah

Faculty of Computer Science & Information Technology
University Putra Malaysia

khwaja24@yahoo.com, {abakar, marzanah, rusli} @fsktm.upm.edu.my

ABSTRACT

The growth of the Internet and web as a source of information and communication has led companies to use websites as an education tool. E-learning is gaining more acceptance as days pass because it provides learning opportunity any time and in any place. Moreover, e-learning has the potential to benefit learner/student, instructor, manager, administrator, organization and society in many ways. Thus it is important to evaluate e-learning from these various perspectives. The main aim of this work is to propose new technique to evaluate e-learning website quality from developer's view. Our technique adopts the weights of quality characteristics which are obtained by carefully selected questionnaires' from professional developer. We also present the evaluation process using AHP technique and the result of trial evaluation for validation of our technique. As result, we believe that proposed technique will be useful to effective evaluation, as well as to develop system with high quality. Furthermore, this technique would enhance the relationship between instructors and developers

Keywords

Quality characteristic, E-learning System, quality evaluation.

1.0 INTRODUCTION

The growth of e-learning systems has increased greatly in recent years, due to the significant advantages of e-learning such as convenience, portability, flexibility and global learning community. Therefore, On-line learning is becoming essential for many real-world tasks, as such there is economic pressure on educational institutions for more flexible learning and cost saving options. Yet, there has been considerable criticism of the quality of the systems currently being used. According to Baruque & Melo (2007) many organizations are still experimenting with e-learning, using different approaches, applying different technologies and models for the delivery of e-learning contents. Hence, how to ensure a quality of e-learning website is still not clear. E-learning web site quality is a complex concept and its measurement is expected to be multidimensional in nature. E-

learning incorporates organizational, administrative, instructional, and technological risks. This makes the evaluation process complex. The evaluation complexity is caused by the large amount of intervening characteristics and attributes, and by the complex logic relationships among attributes and characteristics. Although a lot of work has been done regarding the management, planning and implementation. There are still big differences in the produced material and a lack of an effective e-learning evaluation quality model (Baruque & Melo, 2007; Ozkan & Koseler, 2009; Caramihai & Severin, 2009; Chua & Dyson, 2004; & Yunus & Salim, 2008). Furthermore, there are many stakeholders of e-learning systems such as system developers, technicians, administrators, instructors, instructional designers, multimedia designers, online facilitators, independent evaluators, etc. whose views are also important indicators for a complete e-learning systems evaluation (Ozkan & Koseler, 2009) , but the most important views of e-learning quality are; user view, developer's view and manger's view.

At least to the best of our knowledge no prior work exists specifically on evaluation method of e-learning from developers view point. In this regard this paper intends to contribute.

The reset of this paper is organized as follows. Section 2 presents related work. Section 3 presents research design and section 4 present the particularization quality evaluation technique for e-leaning website. The remaining sections present results and conclusion respectively.

2.0 LITERATURES REVIEW

There are many terms used to refer for online education. Such as education, Internet-based education, web-based education, and education via computer mediated communication. However, the term e-learning is often used as a more generic term and as synonym for online education. According to (Ozkan & Koseler 2009; Paulsen, 2003) electronic learning refers to the use of electronic devices for learning, including the delivery of content via electronic media such as Internet, audio or video, satellite broadcast, interactive TV, CD-ROM, and so

on. There are a great number of different kinds of quality requirements (Lng, Surn, & Georgiaduo, 2003; Kitchenham & Pflieger, 1996; IEEE 1061, 1998; ISO/IEC9126-4, 2000). The different types of quality requirements require quite different types of analysis methods. A quality model can be considered to be a framework for unifying and quantifying differing viewpoints as mentioned in (Kitchenham & Pflieger, 1996).

Types of E-Learning

No single e-learning method is best for every learning need. You will most likely need to use several e-learning technologies as well as traditional learning methods. E-Learning comes in many variations and often a combination of the following:

1. Asynchronous e-Learning:- learning where people are not online at the same time and interaction does not occur without a time delay, allowing people to participate on their schedules such as :-
 - Self-study (Self-study with subject matter expert)
 - Discussion Groups
 - Computer-based (CD-ROM) (Video/audio tape)
2. Synchronous e-Learning :- learning where people are online at the same time such as:-
 - Virtual Classroom
 - Audio and Video Conferencing
 - Chat
 - Application Sharing
3. Blended Learning - combination of online and face-to-face

We conducted extensive survey on quality evaluation methods proposed in the literature, (McCall, 1979; Pruengkarn, Praneetpolgrang & Srivihok, 2005; Baruque & Melo, 2007; Ozkan & Koseler, 2009; Wang, Wang & Shee, 2007; Chua & Dyson, 2004, Yunus & Salim, 2008 & Santos, 1999). According to (IEEE 1061, 1998) Standard Glossary of software engineering terminology, software quality is defined as “the degree to which a system component, or process meets specific requirements or meets customer or user needs or expectations”. In 1991, the International Organization for Standardization introduced a standard named ISO/IEC 9126; software product evaluation- Quality characteristics and Guidelines for their use. The ISO 9126 model was constricted in response to the search for universal quality model. It is based on Mc Calls model (McCall, 1979). ISO/IEC is a generic Quality Model, which can be applied to any software products, and is very

difficult to apply to specific domains such e-learning website, due to the special feature of e-learning website (Britain & Liber, 2003; Chua Dyson, 2004). In other word in e-learning, we can say that quality is ability to reach a specific goal in efficiency, effectively, safe and or satisfaction at specific user situation, that is education, learning, development, assessment, or management (ISO/IEC 9126-4,2000). The new quality standard ISO/IEC 19796-1 was published in October 2005. It provides a framework for the description of quality approaches (RFDQ). A reference framework gives an orientation (tools, methods, instruments and criteria) which help organizations to develop their own quality system. It is not a standard developed for certification. In the future, ISO will publish ISO /IEC 19796-2 as standard to certify organizations, services and products. And will provide orientation for all stakeholders. ISO /IEC 19796-3 reference methods and metrics for quality management and assurance. ISO /IEC 19796-4 guidelines for the adaptation implementation and usage of this multi-part standard, and will contain a rich set of best practice examples.

Baruque & Melo (2007) concerned with applying the governance principles in e-learning, based on risk oriented approach to control standard as function and benchmarking reference. Ozkan & Koseler (2009) proposed a multi-dimensional approach to Learning Management System (LMS) evaluation via the following six dimensions: (1) system quality (2) service quality, (3) content quality (4) learner perspective (5) instructor attitudes and (6) supportive issues. The finding of this research showed that, each of the six factors had significant effect on learner’s satisfaction. Many authors discussed evaluation of e-learning system from pedagogical prospective in (Pruengkarn et al., 2005; Yunus & Salim, 2008; Britain & Liber, 2003& Wang & Wang, 2009).

Ardito, Costabile, Angeli, De,& Lanzilotti (2006) proposed a good methodology, called eLSE (e-learning Systematic Evaluation) based on inspection technique. And Santos (1999) proposed a methodology for evaluating and comparing of websites quality called QEM (website Quality evaluation Method).

In most of the related works the authors were mainly concerned with five dimensions of the quality of e-learning sites namely: system quality, information quality, service quality, attractiveness and their relationship. Table 1 presents a sample of such previous works.

Table 1: Summary of the factors in evaluation of e-learning system

References	QF1	QF2	QF2	QF3	QF4	QF5
(DeLone & McLean, 2003)	System Quality	Information Quality	Service Quality	Intention to use	User Satisfaction	Net benefit
(Shee & Wang, 2008)	Learner Interface	Learning Community	System Content	Personalization		
(Wang, Wang & Shee, 2007)	System Quality	Information Quality	Service Quality	System use	User satisfaction	
(Ozkan, & Koseler, 2009)	System Quality	Information Quality	Service Quality	Instructor Attitudes	learner perspective	Supportive Issues
(Wang and Wang, 2009)	System Quality	Information Quality	Service Quality	User satisfaction	Intention to use	Net benefit

3.0 RESEARCH DESIGN

To achieve our objective an extensive study on related resources (Abdullah & Wei , 2008; Franck & Carvallo, 2003; Chiew & Salim 2003; Delone & Mclean, 2003; Pruengkarn et al., 2005, Sun, 2004) was conducted. The following methodology has been identified as shown in fig. 1.

Case Study

- Step 1: Design a questionnaire for collecting data from developer, who are developing e-learning websites.
- Step 2: Assign points and assign the value for each attributes, which are obtain from questionnaires.
- Step 3: Compute the attributes value, sub-characteristics value and the value of quality characteristics (QC)
- Step 4: Compute the total quality (TQ) of e- Learning website.

4.0 PARTICULARIZATION QUALITY EVALUATION TECHNIQUE FOR E-LEARNING WEBSITE

In this section we present a technique that would enhance the relationship between instructors and developers. A good cooperation between instructors and developers has the effect of increasing the quality of e-learning website, hence the perceived learners' satisfaction of e-learning website (Ozkan & Koseler,

2009). This is because the instructor knows the various pedagogical functions that the system had to support, which software developers may not know. The software developers generally view their design purely from technical point of view, normally based on the ISO model. But, the ISO model alone would be insufficient because it is a general software quality model and does not specify a particular teaching and learning activities needed for good learning (Chua & Dyson, 2004; Britain & Liber, 2003). This paper attempts to identify e-learning quality requirements that can help in meeting customer needs from developer prospective.

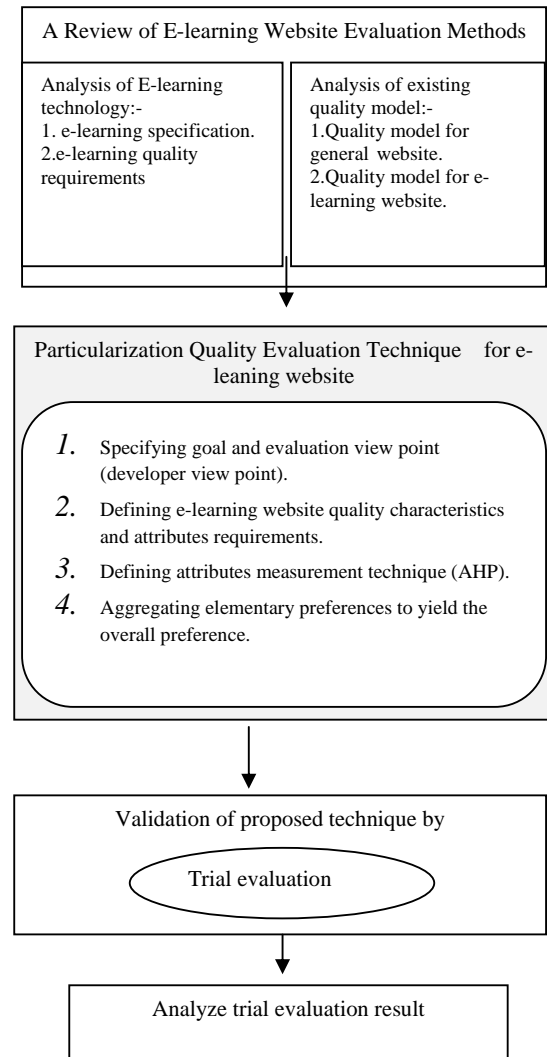


Figure 1: Research Design

The quality characteristics and attributes of the proposed technique are presented in Table 2. We have generally categorized e-learning quality requirements into three levels. The first level includes core services, while the second level includes those which facilitate core procedures and the third level includes factors support level two.

Table 2: E-learning Quality Characteristics, Sub-characteristics, Attributes from Developer View Point

Quality Characteristic	Sub-characteristic	Attributes
Service Content	Management Technique	Calendars
		Well organized
		Student tracking
		e-tests
		User profile
		e-books
	Teaching Technique	announcements
		Self Study
		Scheduling
		Book marking technique
		Notes and highlights
		Archives
	Delivered Method	Online experts
		e-media
		Recommended resource
		User feedback
		Print
		e-text
System Functionality	Supportability	Audio
		Communication
		Video
		Digital library
		Purchase feature
	Browsing Issues	Virtual lab
		Multilanguage
		Upload file
		Download file
		Navigability
	Usability	Link Relevancy
		Level of Scrolling
		Coupling among Sub-sites
		Label of Position
		Site Map
		Feedback technique
		Quality of Help Features
		Web-site Last Update
FAQ Feature		
Information Technology	Communication Technique	E-mail Directory
		Phone-Fax Directory
		Post mail Directory
		Addresses Directory
		Audio/videoconferencing
		Chat
		Facilitator
		Application Sharing
		Discussion forum
		Email service
	Interactive multimedia	
	Security	Virtual community
Virtual Classroom		
Interface Issue	Privacy	
	Cookies	
	Accessibility	
	Cohesiveness to Group	
	Main Control Objects	
Link Errors	Course information	
	Attractiveness	
	Style Uniformity	
System Reliability	Stability	
	Unimplemented Links	
	Invalid Links	
		Broken Links

Drawbacks	Number of Destination Nodes (unexpectedly) under Construction
	Number of Dead-end Web Nodes
	Number of deficiencies or absent features due to different browsers
	Compatibility
Performance behavior	Page Size
	Bandwidth
	Complementarily between sound and image.
	Choose of media with respect to content

4.1 Service Content

Service Content characteristic consists of Management Technique, Delivered Method and Teaching Technique. Content quality in e-learning depends on how well the learning environment is designed and managed, this has an effect on user satisfaction, consequently influences the decision to continue or drop-out of a course (Ozkan & Koseler, 2009; Chiu, Hsu, Sun, Lin, Lin & Sun, 2005). Ardito et al., (2006) defined e-learning platform as the interface environment which may offer a number of integrated tools and services for teaching, learning, communicating, and managing learning material.

To be effective course management system should have a means of making necessary announcements on time. Additionally, it should consist of a module that contains structured exam. Calendar is another important attribute; it can be use for checking upcoming sessions, viewing available courses and to make appointment with teachers or students. Student tracking: to report the learner's performance within a course to a Learning System. In addition tracing allows for both "sequence" and "student" views of real-time progress. Finally, there should be a Teacher and User profile: to present personal information regarding user. We included this sub characteristic to ensure that our model conform to the earlier work of (Paechter, Maier & Masher, 2010), which presented it as part of five fields of instruction requirements for designing and management of e-learning course.

People learn in different ways and at different times. Different people have different preferences in terms of learning style such as reading text, listing audio, doing assignments and reviewing exams or speaking and communication. To support these different learning needs, there is need for multiple e-learning delivery methods and teaching techniques. Attributes that can be grouped under teaching technique include; self Study method, online experts, feedback, recommended resource, archives and bookmarking technique to allow the learner stop the course at any time and restart it from the same point. Other issues when delivering courses can be grouped under service

quality, which includes Print, video, audio, communication. In (Arbaugh, 2002) author stated that flexibility of the delivery of courses comes as a result of the medium being both place and time independent.

4.2 System Functionality

System Functionality consists of browsing issues, usability and supportability. According to (<http://www.netmechanic.com>) study shows that 66% of webmasters do not add a search engine to their site. Reasons for not doing so included time, complexity, and cost. Therefore, we ignored search tools from our requirements. Nowadays, there are many known properties that make website simple and easy to use. In a learning site, it would be good to create a browsing system that has a high link relevancy, means of scrolling, and good structure for sub-sites and labels (current, next and previous) position that points visitors directly to each important section. According to Web usability expert, Nielsen a good navigation system should answer three questions: Where am I? Where have I been? Where can I go? However, visitors appreciate search capability on larger sites, e-commerce sites, and any site that deals with several different products or topics.

Different methods can be used for evaluating the usability of web system (Abdullah & Wei, 2008; Chiew & Salim 2003; Ardito et al., 2006). When usability issues are considered at the design phase, greater returns are possible to both user and developer. Attributes that can be grouped under Usability sub-characteristic site map should be included; this reflects navigation and main content areas. content maps: detailed maps that show what exists on each page and how contents on the page are related. Instructors must perform a variety of tasks in the process of teaching, such as give feedback of accomplishments, help, features, e-mail directory, Phone-fax directory and web-site last update. Which assist them to engage in learning activities (Paechter, Maier & Masher, 2010).

Another important sub-characteristic we recommend contains supporting or auxiliary components, these together are termed supportability. Such components like digital libraries are nowadays critical to both students and teachers. This is because they reduce the cost of buying books, journals and other essential day-to-day needs of teaching and learning. Virtual labs should also be included. Since most often visitors to e-learning site come from different part of the world, there is need for the site to provide at least the essential parts in multiple languages to improve its accessibility.

4.3 Information Technology

Information Technology characteristic consists of communication technique, security technique and interface issue. The quality of communication technique depends on employing various means of communication, such as electronic mail, online threaded discussion boards, synchronous chat, desktop

video / audio conferencing and virtual classroom. We also recommend a facilitator to assists, directs, and stimulates the learning during an online course. This is because interaction with peer students and the exchange of information between students and instructor supports knowledge construction, motivation, and the establishment of a social relationship (Paechter, Maier & Masher, 2010; Shee & Wang, 2008). Thus those who study have the possibility of asking questions and receiving answers. The effects of information technology may decrease or increase the overall quality of e-learning site, depending on how new advances in communication methods and techniques utilized (Wang & Wang, 2009).

E-learning courses need to be accessible to different end users, so there is need to present study materials in different forms and format like CD ROM, DVD, or HTML. To make sure that, information remains confidential e-learning system must provide a good mechanism of ensuring privacy and without affecting accessibility. Certainly, to retain users' patronage, the site has to be attractive and should be consistent in presentation. This consistency is called style uniformity. It makes users to feel at ease wherever they might be in the site; hence it is expected to improve their satisfaction. Consequent upon this is to have cohesiveness to group main control objects.

4.4 System Reliability

Reliability is one of the most important characteristics of assessment of any system. A broken link or a misspelled word may seem a trivial mistake, but it can greatly undermine the credibility of a website. If there is need for people visiting a site to be assured of the quality of the information in the site, different components of the site must be compatible. Therefore, there is need to use an authoring tool that will facilitate.

Certainly, to provide a reliable site, there is need to ensure that the performance at least as it is perceived by user is acceptable. Ensuring that performance remains at acceptable levels is function of many variables. Some of the important considerations we isolate and recommend are: bandwidth must be sufficient in relation to the size and the number of visitors. It will also help, in ensuring that user perception of the site remains positive, if pages are not cluttered with too much unnecessary graphics and multimedia. Therefore, features such as complementarily between sound and image, choice of media with respect to content are valuable.

5.0 CONCLUSION

There are many stakeholders of e-learning systems, but the most important view is developer's views. Therefore, it is critical to evaluate e-learning from the perspective of developer and to provide

recommendations where necessary. In this regard this paper contributes. We proposed four quality characteristics named Service Content, System Functionality, Information Technology and System Reliability. Furthermore, we proposed 11 sub-characteristics with its attributes by following the structure of standard IOS/IEC 9126. Our reason for this is by the employing standard structure the proposed model is most likely to have a higher adoption rate. We believe the proposed technique will be useful to effective evaluation, as well as to develop system with high quality. Furthermore, this technique would enhance the relationship between instructors and developers. However, we preparing further works for general application to real projects; and are our firm believes that the result of the study will contribute to the effectiveness of e-learning; directly increase the satisfaction of students and instructors.

REFERENCES

- Abdullah, R. & Wei, K. T. (2008). Usability Measurement of Malaysia Online News Websites. *IJCSNS International Journal of Computer Science and Network Security*, 8-5.
- Arbaugh, J.B. (2002). Managing the on-line classroom A study of technological and behavioral characteristics of web-based MBA courses, Elsevier, *Journal of High Technology Management Research* 13, 203.
- Ardito, C., Costabile, M. F., Angeli, A. De, & Lanzilotti, R. (2006). *Systematic Evaluation of e-Learning Systems: An Experimental Validation*, NordiCHI 2006, 14-18
- Baruque, L.B. & Melo, R. N. (2007). Towards a framework for corporate e-learning evaluation. In Proceedings of the. (2007. *Euro American Conference on Telematics and information Systems, EATIS '07. ACM*, New York ,Faro, Portugal.
- Britain, S. & Liber, O. (2003). A Framework for Pedagogical Evaluation of Virtual Learning Environments. [verified 10 Oct 2004] <http://www.leeds.ac.uk/educol/documents/00001237.htm> .
- Caramihai, M. & Severin, I (2009). Elearning Tools Evaluation based on Quality Concept Distance Computing. *A Case Study, World Academy of Science, Engineering and Technology*.
- Chiew, T.K. & Salim, S.S. (2003). WEBUSE: Website Usability Evaluation Tool, *Malaysian Journal of Computer Science*, 16 – 1.
- Chiu, Ch., Hsu, M., Sun, S., Lin, T., & Sun, P. (2005). Usability, quality, value and e-learning continuance decisions. *Computers & Education*, 45, 399–416.
- Chua, B.B. & Dyson, L. E. (2004). Applying the ISO 9126 model to the evaluation of an e-learning system, *Proceedings of the 21st ASCILITE Conference*. pp. 184-190. Perth, 5-8 December
- DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A 10-year update. *Journal of Management Information System*.
- Franch, X. & Carvallo, J.P. (2003). Using Quality Models in Software Package Selection. *IEEE Software*, 20(1).
- Guide ISO/IEC 19796-1(2006): How to Use the New Quality Standard for Learning, Education, and Training, Version: 1.0, -12-19.
- IEEE 1061. (1998). Standard for a Software Quality Metrics Methodology
- ISO/IEC, 9126-1.2.3.4. (2000). Information Technology- Software product quality-Part 1 Quality model,.
- Kitchenham, B. & Pfleeger, S.L. (1996). Software Quality : The Elusive Target. *IEEE*
- Lng, M. C., Surn, W. & Georgiadou, E. (2003). Software quality model requirements for software quality engineering, 14th international conference on the software quality requirement.
- McCall, J. A. (1979). Software Quality Management, A Petrocelli Book.
- Ozkan, S. & Koseler, R. (2009). Multi-dimensional students' evaluation of e-learning systems in the higher education context: *An empirical investigation*, Elsevier, computers & Education, No 53, Vo 1285-1296.
- Paechter M., Maier, B., & Macher, D (2010). Students' expectations of, and experiences in e-learning: *Their relation to learning achievements and course satisfaction*, Elsevier, Computers & Education 54 222–229.
- Pruengkarn, R., Praneetpolgrang, P. & A. Srivihok, (2005). An evaluation model for e-learning Websites in Thailand University Advanced Learning Technologies. *Fifth IEEE International Conference*
- Paulsen, M. F. (2003). Work package one : *The Delphi project : E-learning – the state of the art*, NKI Distance education.
- Santos, L. O. (1999). Web-site Quality Evaluation Method: a Case Study on Museums, ICSE 99 - 2nd Workshop on Software Engineering over the Internet, GIDIS, Department of Computer Science, Engineering School at UNLPam.
- Shee, D. Y., Wang, Y. (2008). Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its

- applications, Elsevier, Computers & Education 50 894–905.
- Sun, Ch. (2004). Empirical Reasoning about Quality of service of component based distributed systems. *ACM* 1-58113-870/04/04.
- Wang, W., & Wang, Ch. (2009). *An empirical study of instructor adoption of web-based learning systems*, Computers & Education 53 761–774.
- Wang, Y.S, Wang, H. Y. & Shee, D. Y. (2007). Measuring e-learning systems success in an organizational context: *Scale development and validation* , Elsevier, Computers in Human Behavior, 23(1), 1792–1808.
- Yunus, Y. and Salim, J. (2008). Framework for the Evaluation of E-learning in Malaysian Public Sector from the pedagogical perspective, *IEEE*.