

Evaluation and Selection of the most Applicable Learning Management System

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Abstract: - The paper deals with a complex decision-making problem, the selection and evaluation of Learning Management Systems (LMS) in which several objectives - referring to the definite group of users - like social, technical, environmental, and economic impacts, must be simultaneously taken into account. We introduce Evaluation Cycle Management (ECM), a support methodology aimed at the evaluation of options that occur in the decision-making processes. ECM is based on Multi-attribute decision making (Criteria Evaluation) and Usability Testing (Usability Evaluation). The Multi-attribute decision making in the first phase of ECM presents an approach to the development of a qualitative hierarchical decision model that is based on DEX, an expert system shell for multi-attribute decision support. The second phase of ECM is aimed at Usability Testing on end users. ECM illustrates its usefulness by showing its main features and its application to the above problem. It is based on the theoretical and practical expertise related to the quality and usability assurance of LMS.

Key-Words: - Innovative E-learning Software, Education, Learning Management Systems (LMS), Evaluation Cycle Management (ECM), Criteria Evaluation, Usability Testing, Multi Attribute Decision Making

1 Introduction

Considering the abundance of e-learning systems that have offered education over the Internet during the past decade, it is not surprising that there has been growing interest in identifying design principles and features that can enhance user satisfaction. User satisfaction with technologies related to distance and collaborative learning applications has been found to be significantly associated with usability, that is, the effectiveness, efficiency and satisfaction that it gives to its user in a given context of use and task. The usability of a Learning Management System is often perceived to be the province of the technical expert rather than the content expert; however, technical knowledge is insufficient when it comes to designing and testing systems intended for e-learning. This paper presents one attempt to apply and evaluate different Learning Management Systems and also to discuss the findings in an assessment of the learnability, effectiveness, efficiency and level of satisfaction of an LMS. Results of the case study can provide a better understanding of the ECM methodology, development of multi-attribute decision making and usability testing [3,8].

To achieve the proposed objectives we will present and describe Evaluation Cycle Management (ECM), a novel methodology aimed at the evaluation of options that

occur in decision-making processes.

2 Evaluation Cycle Management (ECM)

2.1 What is ECM?

To assure that a product is good enough to satisfy all the needs and requirements of the users and other potential stakeholders, such as the users' clients or managers, we need to verify the products' characteristics and assess its acceptability within various categories. Several unique methods and techniques for evaluating products/systems are known, as well as many possible ways of combining various evaluation methods.

Evaluation Cycle Management (ECM), which was developed by the authors, can be classified as a combined evaluation system, because it is composed of two independent evaluation methods: Multi-attribute decision making (Criteria evaluation) and Usability testing (Usability evaluation).

2.2 Architecture of ECM

The principal feature that characterizes the Evaluation Cycle Management (ECM) is a two-phase evaluation method with a feedback loop. The first phase of ECM includes Multi-attribute decision making and the

second, Usability evaluation. The results gained from the Multi-attribute decision making model (first phase), developed by experts, is being verified on users as well. In case user usability testing (second phase) shows overly significant changes between the presupposed and the gained results, we return to the first phase and correct the multi-attribute model on the basis of the analysis results. When an observed product/system gains good results with the user testing, or only minor corrections are needed, such a system is recommended.

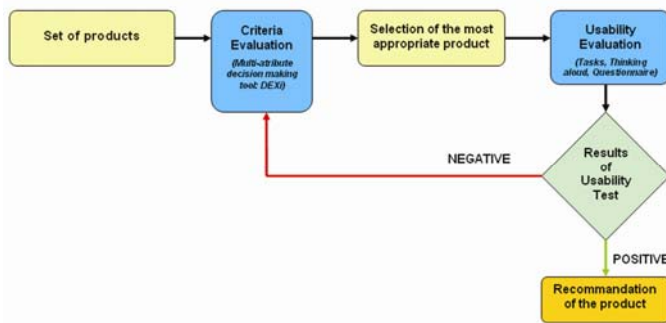


Fig.1: Architecture of ECM

The key advantage of the ECM methodology as seen by the authors is that in the first phase of evaluation (evaluation using a multi-attribute decision making model) only one – the most suitable solution – is chosen which leads to lowered costs and decreased use of time regarding continued evaluation in the second phase (usability testing), for only one solution is subjected to testing and not all [6].

3 Selection of the most appropriate LMS

3.1 Identification of the Problem

Parallel to the wide range of possibilities offered by new generations of educational technologies, a number of Learning Management Systems (LMSs) which support e-learning have been developed and are available on the market. Consequently, customers are often faced with the dilemma of how to choose the optimum LMS for the implementation of the education process for a definite target group. The general aim of our case study was focusing on the usability and applicability aspects of LMSs in relation to definite target group and users: employees in the Slovenian Drava-Mura Region SMEs with a basic knowledge of ICT.

3.2 Criteria Evaluation - Development of the Multi-Attribute Decision Making Model

The decision-making process was divided into four phases: (1) *criteria identification and criteria structuring*, (2) *utility function definition (decision rules)*, (3) *description of variants*, (4) *LMS evaluation and analysis*[1,2,5].

- *Identification, Description and Criteria Structuring*

This phase provides descriptions of criteria which are the components of the decision-making model. The criteria are divided into three main scopes: Student’s learning environment, System, technology & standards and Tutoring & didactics. These three scopes represent the skeleton of the multi-attribute model.

- *Utility Function*

The tree of criteria defines the structure of the evaluation model by defining the criteria and their interdependence. In the final outcome, this means that the overall evaluation of the LMS depends on 57 criteria. In DEX, the aggregation procedure is defined by decision rules, an example of which is shown in Fig. 2.

	Ease of use 39%	Communication 29%	Functional environment 21%	Help 11%	Student's learning environment
1	low	low	<=average	* low	
2	low	low	*	low low	
3	low	<=average	low	* low	
4	low	<=average	<=average	low low	
5	<=average	low	low	low low	
6	>=average	high	high	high high	
7	high	>=average	>=average	high high	
8	high	>=average	high	* high	
9	high	high	*	high high	
10	high	high	>=average	* high	

Fig.2: Utility function for criterion, Student’s learning environment

- *Description of Variants*

The multi-attribute decision making model was tested on three Learning management systems: Blackboard 6 (www.blackboard.com), CLIX 5.0 (www.im-c.de) and Moodle 1.5.2 (www.moodle.org). Blackboard is among the most perfected and complex LMSs on the market. The system offers various communication options (both synchronous and asynchronous) within the learning environment. CLIX is targeted most of all at big corporations, because it provides efficient, manageable, connected and expandable internet-based learning solutions. This scalable, multilingual and customizable software aims at providing process excellence for educational institutions. For educational administrators, CLIX offers powerful features for course management and distribution. Moodle is a free, open source PHP application for producing internet-based educational courses and web sites on any major platform (Linux,

UNIX, Windows and Mac OS X). The fact that it is free of charge is especially attractive for schools and companies which always lack resources for the introduction of new learning technologies.

3.3 LMS Evaluation and Analysis

The evaluation is carried out according to the tree of criteria from the basic criteria up. The method of aggregation is determined by the decision rules. The variant which is awarded the highest grade should be the best one.

Due to the complexity of LMSs and a large number of criteria it is essential that the decision-making model allows us to obtain not only the final assessment, but also a detailed partial analysis of individual elements. In this way we can detect weak points and disadvantages of the system, which can be used as the basis for system improvements.

The advantages and disadvantage of the systems are reflected in Fig. 3, showing evaluation results according to attributes: Functional environment, Ease of use, Course analysis, Tutoring & didactics, Assessment and Standards support for Blackboard, CLIX and Moodle LMS.

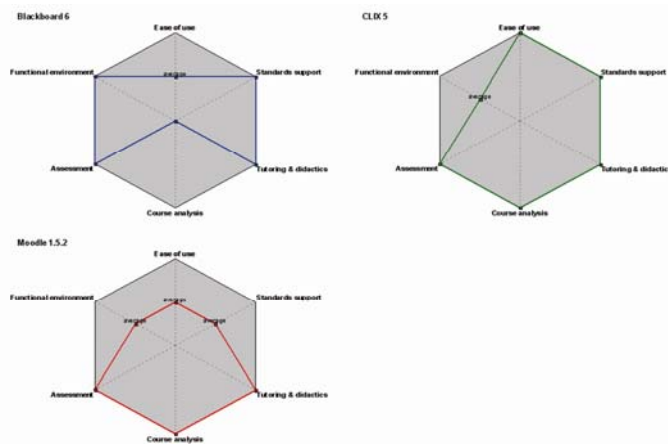


Fig. 3: Evaluation results for Blackboard 6, CLIX 5.0 and Moodle 1.5.2.

3.4 Usability Evaluation of CLIX 5.0

According to the results of the first phase of ECM (criteria evaluation), where the LMS CLIX 5.0 got the highest assessment among three different Learning Management Systems and methodology of Evaluation Cycle Management, we performed the second phase of evaluation: Usability testing (usability evaluation) of the LMS CLIX 5.0.

Standard user test procedures were adopted and were conducted by the respective evaluation administrators, who were responsible for recording the data, transcribing think-aloud protocols of the participants, asking them to fill out pre-test, post-task and post-test questionnaires and participant debriefing [11, 12, 17].

- *Participants*

We selected 10 participants, who were typical representatives of the target audience or were matched as closely to the criterion as possible. They possessed a certain level of experience and knowledge of information and communication technologies (ICT), experience in using software applications and had some basic knowledge about e-learning.

- *Test Objectives*

Usability goals for the LMS CLIX 5.0 were referred to on the hypothesis that users can utilize the services of the observed learning management system quickly, easily and accurately to accomplish their tasks in the way to attain the optimum level of effectiveness and efficiency, and find the navigation design comprehensive and user-friendly to attain an optimum level of satisfaction.

- *Task Scenarios*

A set of seven tasks covering the core functionalities of the LMS CLIX 5.0 and also presenting the potential usability problems. Here below is the list of the tasks:

- (T1) – Updating a personal profile
- (T2) – Booking a course
- (T3) – Accessing the learning resources of a booked course
- (T4) – Taking an e-test
- (T5) – Joining and contributing to the discussion forum
- (T6) – Making a post in the Chat-room
- (T7) – Creating a personal Bookshelf

Each of the above seven tasks was translated into task scenarios, which render the test more realistic and problem oriented.

- *Measurements and Usability Metrics*

Quantitative Data

a) *Effectiveness*: completion rate (percentage of participants who completed each task correctly with/without assistance from a usability administrator), errors (number of errors: in menu choice, selecting an item from a list and other) and assists (number of times looking up on-line help and from a usability administrator).

b) *Efficiency*: task time (mean time of completion of

each task, range and standard deviation of times) and completion rate efficiency (mean task time only for unassisted tasks).

Qualitative Data

c) Satisfaction: ratings and comments obtained through ASQ, CSUQ questionnaires and participant debriefing.

The results of the Usability Test

Quantitative Data

a) Effectiveness and Efficiency

Each participant was required to perform 7 tasks and fill out enclosed questionnaires. The mean time over 7 tasks is 47.65 minutes, with the range from 40.74 to 55.02 and a standard deviation of 4.453. Altogether, participants performed 70 tasks, 59 (84,3%) were correctly completed without assistance and 11 (15,7%) with assistance (on-line help, advice) from the usability administrator. Task 4 (Taking an e-exam) was found to be the most problematic. The mean time for Task 4 is 11.27 minutes and exceeds the time for completing the task (9 minutes), assessed by the experienced user, by 25,2%.

Qualitative Data

a) After Scenario Questionnaire (ASQ) The ASQ was developed to be used immediately following scenario completion in scenario-based usability studies. The three questions of ASQ unequivocally measure one single underlying aspect of participants' perceptions of how easily and quickly the scenarios were completed and the contribution of support information to carrying out the tasks. Each item is rated with a 7-point Likert scale, with 1 being "Strongly agree" and 7 "Strongly disagree". The items are phrased in a positive manner. The overall satisfaction rate over 10 participants is above the average with the mean value of 2.14. The lowest rating of satisfaction, with the mean value 4.67, was for Task 4, which indicates that this functionality is difficult and complex for general users to manage.

b) Computer System Usability Questionnaire (CSUQ)

CSUQ is publicly available questionnaire which contains 19 questions with a 7-point Likert scale for each answer. CSUQ can gauge three factors of satisfaction: *System Usefulness* (SYSUSE), *Information Quality* (INFOQUAL), and *Interface Quality* (INTERQUAL). A higher score gained out of a 7-point Likert scale means higher satisfaction with the system. The average overall satisfaction over 10 participants is 5.68, with a standard deviation 0.48. The implication of the value is that the users' general satisfaction with the LMS CLIX 5.0 is good. Both the system usefulness and interface quality were above the system average,

whereas the information quality was a little bit below the average. A little lower assessment for the INFOQUAL should be attributed to the fact that most of the 10 participants were not satisfied with the supporting on-line help and feedback messages [10, 11, 15, 16].

4 Analysis of Results and Findings

The main goal of the case study was the selection of the most suitable and appropriate LMS among the three available (BlackBoard 6, Moodle 1.5.2 and CLIX 5.0), which would to the greatest degree possible, satisfy the requirements and needs of the target group.

As was already expected at the commencement of evaluation, a system which would entirely satisfy the target group of users was extremely difficult to find. Each system observed had its strengths and weaknesses, thus the choice of the most suitable system was that much harder. The ECM methodology in the first phase – development of a multi-attribute decision-making model – foresees the choice of only one of a number of solutions, namely that which best satisfies the criteria defined especially for the aforementioned target group. Furthermore this solution, selected as most suitable in the second ECM phase was then also validated by testing its usability on end users.

Based on the results acquired with the aid of the first phase ECM methodology (criteria evaluation) it is evident that the LMS CLIX 5.0 obtained the best marks of all three main criteria, at the same time coming closest to the criteria of an optimal solution. Since it was, however, the second ECM phase (usability evaluation) which supplied the answer of whether the selected LMS CLIX 5.0 was really the most suitable solution for the selected target group, it was additionally subjected to the testing of its usability. Ten participants participated in the test, which, on the basis of 7 tasks, verified the key functionalities of the system. The LMS CLIX 5.0 also proved to be an extremely suitable system for the target group of users in the second phase of evaluation according to ECM methodology. While performing usability testing several deficiencies were ascertained which, according to experts, represent merely minor corrections (e.g. facilitation of navigation to e-testing, improvement of on-line help features, facilitation of terminological support texts in on-line documents, better color reconciliation and fonts for the user server, etc.).

Based on the results of the study implemented according to ECM methodology we concluded that the selected

LMS, CLIX 5.0 (with several minor corrections) was suitable for the chosen target group of users – employees in small and middle-sized companies and was also recommended for use by us. Since CLIX 5.0 received good marks both in the first and second phases of ECM and in terms of feedback, consequently modification of the multi-criteria decision-making model was not required.

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