

A TECHNIQUE TO INCREASE THE USABILITY OF E-LEARNING WEBSITES

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ABSTRACT: Distance learning is an ancient idea to impart education to the learners who were unable to join the regular educational institutes. Revolution in information technology has changed this mode of learning to e-learning. E-learning is the mode of education in which the learners in remote areas were educated through the use of technology. Many institutes have developed dedicated websites and learning management systems such as open courseware, to introduce e-learning method. These learning management systems are very efficient, have vast learning material and communication channels without assistive support for physically disabled users. Lack of assistive technology support in these websites stimulated negative user experiences. In this research work an e-learning usability evaluation model based on user's mental model, had been developed. Objective of this research work was to reduce the gap between user's mental model and designer's perception. The major problem while improving usability was a communication gap between user and designer.

Keywords: Usability, Accessibility, User Experience, Cognitive Burden, Learning Adaptive, Usability Evaluation Model.

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INTRODUCTION

Just making things easy to visualize may not be a parameter to address the usability. Usability is a well-defined unit of product adoption level of user with contentment, competence and worth. User experience, cognition and learning ability are important factors for website surfing (ISO-9241-11, 1998). Usability of websites is measured by its user adaptive level, screen reading level, satisfaction and learnability. The above-mentioned factors affect accessibility of a website design, user adaptation and display of contents with ease of use and navigation. Massachusetts institute of technology (MIT) launched its open courseware in 2002 for the first time in the history which gave the concept of e-learning. A lot of irrelevant images or textures on the websites lead to cognitive burden which disturbs the users. A combination of intrinsic burden, germane burden and extraneous burden is known as cognitive burden (Hasan, 2012).

The purpose of developing e-learning usability evaluation model is to reduce the gap between mental model of the user and designer's perception. User's interaction with system is mental model of the user. One of the major drawback is the gap between the mental model and designer's perception, which leads to less usability (Norman, 2004).

The concept for enhancing quality of teaching and learning via technology using virtual learning

environment(s) (VLEs) in medical education is given by Asarbaksh and Sandar (2013). They reported that 85% of the problems can be identified by questionnaire/survey and testing techniques which help to improve e-learning system. Think aloud technique, applied to let the learner to observe the system and to give feedback. They chose attributes like navigation; learning ability, visual design and consistency, which have been used to improve e-learning systems/websites.

It is important to achieve sufficient level of competence in an effective and efficient manner. User's experience is a major challenge, which leads to cognitive burden (Jayakumar and Mukhopadhyay, 2013).

In a study, Buchner *et al.* (2012) demonstrated usefulness of robots by experimental methodology while considering user experience as important issue. User Experience increases gradually and changes periodically. It is not static at all, and introduced their concept by introducing two kinds of robots i-e one working cell and one robotic arm. Robotic arm is feasible and is free to interact. UX measured by the following scales i-e perceived usability, general user experience, emotion and stress.

The accessibility issues regarding disability that affect the users in educational context. Physically disabled persons using websites have a great significant influence by the use of assistive technology. Developers of the websites must have knowledge about the distinguished features of assistive technology to work appropriately in

order to develop websites Freire *et al.* (2013).

The standards for evaluating usability of online learning management systems with a combination of ease in navigation structure were introduced by Hasan (2012). They used two online automated tools, html toolbox and web page analyzer along with a questionnaire directed towards users of Jordan University website. Each category deals with one usability aspect.

A weighted measurement evaluation for user accessibility while using e-learning systems has been developed. They proposed solution using semi-automatic tool. They tested two online learning management systems, as case studies (VULMS and efront) by conducting online survey to measure their usability. Satisfaction of user depends upon the level of usability, which originated from e-learning system Aslam *et al.* (2011).

A model for adaptive learn-ability, usability and user effectiveness of educational content management systems had been developed by Jooet *et al.* (2011). Their research work intended to develop usability evaluation models and a survey tool for measuring the learn ability, usability and efficiency for academic library websites.

A model that affects the efficiency and performance of young users while performing search operations on the web has been presented by Dinet and Kitajima (2011). They identified six mental model styles in their method: technical view, connection view, functional view, process view, technical functional view and functional-connection view. Browsing sites and defining the search processes involves the following three main steps: state the problem, choose the best solution and evaluate the answer.

A task analysis model for groupware to perform a task more precisely was developed by Pinelle and Gutwin (2008). Major components of task model were scenarios, tasks, individual, collaborative subtasks and actions.

A launch of new technology in market comes with lots of risks as time, failure and effort (Norman, 2004). New feature in the product enables user to adopt that product. Designer's objective is to meet the user satisfaction level. User Experience (UX) leads to usability. Usability of a website depends upon the satisfaction level of user (Hassenzahl and Tractinsky, 2011). It is observed in many scenarios that there is no communication between user and designer.

The section 2 focuses on developed model. In section 3, results and discussions for the developed model has been documented. In section 4, conclusion with future research section presented. References cited in section 5.

MATERIALS AND METHODS

The proposed web based learning usability

evaluation model (WBLUEM) is shown in Fig-1. The objective behind the research was to reduce the gap between user's mental model and designer's perception. The discussed factors were the designer's perception, the conceptual model based on user's perception, the user's mental model and the learning system evaluation parameters.

The conceptual model expressed basic functionality, vital standard of systems, websites including internal and external issues. It successfully implemented the fundamental objectives of the developed system. Mental model explicated the feelings of users about the working of these websites in the real world. It was a psychological representation of imaginary, hypothetical and reality.

What user believed about the system was mental model. The user's mental model was based on belief, not facts. The user interface should communicate the basic nature of system well. This was a prime goal of designers. Understanding the concept of mental models can help you to make sense of usability problems in design. When users have erroneous mental models they make mistakes on websites. Designers develop websites according to their mental level, vast knowledge and experience. They have no idea about the categories of different users. A designer cannot understand the accessibility and usability issues of naive users. This bad impression leads to negative user experience towards website. Cognitive science helps to explore mental models. Designers perception is basically guide of user experience that how much user is comfortable. Every user has its own thinking, perception and action, which results in different usability needs. This variation in the usability requirements leads to a gap between the mental model of user and the designer's perception.

Due to lack of communication between designers and users, the designers to develop websites without understanding the usability needs of the users. Users who interact with the system have different mental model and abilities (Al-Khalifa *et al.*, 2014). WBLUEM model is developed to reduce this communication gap. This may only be possible by conducting surveys, interviews and getting feedback. Based on user perception, the designer changes interface, perform some iterations and validations. The learning system evaluations parameters given in table 1 are used to conduct these kind of surveys. The five parameters usability, accessibility, cognitive burden, learnability and user experience are used for evaluation of a website. Lack of communication between user and designer causes the issues related to usability and accessibility. This leads to cognitive burden, which has influence on behavior towards user experience. All these factors directly or indirectly affect the learning adaptive-ness of the users. This model has practically implemented use of an online

questionnaire. User experience is a major challenge, which leads to cognitive burden.

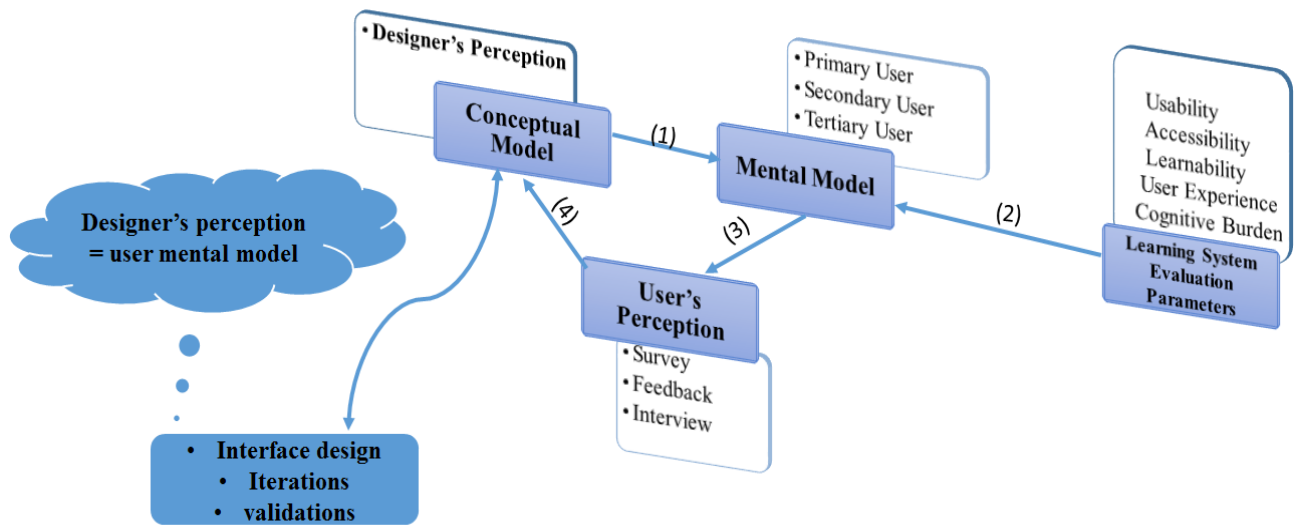


Fig 1: Web Based Learning Usability Evaluation Model

RESULTS AND DISCUSSION

The proposed approach used in current research work was based on an approach of a simple model to define the relationship between system, user and designer (Norman, 2004). The model developed in this research was an enhanced approach of same model. Also this model was based on earlier developed cognition model (Thielschet *al.*, 2013). Researchers added the conceptual model, which was a main element of WBLUEM. The gap between users' mental model and designers' perception may be reduced by conducting surveys, interviews and feedback from users time to time. The proposed model is shown in figure 1. When different kinds of users interact with a website their perception about that website

is developed. Conceptual model was used by different kind of users. When they have some accessibility or usability issues they will suggest in the form interviews. In this way, designers know what user want in the website. The interaction tools used to fill the gap between designer and user are survey, feedback and interview. In a study, Jooet *al.* (2011) developed model for adaptive learn-ability, usability and user effectiveness of educational content management systems. Designer again updates interface, performs iterations and validations. Then user's mental model and designer perception gets equal. Hasan (2012) introduced new standards for evaluating usability of online learning management systems with a combination of ease in navigation and structure.

Table 1. Usability Evaluation Parameters Based Questionnaire

Usability Evaluation Parameters	
Parameters	Sub Parameters
Usability	Browser Compatibility, Collaboration Support, Security, Ease of Use, Ease of Navigation, Completeness, Reliability and Efficiency, Multilanguage Support, Universality, Load Time, Accuracy
Accessibility	Hardware And Software Support, Controllability, Readability, Navigability, Display Space, Helpfulness
Cognitive Burden	Satisfaction, Display of Content, Readability, Use of Aesthetics, Design Consistency
User Experience	Satisfaction, User Friendly interface, Error Handling and Support, Attractiveness
Learning Adaptive	Remember ability, Pedagogy, Learner Facilitation, Curriculum Management

VULMS and Coursera were tested using virtual testing tool. The researchers tested the test bed VULMS and Coursera using Virtual-testing tool. The testing tool was used to measure the usability and accessibility of the

educational as well as other website. Any of the website can be checked by giving its URL or by uploading an HTML file. The complete description of errors is shown in table 2.

The results obtained from proposed model were compared with the previous exiting approaches to

validate this research. The comprehensive comparison is shown in table 3 and 4.

Table 2. Results obtained Using Proposed Model/Tool.

Description	Coursera	VULMS
XML Issues	8 errors	18 errors
XHTML issue	195 errors	7 errors
Accessibility	216 accessibility issues	5 pages with accessibility problems
Standards	1 page that violates W3C standards	5 pages that violates W3C standards
Usability	1 page with usability issues	5 pages with usability issues

Table 3. Comparison of Testing Tools with Proposed Tool.

Tool Name	W3C Validator	Virtual Testing tool
Capacity	Single webpage (main page)	Complete website
Criteria	HTML code, HTML 4.01 without repairing	Usability, Accessibility, HTML 5.0 with Repaired code
Base	W3C compliance	WCAG 1.0, 2.0, 3.0 , W3C compliance

In this section the researchers had discussed the validity of this research by comparing it with the results of already existing studies and validated the research. Aslam *et al.* (2011) used the questionnaire based technique for the comparison of two different leaning management systems of different institutes. Shrivastava *et al.* (2012) used the questionnaire as a tool. Mentis (2012) conducted a survey based on hypothesis. Asarbakhsh and Sandar (2013) used questionnaire based on learner observation and scenario. Jayakumar and Mukhopadhyay (2013) used a survey based on user feedback. Now in this proposed approach for enhancing the usability, an online survey questionnaire based on think-aloud and review of task analysis is used. No one of all above researchers used think-aloud and review of task analysis in combined fashion. So this technique has enabled us to get a proper user feedback about the usability of learning websites and hence concluded towards a more effective solution.

As far as the support for tool is concerned, again the existing techniques were either manual or semi-automatic. Only Aslam *et al.* (2011) introduces a semi-automatic support of tool in their research. All others, in our considerations, Shrivastava *et al.* (2012), Mentis (2012), Asarbakhsh and Sandar (2013) and Jayakumar and Mukhopadhyay (2013) used the manual ways and had no support of automatic tools. The tool proposed in this research is fully automatic. Hence, this proposed solution is far better than manual and semi-automatic tools used by the previous researchers.

The criteria used by Aslam *et al.* (2011) to evaluate the usability of learning management systems was based on feedback and interactivity, learning material, assessment, visibility, learner facilitation and support, error handling and prevention, collaboration support. Shrivastava *et al.* (2012) used the functionality, reliability and efficiency to observe the usability of

different learning management systems. Mentis, 2012 made the attractiveness, controllability, helpfulness, efficiency and learn ability as criteria to formulize the usability of learning management systems. Asarbakhsh and Sandar (2013) based their research for usability of learning management systems on the external quality attributes. Jayakumar and Mukhopadhyay (2013) used accuracy, feasibility, utility and propriety for evaluation. All above parameters and criteria used cover some of the aspects of evaluation. A complete set of all parameters was not used by previous researchers. In this proposed model, the researchers had used usability, accessibility, cognitive burden, user experience, and learning adaptive (all with their sub -parameters). Therefore, it is concluded that this research covers all parameters which were required for the evaluation of learning management systems. Cognitive burden, user experience, and learning adaptive were not taken under consideration by any of already existing studies. So this proposed model has comprehensively taken into account the vast spectrum of criteria to evaluate the usability.

Aslam *et al.* (2011) used EFront LMS, VULMS as a test bed in their research. Shrivastava *et al.* (2012) used Stanford University website and Georgia Institute website in their research. Mentis (2012) used the Namik Kemal University (NKU) website to perform his research. Asarbakhsh and Sandar (2013) used comparative study to conduct their research. Jayakumar and Mukhopadhyay (2013) showed their results only on theoretical basis. In this research, VULMS and Coursera learning management systems were used as test beds to evaluate the usability. These were more efficient and widely used than other used by previous researchers. The others were only simple websites or some of them had used either VULMS or Coursera. None of them used both of these LMS as test bed. Both VULMS and Coursera are

based on very complex and comprehensive LMS, so more options to be explored for the usability.

Aslam *et al.* (2011) adopted online data collection module to conduct their research work. Shrivastava *et al.* (2012) used Logical Scoring Preferences to propose their solution. Mentis (2012) implemented Website Analysis and Measurement Inventory methodology in their research. Asarbaksh and Sandar (2013) adopted think aloud to conduct the research. Jayakumar and Mukhopadhyay (2013) used Website Quality Assessment Model. In this research, online data collection survey and task analysis, Think aloud and Virtual Testing Tool are used to propose and implement this model.

The researchers had developed usability evaluation model for e-learning websites, by elaborating some important factors in a comprehensive way compared to previous approaches. The researchers had defined some tasks in an online activity where the researcher had collected users feedback based on think-aloud technique. The researchers had also developed criteria of usability evaluation based on some parameters as usability, accessibility, cognitive burden, and learning adaptive all with their sub-parameters. In the proposed conceptual model, the researchers had elaborated some important factors to measure the usability and accessibility. This model performed better than the previous models as shown in table 3. The deficiencies in the previous models had been addressed in this model.

The results obtained by the implementation of this proposed model is shown in table 2. The researcher had selected VULMS and global learning management system of Coursera as case study. The improvement in the accessibility of website directly and indirectly, increases the usability of websites.

Conclusion and future work: Websites play important role in e-learning as instructors and virtual classrooms are located at remote distance where everyone learns on equal level. Their testing and evaluation is an important aspect. User surveys are always best for evaluation of websites/learning management systems. The focus during this research was to increase usability of learning websites by the development of usability evaluation model. Designer's perception must match to user's mental model, which was only possible by taking user feedback and suggestions. The results shown in table 3, VULMS got 8 points for task analysis review and Coursera got 6 points for the same activity. Use of assistive technology support was suggested in findings and outcomes section, which is helpful for physically disabled users. Web based learning is a strong tool in developing countries. For a healthy interaction of the user to the websites, continuous feedback is necessary from users for learning websites. To improve the usability of the websites/LMS designers may be deploy a site

intercept survey.

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