DEVELOPMENT OF USABILITY CRITERIA FOR E-LEARNING CONTENT DEVELOPMENT SOFTWARE

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ABSTRACT

Revolutionary advancements have been observed in e-learning technologies though an amalgamated evaluation methodology for new generation e-learning content development tools is not available. The evaluation of educational software for online use must consider its usability and as well as its pedagogic effectiveness. This study is a first step towards the definition of criteria for evaluating e-learning tools. A preliminary user study involving a group of pre-service instructional designers, observed during their interaction with e-learning tools, is reported. Throughout the study, specific usability attributes of these e-learning tools were identified. Participants were assigned to rate the importance of functional and pedagogical competences proposed during the criteria development phase. The findings of the study revealed 31 evaluation criteria under the headings of technical, media, and assessment competences. Among the groups of benchmarks proposed and rated by the users, assessment was considered as the most important one while technical and media features were even.The following step was actual implemention of the usability criteria into evaluation of fifteen leading software used in e-learning across the world. Mostly, tools were observed as having limitations in terms of capabilities. Comparing to the other software, Captivate, Softchalk, and Lectora were regarded as outstanding tools by the participants. Following the discussion on the limitations of the study, some implications for further research were proposed.

Keywords: Usability, pedagogic usability, web based learning, content development tools

INTRODUCTION

Last two decades have witnessed the transformative effect of Internet on the design and development of e-learning environments which refers to the use of the internet and computer-based technologies to facilitate teaching and learning (Horton, 2006; Ruiz, Mintzer & Leipzig, 2006). Becoming very important in fields where access to learning materials needs to be brought about effectively and efficiently, e-learning is firmly embedded in many of the current educational theories. To examplify, it is widely recognized that learning is a social process (Vygotsky, 1978; Wenger, 1999) and Fowler and Mayes (2000) explain how learning relationships can encourage the conceptualization and re-conceptualization cycle which facilitates deep understanding. Kandies and Stern (1999) have asserted that web-enhanced learning improves instruction and course management and offers numerous pedagogical benefits for learners helping them become more active and self-directed learners. As with any other forms of learning, the strength of e-learning heavily relies on its delivery method and the instructional way by which specific media utilized. For this reason, the tools implemented into e-learning modules have to be pedagogically skillful in triggering an interactive, autonomous, and constructive learning climate.

The e-learning domain is getting over its early stages of development and classic tutorial types courseware are replaced to interactive and LMS friendly content development options. The development of content for e-learning environments includes the need of large teams, time constraints, and costs caused the emergence of rapid e-learning development tools. Nowadays, e-learning vendors have produced a number of e-learning authoring tools for creating learning objects for incorporation into learning or course management systems. These broadly split as follows: 'Powerpoint Plugin Authoring Tools' which are very easy to use as most people are familiar with Powerpoint. 'Desktop Authoring Tools' which are installed on your desktop and are generally more complex than the Powerpoint tools but they give you more control over the style and interactions. 'Server-Based Tools' which are hosted on a server and are typically accessed via a web browser over the internet. In their book, `E-learning Tools and Technologies`, William and Katherine Horton (2003) mention the roles of e-learning development tools in course and website authoring, testing and assessment, media editors, and content converters. Merrill (2000) specifies a pedagogic architecture for such tools and names it as `learning-oriented ID tool` which is one that has built-in instructional strategies which are based on the scientifically verified principles of instruction.

These tools, apart from developing multimedia training materials, simplify to prepare and publish course content to more than one learning management system (LMS). The software allows the instructional designer or the content developers to generate storyboards and support a variety of media and file types, such as text, graphics, video, and audio. Most include assessment and test creation features. On the other hand, since there is a shortage of comprehensive manuals or guidelines developed for adoption of these tools, it may take a long time for the users to handle them efficiently. Relatively, in many cases the instructional designer is not a capable programmer, and often the proficient programmer is not an instructional designer. Hence, attempts to adopt and utilize e-learning tools may turn into a mind-confusing and laborious activity.

Evaluation methods and curricula have become very important in a climate where there is increasing concern with assessing and maintaining quality (Jones et al. 1999). The adoption of e-learning tools deserves a profound attention and educational stakeholders require appropriate guidelines as well as effective evaluation methodologies to implement usable content development software (Zaharias, Vasslopoulou & Poulymenakou, 2002). However, a well-documented and widely accepted evaluation methodology of e-learning tools does not yet exist (Ardito et al. 2006). The current study attempts to respond a lack of particular guide for evaluating the usability of e-learning content development tools.

Usability Evaluation of E-learning Tools

The term usability was originally derived from the term 'user friendly' (Folmer et al. 2002). Usability is considered as the most important aspect of any interactive software for educational settings (Zaharias et al. 2002). The ISO 9241 Standard (1988) defines usability as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use'. Since, usability plays a significant role towards the success of e-learning software, an e-learning environment or tool should be evaluated considering both its usability as software and its didactic effectiveness (Ardito et al. 2004; Ardito et al. 2006; Costabile et al. 2005). In other words, a systematic evaluation should concentrate on the platform and the educational modules (Tervakari, 2002).

Moreover, the usability of e-learning environments has been defined as the extent to which an application is learnable and allows users to accomplish specified goals efficiently, effectively, and with a high degree of satisfaction.

In other words, if an e-learning tool is not usable enough, it prevents student's learning: the learners would not spend more time learning how to use the software rather than learning the contents. Evaluating usability is now considered an essential part of the system development process and a variety of methods and has been developed to support the human factors professional in this work.

Silius and Tervakari (2003) say that it is important to evaluate the pedagogical design of e-learning systems. Notess (2001) asserts that usability testing needs additional consideration in the light of the web-based learning environments, such as learner satisfaction with the learning content, learner perception of the applicability of the content, learner enjoyment of the learning experience, and actual learning, measured via tests.

The term "pedagogical usability" is used, in this paper, to denote whether the tools support various learners to learn in various learning contexts according to selected pedagogical objectives (Tervakari, 2002). According to Silius and Tervakari (2003) the pedagogical usability can be divided into three main categories as support for; organization of the teaching and studying, learning and tutoring processes as well as the achievement of learning, the development of learning skills.

Various usability evaluation methods exist (Dix, Finlay, Abowd & Beale, 2004) of which some of the most well-known are predictive evaluation, heuristic evaluation, naturalistic observation, user-based methods such as questionnaires and interviews, and usability testing (Preece, Rogers, & Sharp, 2007). In broad terms it is worth making the following distinctions between evaluation methods as user-based: where a sample of the intended users try to use the application, expert-based: where a usability expert makes an assessment of the application, and model-based: where an expert employs formal methods to predict one or more criteria of user performance. Testing an application with a sample of users is generally considered as the most reliable and valid usability evaluation method (Dillon, 2001). In a user-based evaluation, test subjects are required to perform a set of previously defined tasks. Depending on the primary focus of the evaluator, the users' success at completing the tasks and their speed of performance are used to clarify the usability level. After the tasks are completed, users are often asked to provide data on likes and dislikes through a survey or interview, or may be asked to view with the evaluator part of their own performance on video and to describe in more detail their performance and perceptions of the application (Partala & Kallinen, 2012).

The evaluation of software prior to its use, which, typically occurs when teachers are either planning lessons or making purchasing decisions (Squires, & Preece, 1996). The number of studies devoted to identify usability issues of e-learning systems and software is not large (Storey, Philipps, Maczewski & Wang, 2002). Moreover, it is often the case that the proposed criteria are only vaguely stated, so that an actual measurement is left to subjective interpretation and implementation. This paper has conducted work in the evaluation of various e-learning content development tools. The work presented in this paper is mostly focused on defining the usability aspects of e-learning software by soliciting the perceptions of prospective instructional designers as a group of users. The goal of this research is to reveal the results of an evaluation study in which various e-learning development tools were compared in terms of their pedagogic usability features. This comparison has been done in terms of technological competences, skills needed, and e-learning standards (SCORM).

Twenty-eight independent evaluators have provided required information to compare the tools. Later these independent comparisons were analyzed to come up a consensus. The following research questions were investigated:

1. What are user-based usability benchmarks of e-learning software?
2. What are users' evaluations toward usability guidelines of e-learning software?
3. What are users' evaluations regarding various e-learning software?

METHODS

Participants

The current study involved 28 senior students of a Multimedia Design, Development and Evaluation (MDDE) class at the Kirikkale University in Turkey. This course is provided to sophomore students attending computer education and instructional technologies departments of faculty of educations. They participated in the experiment as part of their credits for the MDDE course. The course curriculum involves authoring systems for PCs, courseware development phases, and interface design principles, imbedding multimedia into the software, user interaction, feedback systems, navigation, and multimedia evaluation. All participants had a basic knowledge of usability of interactive systems and of usability evaluation techniques, because they had some previous experiences of evaluating software systems.

Procedure

As a preliminary users study, a group of prospective instructional designers were observed during their interaction with an e-learning software in a real situation. The participants were provided with a list of the 15 leading e-learning content development tools and asked to develop an instructional module through the specific software they chose. The tools, identified through a review of literature, focused in the current study were; Softchalk, Content Point, Outstart Trainer, Tutor Author NG, Toolbook, Turbo Demo, Viewlet Builder, Ignite 4, Ready Go Web, Camtasia Studio, Lectora Inspire, Articulate, Mos SOLO, Course Lab, and Captivate.

Before the experiment process began, all participants were presented with a short demonstration of the tools to be evaluated. Each tool is reviewed by a group of students who have regularly used it to build instruction. Each group, consisting of three people, participated in their specific evaluation sessions in which the usability technique adapted to the context of e-learning was illustrated. The experiment in the current study consisted of 12 weeks. During the first six weeks, participants elaborated on designing and categorizing an evaluation criteria used to rate the tools. In the meantime, in order to be exposed to details of the software, learners were also expected to design and develop an instructional module exemplifying the basic features of that particular software without assigning them any content themes. The participants were not limited on the content type they were required to develop through the software. The last six weeks of the semester were devoted to actual evaluation of the e-learning systems based on the guidelines (criteria) developed within the previous stage.

Instrument

The data were collected through an evaluation form developed by the participants of the study. The development phase of the evaluation form was also included in the study as a research issue. The aim to develop the evaluation form was to purport the significance levels of the educational usability benchmarks of e-learning content development tools' from the perspectives of prospective instructional designers. The evaluation form was also utilized to determine how participants rated specific software in terms of basic benchmarks emerged from the evaluation phase. The parameters included in the evaluation form were identified by the students through a semester long course focusing on multimedia design, development and evaluation provided to pre-service teachers attending computer education and instructional technologies departments of Faculties of Education in Turkey.

To identify items for possible inclusion in the evaluation form, participants were asked about their experiential learnings. Additionally, a number of web and instructional design guidelines have been reviewed by the students, as well as a number of usability evaluation heuristics, checklists, and questionnaires. More specifically, an extensive review of prior studies referring to e-learning and usability was conducted by the researcher and shared with the participants (Tervakari, 2002; Trinchero, 2004 cited from Ardito et al. 2006). On the evaluation form each question is accompanied by rating scale including "unimportant (1), of little importance (2), moderately important (3), important (4), and very important (5)". Evaluators are asked to rate the package of questions connected to each criterion e.g. media. The questions have been modified so that the evaluator does not have to think to which degree a particular criterion has been reached. The evaluator answers to simple questions like "is it possible for a user to change the font size of the web page by using browser settings?" The Cronbach's Values for the evaluation form were calculated as follows; technical competences (0.86), media competences (0.81), and assessment competences (0.89).

ANALYSIS

This chapter will provide a guideline rated in terms of importance by the prospective instructional designers. The data gathered were analyzed through descriptive statistics via SPSS 17.0 software. Means and standard deviations were provided within the tables. Table 1, including 14 criteria, depicts the participants' perceptions toward the importance levels of technical competences of e-learning tools.

Table: 1
Participants' perceptions toward the importance levels of technical competences

Technical Competences	$\overline{X}$	sd
To be able to preview the content onstage	4.21	1.08
To be able to upload the content on LMS	4.20	1.15
To have importing and exporting options for different media files	4.08	1.05
To have update options	4.01	1.40
To be able to take screenshot	3.73	1.44
To have Rss and Podcast connections	3.54	1.24
To have mobile application	3.17	1.03
To be able to give time limits, specific to the prepared pages	3.33	1.37
To be able to give links to the content	3.04	1.10
To have mid-term exam preparation options	3.00	1.43
To be able to encode the content	2.98	1.34
Not to have a page-limit for the content	2.88	1.08
To be able to customize screen width when taking screenshot	2.38	1.16
To be able to make changes on the screenshot	2.17	1.32
Total	3.33	1.07

The results shown in the table above indicate that after defining 14 different technical competence levels for the e-learning content development tools, participants rated the items within the range of moderately important(3) to very important (5). Those which rated as very important are 'to be able to preview the content onstage (4.21), to be able to upload the content on LMS (4.20), to have importing and exporting options for different media files (4.08), and to have update options (4.01). On the other hand, 'to be able to take screenshot (3.73), to have Rss and Podcast connections (3.54), to be able to give time limits to the prepared pages (3.33), to be able to give links to the content (3.04), and to have mid-term exam preparation options' were rated at the level of important by the participants.

Not perceived as not important though, 'not to have a page-limit for the content (2.88), to be able to encode the content (2.98), customize screen width when taking screenshot (2.38), and make changes on the screenshot (2.17) were considered as moderately important factors of e-learning content development software. The overall importance rate of the first group of criteria was measured as 3.33 in the category of important. The following table will portray the competences proposed by the participants and their ratings of importance for the group of criteria under the heading of 'media competences'.

Table: 2

Participants' perceptions toward the importance levels of media competences

Media Competences	$\overline{X}$	sd
To be able to support outputs with various media extensions (swf, jpg, avi, mp3, mp4, flv)	4.33	1.10
To be able to modify contrast, brightness, color options of visuals	4.29	1.06
To be able to record audio files	3.96	1.10
To be able to watch videos from different URL addresses	3.80	1.16
To be able to create interactive texts	3.73	1.29
To be able to create animated texts	3.69	1.33
To be able to use zoom area tool	3.53	1.24
To have transition effect features for the prepared pages	2.76	1.28
Total	3.32	1.07

Table: 2 shows the participants' ratings toward the eight different sub-criteria to evaluate media competences of e-learning software. The results point out that while two of the tools' capabilities related to supporting (4.33) and modifications (4.29) of audio-visual files were rated as very important, participants declared that to be able to; record audio files (3.96), watch videos from different URL addresses (3.80), create interactive texts (3.73) and animated texts (3.69), and to be able to use zoom area tool (3.53) are also important for evaluating e-learning software. The only item which was regarded as moderately important is about whether the tool has transition effect features for the prepared pages or not (2.76). The total value dedicated to the media related competences of e-learning tools was observed as 3.32 which fall into the 'important' category from the perspectives of participants. The following table, including nine competences, shows how the participants rated assessment related competences of e-learning software.

Table: 3

Participants' perceptions toward the importance of assessment competences

Assessment Competences	$\overline{X}$	sd
To be able to give feedbacks to the answers given for the questions	4.57	1.14
To be able to give grades to the answers given in quizzes	4.30	1.11
To be able to write hints about the question to the question area	4.26	1.10
To be able to organize a quiz group	4.14	1.06
To have a question pool option	3.93	1.03
To be able to import questions from exterior question pools	3.86	1.07
To be able to ask questions over pictures	3.78	1.17
To be able to add pictures to the questions	3.46	1.01
To have a voice alert in feedbacks	2.76	1.12
Total	3.90	1.11

According to the results, participants perceived 'to be able to; give feedbacks to the answers given for the questions (4.57), give grades to the answers given in quizzes (4.30), write hints about the question to the question area (4.26), and to be able organize a quiz group (4.14) as very important benchmarks of e-learning software evaluation.

The results also indicated that while the only competence rated as moderately important is to have a voice alert in feedbacks (2.76), the items related to be able to; import questions from exterior question pools (3.86), ask questions over pictures (3.78), add pictures to the questions (3.46), and to have a question pool option (3.93) were rated as important factors while evaluating e-learning software. The overall rating of assessment competences were came out as 3.90 which is the highest competency category comparing to the other two groups. The following table is related to participants evaluation of specific e-learning tools focused throughout the evaluation phase. The scale exploited includes the items of unsatisfactory (1), poor (2), satisfactory (3), good (4), and outstanding (5).

Belve Table: 4 provides results under three sub categories of competencies (technical, media, assessment), and total values. In terms of technical competences, all of the software were considered as 'good' and 'outstanding' except for 'Ready Go Web (2.49), Viewlet Builder (2.76), and Mos Solo (2.34). While Captivate (5.00), Softchalk (5.00), and Lectora (4.76) are outstanding group of the list in both media and assessment competences, the only tool labelled as 'poor' is Mos Solo (1.79). None of the tools were seen as poor or unsatisfactory in terms of assessment competences. The overall values point out that Captivate (4.95), Softchalk (4.36), Lectora (4.67) are evaluated as the leading competent tools comparing to the rest of the list. Camtasia (3.80), Articulate (3.80), and Ignite 4 (3.07) were also labelled as 'good' software. The rest of the tools were considered as 'satisfactory' by the participants. In comparison with each other, all of the tools have various pros and cons though; none of them was evaluated as unsatisfactory.

Table: 4.
Participants evaluations of specific e-learning tools in terms of the quality competences

	Technical		Media		Assessment		Total	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Captivate	4,86	1,40	5,00	1,87	5,00	1,79	4,95	1,68
Softchalk	3,39	0,07	5,00	1,87	4,68	1,47	4,36	1,09
Camtasia Studio	4,34	0,88	3,74	0,61	3,34	0,13	3,80	0,53
Lectora Inspire	4,23	0,77	4,76	1,63	5,00	1,79	4,67	1,40
Articulate	4,01	0,55	3,34	0,21	4,03	0,82	3,80	0,53
Ignite 4	3,12	0,34	3,24	0,11	2,87	0,34	3,07	0,20
Ready Go Web	2,49	0,97	3,05	0,08	3,27	0,06	2,94	0,33
Turbo Demo	3,07	0,39	2,53	0,60	3,08	0,13	2,90	0,37
Viewlet Builder	2,76	0,70	2,37	0,76	2,53	0,68	2,55	0,72
Toolbook	3,67	0,21	2,63	0,50	2,58	0,63	2,96	0,31
Tutor Author NG	3,45	0,01	2,48	0,65	2,28	0,93	2,74	0,53
Tranier	3,58	0,12	2,26	0,87	2,43	0,78	2,75	0,52
Content Point	3,41	0,05	2,59	0,54	2,67	0,54	2,89	0,38
Mos Solo	2,34	1,12	1,79	1,34	2,12	1,09	2,08	1,19
Course Lab	3,28	0,18	2,17	0,96	2,35	0,86	2,60	0,67

DISCUSSION AND FINDINGS

As mentioned in the literature review, among interactive system developers and users there is now much agreement that usability is an essential quality of software systems. Usability evaluation is a core component of user-centered systems design and an essential competency for HCI domain. However, evaluating software for pedagogical purposes is not a straightforward job as in evaluating printed materials. The evaluation of e-learning applications deserves special attention, and evaluators need effective methodologies and appropriate guidelines to perform their task.

The present study was designed to determine a usability guideline for e-learning content development software. The study is also intended to provide insights to e-learning practitioners and distance education stakeholders in terms of how e-learning software can empower instructors and learners to develop e-learning specifications to meet individual instructional goals.

The findings from this study make several contributions to the current literature. The overall findings of the current study suggested 31 criteria classified under three categories as technical (14), media (8), and assessment (9) competence levels for the e-learning content development tools. In other words, evaluation patterns that are able to lead the educational stakeholders in the analysis of e-learning software are classified within technical, media, and assessment related benchmarks. The highly checked options for technical competences were related to uploading, previewing, importing, and exporting skills of the software. Users also noted that supporting various output file types and being able in modifying the visuals are critical media competences. Besides, participants underlined that being able to provide an interactive and feedback-rich assessment environment is a required feature for effective e-learning instruction through the software. Among the groups of benchmarks proposed and rated by the users, assessment was considered as the most important one while technical and media features were even.

The results of participants' evaluation of e-learning software revealed that there is a threefold discrepancy among the tools evaluated within the sub categories of technical, media, and assessment competencies. The first group including Captivate, Softchalk, and Lectora were regarded as outstanding tools by the participants. The highest rates were observed within the technical competences section.

The tools which were labeled in second category are Camtasia, Articulate, and Ignite 4. There are also tools while rated as satisfactory but not perceived as fully competent. To sum up, the e-learning software systems explored have varying functionalities and different user interface designs. They might have been built based on the same kind of learning processes in mind. Apparently, most tools were observed as having limitations in terms of capabilities. Some others have complex functionalities or may become terrific for some uses. Furthermore, needs in e-learning environments are likely to change and so one tool is unlikely to do everything it is supposed to do. E-learning tools are needed to facilitate sophisticated interactivity between the learner and the materials, tutorials, assessments, simulations, games, and animated models.

The usability evaluation process shows that e-learning programmes should be developed to be student centered, relevant, motivational, and able to accommodate individual student study routines. Besides, they must be well designed web based, educational resources. E-learning activities must be prepared to be as flexible as possible. However, with a small sample size of tools, caution must be applied, as the findings might not be transferable to all e-learning software being currently used in the field. By the time you are done compiling a list of e-learning tools, it is likely that there are even more of them available then when you started compiling the list. We've mentioned a few of them below, but I am sure that my list is less than complete.

Although graphics tools are commonly used to build buttons, logos, image maps, and other such items that are components of online instructional content, they are not reviewed here. The current investigation was also limited by the time. More research on this topic needs to be undertaken before the association between effective learning and the design criteria of software is more clearly understood.

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