ERGONOMIC EVALUATION OF E-LEARNING SYSTEMS

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INTRODUCTION

In order to achieve maximum interactive system transparency and enable users to fully concentrate on their work, the discipline of human–computer interaction (HCI) systematically applies knowledge about human purposes, human capabilities and limitations on one side, and those about the machine on the other. HCI research has provided numerous principles and guidelines that can steer designers in making their decisions. However, while applying good design guidelines alone is a good start, it is no substitute for a distinct interactive system evaluation. To enable and facilitate the design of usable interactive systems according to usability engineering principles, usability evaluation plays a fundamental role in a human-centered design process.

In today's emerging knowledge-for-all society, knowledge is considered to be a foundation of all aspects of society and economy in general, and the need for its rapid acquisition is more important than ever. E-learning, as an instructional content or learning experience delivered or enabled by electronic technology [1], is placed at the crossroad between information and communication technology (ICT) and education. However, progress in the field of e-learning has been very slow, with related problems mostly associated with the interface design of e-learning systems that did not meet users' needs[2]. In order to improve the learning experience and to increase the system intelligent behavior, the findings of relevant studies emphasize the central role of user interface design [3]. Furthermore, despite the important role of usability evaluation, the usability studies in the area of e-learning are not very frequent [4], and a consolidated evaluation methodology for e-learning applications is not available [5, 6].

On the other hand, although computers are being used at different levels of the teaching process (as the subject of teaching and a tool for supporting the teaching process) and despite decades of research, their use for tutoring (as the teacher itself) in everyday teaching environment has been quite limited [7]. With the intention of accomplishing the latter role, some systems, labeled intelligent tutoring systems (ITSs) [8], heavily rely on artificial intelligence techniques supporting student intelligent guidance. Despite the fact that ITS aim at imitating a human tutor and their usage for tutoring is still not a part of daily classroom settings, it has been argued that such technology-enhanced learning can improve the overall process of learning and teaching [9].

DEFINING USABILITY

Usability is the extent to which users can use a computer system to achieve specified goals effectively and efficiently while promoting feelings of satisfaction in a given context of use [11].

As Dix et al. highlight, usability evaluation (UE) consists in methodologies for measuring the usability aspects of a system's user interface (UI) and identifying specific problems. Usability evaluation is an important part of the overall user interface design process, which ideally consists in iterative cycles of designing, prototyping, and evaluating. Usability evaluation is itself a process that entails many activities depending on the method employed.

Common activities include:

- Capture - collecting usability data, such as task completion time, errors, guideline violations, and subjective ratings;
- Analysis - interpreting usability data to identify problems in the interface;
- Critique - suggesting solutions or improvements to mitigate problems.

Progress in the field of e-learning has been slow, with related problems mainly associated with the poor design of e-learning systems. Moreover, because of a depreciated importance of usability, usability studies are not very frequent.

However, despite widespread use of e-learning, the critical examination of its usability is a newer field [12]. For example, some higher education institutions have developed web-based learning applications and tools without adequate consideration of usability [13]. Other studies [14, 15] show that although there are many reasons for high attrition from e-learning programs, such as irrelevant content and inappropriate use of technology, the major factor is poor usability of e-learning applications.

It is important that e-learning environments are designed and evaluated in an educationally effective manner by taking into account both usability and pedagogical issues [14, 16, 17, 18].

There are various usability evaluation methods (UEMs):

- analytical;
- inspection methods such as expert heuristic evaluation;
- surveys by questionnaires and interviews;
- observational;
- experimental methods [19, 20, 21, 22].

Selection of an appropriate UEM requires consideration of its cost and effectiveness [16].

In the case of e-learning, selection of a UEM is particularly important, because unless a system is easily usable, learning is obstructed and students spend more time learning how to use it than learning from it [16].

USABILITY IN THE CONTEXT OF E-LEARNING

There is a current focus on research on the intersection of human-computer interaction (HCI) and e-learning environments to determine how to engage learners and motivate them to interact with these systems [23]. Usability is a key issue in HCI, since it is the aspect that commonly refers to quality of the user interface [24]. The International Standards Organization (ISO-9241) defines usability as [25]: 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. Usability of e-learning applications significantly affects learning, since learner interactions with e-learning interfaces should result in true learning rather than in successful completion of tasks. As well as being a computing system, an e-learning product is also tutorial matter. The effectiveness of learning and users' satisfaction with a resource are therefore part of its usability. The interface should not be a barrier to learning or distract learners from achieving their learning goals. Ideally, the interface should be virtually invisible to the learner [16, 17, 26]. When systems are not easily usable, learners might spend excessive time trying to understand the system and how to use it, rather than engaging with the actual learning content [17]. In fact, there should be a synergy between the learning process and the interaction with the application [16, 18].

USABILITY EVALUATION OF E-LEARNING

Usability evaluation is concerned with gathering information about the usability or potential usability of a system, in order to assess it or improve its interface by identifying problems and suggesting improvements [22]. To ensure usability, evaluation should, ideally, be performed during development [27]. Conventional UEMs for user interfaces such as user surveys, observation and testing, and heuristic evaluation can be applied to identify problems in e-learning applications [14]. However, Squires and Preece [18] recommend that these approaches should be used differently in evaluating e-learning. Considering the discussion in Section 2.2, evaluation of educational software should investigate usability, interaction design, pedagogical effectiveness, learning content, and how well learners are supported in learning. Similarly, Masemola and De Villiers [28] point out that evaluating e-learning is different from evaluating conventional task-based software since, in the former context, the focus is on the process supported by the application (learning) rather than on a product generated by interacting with the system. There should be an integration of usability, didactic effectiveness and learning issues in such evaluations [16, 18, 29, 30].

The selection of appropriate UEMs depends on various factors. Since some instructors and developers are unfamiliar with the methods [31] and cannot undertake evaluations themselves, it is important that inexpensive, effective and noncomplex methods be used to evaluate usability and to determine usability problems [16].

THE NEED TO DEVELOP A USABILITY EVALUATION METHOD FOR E-LEARNING APPLICATIONS

Organizations and educational institutions have been investing in information technologies to improve education and training at an increasing rate during the last two decades. Especially in corporate settings continuous education and training for the human resource is critical to an organization's success. Electronic learning (e-learning) has been identified as the enabler for people and organizations to keep up with changes in the global economy that now occur in Internet time. Within the context of corporate training, e-learning refers to training delivered on a computer that is designed to support individual learning or organizational performance goals (Clark and Mayer, 2003). Although e-learning is emerging as one of the fastest organizational uses of the Internet (Harun, 2002), most e-learning programs exhibit higher dropout rates when compared with traditional instructor-led courses. There are many reasons that can explain the high dropout rates such as relevancy of content, comfort level with technology, availability of technical support etc. but one major contributor is the poor usability of e-learning applications. The latter is the focal point of this study.

Evaluating the usability of e-learning applications is not a trivial task. Increase in the diversity of learners, technological advancements and radical changes in learning tasks (learner interaction with a learning/training environment is often an one-time event) present significant challenges and render the possibility of defining the context of use of e-learning applications. Identifying who are the users and what are the tasks in e-learning context impose extra difficulties. In the case of e-learning design the main task for the user is to learn, which is rather tacit and abstract in nature (Zaharias and Poulymenakou, 2006). As Notess (2001) argues "evaluating e-learning may move usability practitioners outside their comfort zone". Squires (1999) highlights the need for integration of usability and learning and points out the non-collaboration of workers in HCI and educational computing areas. In fact usability of e-learning designs is directly related to their pedagogical value. An e-learning application may be usable but not in the pedagogical sense and vice-versa (Quinn, 1996, Albion, 1999, Squires and Preece, 1999). Accordingly usability practitioners need to familiarize themselves with the educational testing research, learning styles and the rudiments of learning theory. Nevertheless very little has been done to critically examine the usability of e-learning applications; there is an ellipsis of research validated usability evaluation methods that address the user as a learner and consider cognitive and affective learning factors that support learners to achieve learning goals and objectives.

IMPORTANCE OF USABILITY EVALUATION

Research in the HCI field has provided numerous principles and guidelines that can steer designers in taking their decisions. Nevertheless, although applying good design guidelines alone is a good start, it is no substitute for system

assessment. To enable and facilitate design according to usability engineering principles, usability evaluation plays a fundamental role in a human-centered design process [32, 33]. Numerous different approaches to the assessment and measurement of interaction between users and systems are known in the literature. Every one of them considers usability in terms of a number of criteria which formalize the user behavior to be supported, and provides usability objectives at an appropriate level [34]. Moreover, usability as a quality of use in a context [35] should be viewed as comprising two essential aspects: (1) efficacy in use, considered primarily as involving measures of user performance, and (2) ease of use, considered primarily as involving subjective judgments' [36].

Although usability is the basic parameter for the evaluation of e-learning technologies and systems [37], the idea of e-learning usability is still quite new [38]. Concerning usability evaluation methods, it has been claimed that usability assessment needs further consideration of the learning perspective [39]. There are some approaches adapted to e-learning [40], although some authors propose applying heuristics without further adjustment to the e-learning context [41, 42, 43]. Obviously, there is a need for further research and empirical evaluation [44], since an established set of heuristics [45] and a joint evaluation methodology for e-learning applications are not yet available [5, 6].

Furthermore, the employment of design-for-all in e-learning environments promotes individualization and end user acceptability, ensuring that usability and accessibility should be design concerns. For this reason, the design of accessible and easy to use e-learning system able to address the needs of all potential users requires additional considerations.

The main issues regarding universal design related to e-learning systems include:

• Learner-centered design paradigm: the same practices followed by the HCI community must be used in order to ensure learn ability, a major issue for e-learning, as rephrased by Don Norman [46].

• Context of use approach: in order to match users' needs in the natural working environment, e-learning system should be seen in terms of a four-component model of HCI [47]: whether the user for whom it is designed can use it with acceptable levels of usability and accessibility, for the tasks that s/he needs to do, in the local environment in which these tasks take place, using the available technologies.

• Individualized approach: the consideration of users' different individual characteristics relevant to learning styles and preferences fosters individualization and end-user acceptability.

• Pedagogical framework: the support of (new) pedagogical approaches that blend new and old ways of learning in order to maximize the learning potential of technology [48].

• Guideline framework: the employment of usability and accessibility guidelines for e-learning quality assessment.

Comprehensive research concerning an evaluation methodology addressing such a broad spectrum of issues is needed.

FUTURE WORK

More research needs to be conducted in order to develop and to standardize usability evaluation methods in application for e-learning. The major challenge is to provide a usability evaluation technique, which incorporates learners' perceptions, integrates usability and instructional design, and at the same time is simple, cheap and reliable.

For further developing the survey evaluation is going to be used for evaluation of e-leaning application chosen for the experiment.

A questionnaire survey and interview will be taken, for the evaluation among learners.

CONCLUSIONS

Current efforts in designing the IST products and services that satisfy the needs of all potential users of today's emerging knowledge-for-all society address user interfaces as one of key issues. They place the individual at the very core of development, emphasizing the necessity to design technologies for users and to make interaction accessible and usable. Knowledge is the most important resource in the context of the knowledge-for-all society, and the need for its rapid acquisition is more important then ever. Within this framework, e-learning systems have a particularly important role because of the increasing need to support educational flexibility as well as self-education and life-long learning.

Usability goals will be achieved if the system capability is actually used to a specified level of user performance, as well as to a specified level of subjective assessment. These objectives enabled to highlight the need of quantifying usability in terms of user (teachers and students) performance and satisfaction.

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