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Exploring user satisfaction for e-learning systems via usage-based metrics and system usability scale analysis

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ABSTRACT

The use of e-learning technology is incontestably recognized as an important and integral part of the educational process. Considerable research studies are carried out in order to apprehend how effective and usable e-learning systems. In this paper, an empirical-based study is conducted to explore how lecturers interact with an e-learning environment based on a predefined task model describing low-level interactions. Client-side log data is collected from university lecturers from the Electrical and Computer Science departments. Subsequently, data analysis is conducted to infer the usability degree from the estimated usage metrics together with further exploratory analysis from user feedback via System Usability Scale. Experimental results reveal that the System Usability Scale score is not a sufficient measure to express the true acceptance and satisfaction level of lecturers for using the e-learning systems. The evaluation must be fulfilled in tandem with analyzing the usage metrics derived from interaction traces in a non-intrusive fashion. The proposed approach is a milestone towards usability evaluation to improve the acceptance and user experience for academic staff and students.

1. Introduction

The unprecedented growth of internet-based technology has led to the advent of numerous approaches devoted to the area of education manifested in the use of e-learning systems. The pace of e-learning is getting remarkably higher as most of the educational institutions have already installed web-based systems for offering online courses (Garrison, 2011; Guri-Rosenblit, 2006). These often complement traditional methods enabling students to engage from any place with their learning through various materials alongside or instead face-to-face teaching delivery (Guri-Rosenblit, 2006). The European commission defines the e-learning process as the use of Internet and multimedia technologies to improve the quality of teaching through providing access to resources and educational services as well as enabling remote evaluation, exchange and collaboration between students and lecturers (Dominici & Palumbo, 2013; Nichols, 2008). The main motives behind the use of e-learning technology are to enforce a profound change in the way teaching takes place in educational institutions from the still widespread transmissive approach towards the more participated, self-regulated and interactive methods that are considered as important for improving the learning outcomes (Garrison, 2011; Persico, Manca, & Pozzi, 2014). Interestingly, e-learning platforms are being recently introduced in schools, public administrations and corporations to increase the learning opportunities and overcome the drawbacks of traditional teaching (Stoffregen, Pawlowski, & Pirkkalainen, 2015; Violante & Vezzetti, 2015).

As more and more universities worldwide have opted to use e-learning environments for their course delivery, research in e-learning systems have attracted considerable interest in order to apprehend how effective and usable e-learning systems in terms of principles related to human computer interaction (Bringula, 2013; Escobar-Rodriguez & Monge-Lozano, 2012; Navimipour & Zareie, 2015). Positive user experience is of prime importance for educational learning systems playing vital role for the acceptance, satisfaction and efficiency of academic institutions. This is mainly because the availability of technological infrastructures and systems is not adequate to enforce the uptake of new educational approaches from both sides of the lecturer or the learner (Laurillard, Oliver, Wasson, & Hoppe, 2009; Persico et al., 2014; Phillips, McNaught, & Kennedy, 2012). The usability nature of e-learning software products is a key characteristic to achieve the

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acceptance of academic users regardless of their background, experience or orientation. Usability is defined as the extent to which a product can be easily used by specified users to achieve certain goals with effectiveness, efficiency and satisfaction. The satisfaction part is related to how the users believe or feel positively that the system meet their requirements (Capece & Campisi, 2013; Lee, Kim, & Lee, 1995; Yeh & Lin, 2015). Meanwhile, other researchers have defined satisfaction as the gap between the expected gain and the actual again when using the system (Tsai, Yen, Huang, & Huang, 2007). Software systems are valued on the basis of its graphical interface and the related power of communication and expression for the implemented functionalities (Cassino, Tucci, Vitiello, & Francese, 2015). It is no doubt that usability is now recognized as an important software quality attribute, earning its place among more traditional attributes such as performance, robustness and security.

There is a dearth of studies and approaches devoted for the exploratory evaluation of the acceptance and usability aspect by university lecturers for using e-learning applications. Motivated by the fact that the process for introducing e-learning systems is bound to have a slow and complex trend (Persico et al., 2014) which needs to be understood and evaluated beyond the use of just summative ways, hence we explore in this paper an empirical-based study to assess the satisfaction level of how lecturers interact with an e-learning environment system based on a predefined task model describing low-level interactivity details. The main thrust of this research is to evaluate the usability of the e-learning platform as usability is considered a vital attribute for the adoption of educational systems by lecturers. An online automated system for formalizing user interaction with a given system guided through a set of rules describing certain goals to be achieved by the end user is setup for usability practitioners. The task model is mainly utilized to capture all the interactions and navigation path to be carried out by the university staff. Empirical client-side log data is collected from university lecturers from the Electrical and Computer Science departments participating within the usability evaluation of the e-learning system in a non-intrusive fashion without the need to install additional tools. The Moodle e-learning platform is used as the case study for this research. Subsequently, data analysis is conducted to infer the usability level. This is carried out in compliance with the defined task model and usability metrics describing efficiency of use. Regardless of the fact that users have expressed higher satisfaction scores through the System Usability Scale (SUS) (Brooke, 1996), empirical results performed to inspect the usability of the e-learning platform have revealed that potential reasons to impede the adoption of new technologies within the teaching process is primarily related to the complex nature of the software interface where the majority of lecturers failed to complete simple tasks.

This paper is organized as follows. The next section outlines the existing approaches and studies related to the evaluation of user satisfaction for using e-learning systems. The theoretical description of the presented approach for quantifying the usability is described in Section 3. Section 4 is devoted to show the experimental results attained for the evaluation of the Moodle Platform. Finally, discussion and conclusions are drawn.

2. Literature review

Evaluation of e-learning applications in terms of user experience and satisfaction has received recently considerable attention from the research community in order to assess and quantify the satisfaction and effectiveness level for both students and lecturers. This is due to the increasing concern that despite the wide use of e-learning technologies, the intended impact on education is not achieved (Asarbakhsh & Sandars, 2013; Phillips et al., 2012). Ivory et al. (Ivory & Hearst, 2001) argued that the automation of usability evaluation for software systems would help to increase the coverage of testing as well as reduce significantly the costs and time for the evaluation process. Hornbæck (Hornbæk, 2006) reviewed an extensive list of studies related to usability evaluation covering over 180 published papers examining critically the practice of measuring usability of software systems. The main aim of the conducted study was to understand and explore the challenges facing the reliability as well as the validity of usability evaluation methods. Fernandez (Fernandez, Insfran, & Abrahão, 2011) surveyed the recent studies related to usability evaluation where they have categorized the different methods into broadly two main classes; empirical and inspection methods. The study reviewed by Fernandez was primarily aimed to investigate the applicability of the usability evaluation techniques for web applications.

2.1. E-learning evaluation models

There are a number of methods and theories in the literature for understanding, predicting, and assessing the interaction process with its involved parts including personal factors, behavior, and the environment. In order to assess the user acceptance for technological products, one of the most well established models is the Technology Acceptance Model (TAM), which was proposed by Davis (1989). The TAM is tailored to include questions to explore two aspects of the user satisfaction which are: perceived ease-of-use and perceived usefulness. The ease of use refers to how users believe that adopting a particular technological product would require no effort and hassle to use it (Davis, Bagozzi, & Warshaw, 1989). The perceived usefulness concerns the degree to which a user believes that using a particular software system would improve their job performance. The Technology Acceptance Model has been used in various studies to assess the factors affecting individual's use of technology (Venkatesh & Davis, 2000). For research studies related to assess the usability aspect of the Moodle e-learning platform, Persico (Persico et al., 2014) employed the Technology Acceptance Model to investigate the willingness of university users for the adoption of e-learning systems. Evaluation is based on three dimensions including usefulness, ease of use and effectiveness. Escobar-Rodriguez (Escobar-Rodriguez & Monge-Lozano, 2012) analyzed how university students use the Moodle platform in order to determine and understand the factors which might influence their intention to use the platform. The Technology Acceptance Model is used to assess the usability of the system in terms of perceived usefulness and ease of use against actual usage behavior.

There are other related models and theories such as The System Usability Scale (SUS) which was proposed mainly for the evaluation of web applications for two aspects; the learnability and usability. The SUS is a well-researched and widely used questionnaire for assessing the usability of mostly web applications. Surprisingly, only a few studies in the literature have used SUS to evaluate the perceived usability of e-learning management systems (Orfanou, Tselios, & Katsanos, 2015). The first study of using the SUS for e-learning systems was conducted by (Renaut, Batier, Flory, & Heyde, 2006) to inspect usability problems for the SPIRAL platform. The researchers employed the SUS scale as a post-assessment of the usability of the software system reporting an average score of 72% for the participating university lecturers who described the platform as positively easy to use. In (Simões & de Moraes, 2012), Simoes examined the usability of the Moodle e-learning platform using three different evaluation methods including the SUS questionnaire to assess user's satisfaction for a sample size of 59 students. The authors concluded that the SUS is an effective tool for