Systematic Usability and User Experience Evaluation as a Basis for the Redesign of an e-learning Platform

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Abstract—This paper introduces a methodology and results of the usability and user-experience evaluation of OpenScout portal which aims at providing skill- and competency-based federated search and retrieval web services that enable users to easily find, access, adopt, use, tag and exchange free content for management education and training. Why usability and user-experience evaluation? In the process of developing such complex (web) applications and systems, developers are often not sufficiently aware of the criteria of usability as a key qualitative factor of the system, which measures the consistency of the product with the needs, goals and requirements of end users. Therefore many users have difficulties when interacting with a system which adversely effects on their effectiveness, efficiency and satisfaction and have possible negative influence on decision to its future adoption. In our case a combination of usability evaluation methods (UEMs) were deployed: Eye-tracking, Retrospective Think-Aloud, Heuristic Evaluation, different Questionnaires and System Usability Scale to address the particularities of the portal and specific research goals: identification of usability problems (UPs) as well as user experience (UX) from which HCI experts can prepare redesign proposals for the prototype improvement.

Index Terms—Usability Evaluation, Eye-tracking, Web services, Free Learning Materials

I. INTRODUCTION

Considering the abundance of various educational portals that have been offered 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 interactions with such systems which consequently influence user satisfaction. Indeed, user satisfaction with technologies related to distance and collaborative learning applications is an integral part of usability, which is traditionally defined in terms of effectiveness, efficiency, and satisfaction that a system gives to its user in a given context of use and task (ISO 9241-110) [4]. The usability of an educational portal is related to its level of use and evaluation of its usability is part of the processes of establishing its quality. In the literature, there are numerous recommendations for the design of pages, text, graphics, and navigation in web portals. In spite of that, it is still recognized that “severe usability problems are present and common” [1].

Usability evaluation of web based environments is traditionally conducted by means of task performance measures and subjective measures such as questionnaires, interviews, etc., but sometimes these traditional usability testing methods do not provide evaluators with all the information needed for an in-depth usability research analysis of the system. The evaluation of the user’s thought process is difficult to access with classical usability techniques. Eye movement data and eye fixations can supplement the data obtained through usability testing by providing more specific information on the user’s visual attention. Research has shown that the user’s eyes do not wander randomly and that people look at what they are working on [3], therefore incorporating an eye tracking technique into the usability evaluation can provide some additional information. This paper further discusses the preparation of usability evaluation plan (requirements and goals) that employed a methodology combining traditional usability methods and eye tracking technique.

II. BACKGROUND

In the framework of the OpenScout project (www.openscout.net), which is co-funded by the European Commission within the eContentplus Programme as a Targeted Project in the area of Educational aims at accelerating the use, improvement and distribution of open content in the field of management education and training with a focus on SMEs and continuous training by providing skill-based search of content to large communities for learning – either in professional user communities (via integration with LMS systems) as well as to open web 2.0 communities (via integration to social network platforms). The case of usability and UX evaluation was developed OpenScout portal which covers the whole value-chain of user-generated and community-improved content: from skill-based search/retrieval to support of users to improve existing and generate new contents. OpenScout is focused on two main goals:

1. To provide federated, Skill- and Competency-based search and retrieval web services within LCMS systems and social network platforms to end users: The envisaged e-content services will increase the use of open content within LCMS systems as well as open the access directly within web 2.0 social network platforms. The searched and retrieved content will originate from a large pool of different content repositories, will be of various types, and will be used in a number of ways, either as part of formal learning scenarios or as informal learning content offered directly to end users.

2. To support user-improved content: Integration of a number of novel content management and use models, with a high potential for cross-cultural/national transferability, and build an open community of providers.
In this community, users are enabled and supported to localize, adapt and improve existing materials and republish them. This will lead to an exponentially increasing amount of contents and to new solutions for many domains [7].

Figure 1. OpenScout portal

Like most technology-enhanced learning (TEL) systems, users of the OpenScout portal (http://learn.openscout.net) have to authenticate themselves by logging in with user name and password (see Figure 1). After entering the portal they can update their profile, including personal attributes, photo, etc. Students, professionals in SMEs or large enterprises as well as teachers or course designers can search for open management content amongst multiple repositories that fits their specific needs.

Figure 2. OpenScout flow

The OpenScout portal provides users with an interface to start a keyword based search, filter search results, include competence search criteria, or add social metadata like tags, comments or ratings. Additionally, users are presented with recommended free tools for content adoption, collaboration and communication, they can search and follow friends who share same interests and view their content recommendations, etc.

III. THE EVALUATION METHODOLOGY

It is imperative to validate the design of the portal that can support users to achieve their tasks with effectiveness, efficiency and satisfaction (i.e. the three usability metrics: ISO 9241-110) [4]. Hence, informal Heuristic Evaluation (HE), User-based usability tests (UT) and Retrospective Think Aloud (RTA), three common usability evaluation methods (UEMs) will be employed to evaluate the system. HE, based on Jacob Nielsen’s ten usability heuristics, will be applied by a usability specialist to predict where UPs most likely occurred [6]. This evaluative activity aims to identify relatively severe usability and user experience problems of the prototype. Problems and suggested solutions will be reported to the design and development team, thereby removing the problems from the prototype before having it tested by end-users. Laboratory based user tests will be conducted to identify remaining usability problems and prepare improvement suggestions for redesign (i.e. recommendations). In addition to conventional performance measures (e.g. task completion rate, time-on-task), psycho-physiological measures with the use of sophisticated eye-tracking technique will be employed as well. Data gathered with the RTA and eye tracking technique such as eye movements (saccades) and eye-fixations, which somewhat reflect patterns of a user’s searching and navigating the interface, can provide insight into a user’s visual attention and perhaps into a user’s decision making process, albeit with reservations, given human interpretations of the data. Nonetheless, data about user visual attention provided by the eye-tracking technique can supplement evaluation outcomes from traditional usability testing [8]. This not only addresses the goal of validating the system but also the research interest of investigating the relationship between objective and subjective usability measures.

User-based usability test (UT)

In general, there are two types of usability evaluation: formative and summative. The former is diagnostic with the goal of identifying usability problems (UPs) and, possibly, solutions to resolve them, whereas the latter is benchmarking with the goal of gathering baseline measures that are used to compare with the performance of the next iterative version or competitive products/services. In the current context, we have addressed both aspects.

A. Participants

OpenScout aims to establish an active user community of open management content with a focus on both providers and learners which using differentiated approaches like: SMEs and Companies, Educational institutions, Instructors and trainers, Students/learners and other participants, Librarians. To ensure the representativeness of the evaluation we have carefully selected fifteen participants (7 female and 8 male) whose native language is Slovenian. All of them had the educational level of at least the first university degree. Their participations were voluntary. They were designated as P1, P2 and so on. Prior to working out the task scenarios with the portal, the participants were
required to complete a Pre-test Questionnaire on demographic data (e.g. gender, age, job title etc.). This questionnaire also reflects the average level of competence in ICT (M = 3.70), the average level of competence in social networking (M=4.09), the average level of competence in online collaboration and communication (M = 3.81) and the average level of knowledge in economics (M=3.36). We convert the nominal to interval scale, with left anchor “1” indicating the lowest level and right anchor “5” the highest level of the attribute in question. All test participants were ‘virgin users’ what means that none of the participants had interacted with the OpenScout portal before they took part in the usability tests. These demographic data are relevant for interpreting the results of usability tests.

B. Apparatus

The Tobii T60 eye tracker (http://www.tobii.se) paired with a 15” LCD monitor (96 dpi) set at a resolution of 1280 x 1024 was used for this usability evaluation (see Fig. 3). This eye tracker was developed for absolutely contact-free measurement of eye movements including automatic head-movement compensation [10]. The human eye moves by alternating between saccades and fixations. A saccade is the quick movement of the eye in order to move focus from one area to the next. A fixation is the time spent looking at the newly found area. An eye tracker follows the eye during its saccades and tracks the location of the fixation points. Gaze data are logged by Tobii Studio v2.3 (eye-tracking recording and analysis software). Before starting the tasks, a 9 point calibration of the eye tracker for each participant using Tobii Studio needs to be performed. All web pages were shown in Internet Explorer 9; the browser window is sized to 1280x995 pixels. The use of additional windows was prohibited. In addition, a laptop (OS Win 7, 15.4” Display monitor) was in juxtaposition with the eye tracker. It was connected to the website displaying the scale of SMEQ [9]. Figure 3. Test person in an eye tracking situation (Tobii, 2011)

C. Task Scenarios

At the first usability testing a set of three tasks covering the core functionalities of the OpenScout portal and also presenting the potential usability problems was defined. Here below is the list of the tasks:

(T1) – Explore “OpenScout portal” and carry out a registration
(T2) – Search for Management Learning Resources
(T3) – Publish Learning Resource

Each of the above three tasks were translated into task scenarios, which render the test more realistic and problem oriented (e.g. T3 Scenario: “Imagine that your institution has decided to create a new course on supply chain management. You are delighted to have been selected as responsible for tutoring in the new course. A special working group at the institutional level has created a list of competences that course participants are required to obtain after finishing the course. As part of the preparation for your course, imagine that you have already searched for materials on the topic that other authors - professors and practitioners have offered to the public on OpenScout. You have taken the most appropriate materials and adapted them for your audience. In the next Task, you are asked to offer the adapted material to other members of the OpenScout community under Creative Commons License. To meet this purpose you are required to publish the material to the OpenScout portal.

Please, go to the Publish section of the portal. First, describe the educational content of the material by filling in the values for as many attributes as you can; such as title, language of the translated slides, competences that the students are expected to obtain at the end of the course, rights, etc. Then, select on your computer a file with the title AdaptedEduSCManagement.pdf and upload it to the portal.”).

D. Testing procedure

First, test participants were welcomed and briefed about the goal and procedure of the usability tests, which was followed by an explanation of the equipment to be used. Participants were asked to complete a Pre-test Questionnaire and perform a set of selected task scenarios that cover most frequent as well as critical functionalities of the portal. After the training tasks, the participants were given time to make themselves comfortable in front of the PC before the eye tracking calibration commenced. A 9-point calibration with corner correction was used at all times. The participants were also asked to keep their head as still as possible during the experiment as to minimize inaccuracy caused by head movements (see Fig. 3).

After each task, participants were asked to complete the After-task questionnaire, consisting of four questions (Q1-Q4), which were derived from the literature on usability research [5, 9]. Specifically, Q.1 and Q.2 evaluate the extent to which the participants were satisfied with the ease and amount of time required to complete the task, respectively. A 7-point Likert scale was employed with left anchor indicating lowest level of satisfaction and right anchor the highest. Q.3 and Q.4 evaluate the same two variables, which are nonetheless phrased differently (i.e. how hard and how time-consuming) and gauged with an online tool Usable Surveys designed to measure subjective mental effort (http://www.usablesurveys.com/index.php). After completing all the three tasks, participants were asked to provide a description of their experiences doing the retrospective think aloud (RTA) [11]. A number of studies have shown that replaying the participant’s gaze during an interview held after the task uncover significantly more usability problems than using other...
known usability methods. Moreover, studies also show that a significantly higher task-completion rate is achieved when using this method than when applying conventional think aloud methodology. At the end of the testing participants were asked to complete Post-test questionnaire entitled “System Usability Scale (SUS)” [2], which consists of 10 questions and has psychometric properties.

The participant spent a long period of time in randomly moving around the user interface to locate the functionality to deal with the task. The participant failed to accomplish the task or got a wrong output.

UPs identified in each of the three tasks are reported based on the following structure:

- **ID** - Unique identifier of a UP with the designation UP (task number, serial number)
- **Context** – Where on the UI the UP is located
- **Description** – What the UP is about
- **Severity** – How serious the UP is
- **Recommendation** – How to resolve the UP identified

Note that the variable Severity is categorized into three levels, namely:

- **Severe**: prevent the user from completing a task or result in catastrophic loss of data or time.
- **Moderate**: significantly hinder task completion but for which the user can find a work-around.
- **Minor**: are irritating to the user but do not significantly hinder task completion.

### IV. CONCLUDING REMARKS

In the process of usability testing we identified in total 8 usability problems in with one being severe, three moderate and four minor. No fatal loss of data occurs. Only in Task 3, there is some visible loss of time. Furthermore, the average System Usability Scale (SUS) score is 61.3 (SD = 14, range: 38 – 89.5) and RTA data indicating that the participants were generally satisfied with deploying the OpenScout portal to achieve the given tasks. The average perceived ease-of-use and perceived efficiency were both 5.2 (out of 7); the average difficulty level and time-consumingness were 36.2 and 39.7, respectively. The average task completion rate was 93.5%.

Generally speaking, the usability tests have been satisfactorily conducted with some useful and interesting results. Reflecting on what could have been done better, the following points can be considered:

- Recruiting participants with relevant background in economics, thereby enhancing the user representativeness – a critical factor affecting the validity of test data. From the research perspective, it is intriguing to compare and contrast usability outcomes between the novice and expert groups, which are defined in terms of their level of domain-specific knowledge
- The consistency of bi- and multi-lingual versions of the OpenScout portal should be verified. Otherwise, the language barrier would undermine the validity of empirical findings.

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