1. Introduction

The advent of the Internet had a great impact on distance education and rapidly e-learning has become a killer application. Education institutions worldwide are taking advantage of the available technology in order to facilitate education to a growing audience. Everyday, more and more people use e-learning systems, environments and contents for both training and learning. E-learning promotes education among people that due to different reasons could not have access to education: people who could not travel, people with very little free time, or with disabilities, etc. As e-learning systems grow and more people are accessing them, it is necessary to consider when designing virtual environments the diverse needs and characteristics that different users have. This allows building systems that people can use easily, efficiently and effectively, where the learning process leads to a good user experience and becomes a good learning experience.

E-learning systems and environments are designed taking into account a set of technological and pedagogical aspects [10], and should also be designed considering Human-Computer Interaction (HCI) and usability concepts and methodologies. HCI offers a core of concepts and methodologies that constitute a step ahead in the design of interactive systems [15]. E-learning is based on computers, devices and screens and is fundamentally interactive and, for this reason, HCI is a key element in the design of interactive e-learning systems that take into account user needs and characteristics. Usability becomes a key factor in the user’s ability to acquire knowledge in a satisfactory manner.

User-Centered Design (UCD) [5] is a design philosophy and a process in which the needs, wants and limitations of the end user of a product are the focus of each stage of the design process. By involving the user at each phase of the development process, we ensure that the end product responds to the users’ characteristics and, therefore, provides students a positive learning experience. Moreover, we ensure that students do not need to learn new competences in order to learn how to use the environment again. Both the positive learning experience and the maximization of the acquired competences are key for promoting lifelong learning.

This paper describes the application of a UCD process to the development of a virtual classroom. The classroom re-design project is part of the wider project of designing a virtual campus and one of its goals is to prove that by applying UCD in an e-learning environment we can develop a learner-centered design process that ensures the quality of the developed products and guarantees a good learner experience. This paper is organized as follows: Section 2 describes the importance of user centered design and usability evaluation as a way to build a positive learning experience. Section 3 describes the services offered by the virtual e-learning environment of the Universitat Oberta de Catalunya and a proposal for adopting UCD methodologies in the virtual campus redesign project. Section 4 describes the redesign carried out for a new virtual classroom. Finally, the conclusions of this paper and the current and future research lines are summarized in Section 5.

2. User Centered Design, Usability and User Experience in E-Learning

As in any virtual environment, the design of e-learning systems also needs to be user centered [5] taking into account the user’s characteristics and abilities interacting with the virtual environment and learning materials, and comply with usability, thus with learning efficiency and effectiveness, and student satisfaction. Nielsen [12] defines usability as a quality attribute that assesses how easy user
interfaces are to use, and is defined by five quality components: learnability, efficiency, memorability, handling of user errors and user satisfaction.

Directly related to the concept of efficiency linked to usability, learnability is a concept which in many times refers to the speed in which one learns a specific application. Learnability is the degree to which a user interface can be learned effectively and quickly, but learnability also refers to the efficacy in which a specific e-learning content is learned [6]. Usability refers to the functionality and the learnability to the cognitive process; therefore, the least effort devoted to functionality, the more effort the user will be able to dedicate to learnability. Nevertheless, it is important to achieve both usability and educational goals. Students should easily interact with the learning materials and the virtual environment, and concentrate to achieve the learning goals and competences. Therefore, the main goal is to identify e-learning design solutions that would reduce the user frustrations, increase usability, learnability and satisfaction. The concept of user experience or learner experience is directly related with usability and satisfaction, although it is broader. User experience is included in user centered design and takes into account every aspect related to improving the design, and it will focus on user perceptions, feelings and interactions with the system [13]. User experience is one of the key factors when designing and building online services and it is directly connected with usability, ease of use and user centered design. It takes into account what the user feels and experiences when interacting with a system. As the concept of user experience is subjective, it is needed to settle a whole methodology that helps us to measure and quantify such experience.

The design of usable e-learning systems and materials can be defined upon three dimensions: learner, content and system. The learner or user dimension includes the identification of users, their needs, preferences and characteristics. The content dimension includes the identification of design guidelines, techniques and requirements that should be followed, and the different issues related with the separation of content and visualization of such content. The system dimension includes the identification of the requirements and features of the virtual environment, and the task analysis and interaction design. Some previous work and studies show the importance of usability in the field of e-learning [11, 2, 16].

In virtual learning environments, it is decisive to gain insight about user behavior and understand how learners navigate through the learning materials and the virtual environment. Understanding learner behavior provides very useful information to usability engineers and system designers for determining whether the e-learning web interface is well designed or not, and which user tasks generate more failure or frustration [7]. The information gathered from the students becomes extremely relevant to the advancement in the design and development of innovative e-learning applications, tools and services that facilitate achieving the instructional and educational goals [3].

3. User Centered Design at the UOC virtual campus

The Universitat Oberta de Catalunya (UOC, in English known as Open University of Catalonia) is a completely online university with more than 40000 students and more than 2500 people including instructional designers, teachers, tutors, academic and technical staff, and so. The UOC virtual campus is an integrated e-learning environment which allows users to communicate with other users with complete timetable independence, using an asynchronous approach, and includes an agenda, a news service, virtual classrooms and laboratories, a digital library and other e-learning related tools. UOC has a student centered pedagogical model that ensures a guided learning path through the use of selected learning resources, according to the expertise of a team of instructional designers, usability experts and, of course, teachers. In addition to this student centered pedagogical model, a learner centered design perspective is used to design and evaluate the virtual campus environment and tools. Within the UOC virtual campus, each subject has a virtual classroom with all the needed elements for the development of the teaching and learning process: e-mail, access to documentation, the activity based teaching plan model, access to evaluation results, access to the teacher board, forums, debates, etc. The virtual campus classrooms are the meeting point of the different learning activities.

By applying a UCD process to the redesign of the virtual classroom environment, we can ensure that the environment provides what it was thought to provide at the same time that we hope to obtain important conclusions on the Learner-Centered Design (LCD), that is how the LCD should differ from UCD in order to guarantee a good learner experience. As mentioned earlier, the current work-in-
progress is part of the Campus project. The goal of this project is to develop a higher education platform in open source software and its key aspects are what make it unique in the field of e-learning. First, the virtual campus will support up to 10,000 users connected at the same time. Second, the product design will follow a user-centered designed (UCD) approach. Third, the user interface will follow usability and accessibility principles and standards. This work-in-progress focuses on the second key aspect: the UCD process as a tool to guarantee the quality of the end product. From a UCD perspective, the project follows the principles of ISO 13407 [9]: the active involvement of users and a clear understanding of the user and task requirements, an appropriate allocation of functions between users and technology, iteration of design solutions and multi-disciplinary design. Moreover, this international standard established in 1999 describes four user-centered design activities. We will see how these activities are applied in our project: understand and specify the context of use, specify the user and organizational requirements, evaluate designs against requirements and produce design solutions. The project is divided into 12 work packages, the first one being related to understanding and specifying the contexts of use as well as gathering the user requirements. Regarding the organizational requirements also mentioned by ISO 13407, in the case of the Campus project some are defined by e-learning recommendations such as SCORM [1] and IMS [8] and others are institution-dependent.

3.1 User profiles, personas, scenarios and needs

The output of the first work package is the knowledge about the user, the environment of use, and the tasks that he or she uses the product for. The first step of this activity is to define the user profiles; that is to obtain a detailed description of the attributes of the virtual campus users (students, faculty and staff). These user profiles are defined based on quantitative data such as socio-demographic, psychographic and academic information. A qualitative analysis combined with these user profiles will help define the personas, scenarios and needs. Personas [14] are fictional characters created to describe typical users. These personas have a name, a face, goals and tasks, skills, hobbies, etc. This design tool is used to narrow the gap between the end-users and the design teams and help these teams focus their efforts on the users’ needs and expectations. Scenarios [4] are descriptions of the actions needed to accomplish specific tasks and might include the behavior description in a given situation. Scenarios include the context, the actors, the goals, the sequence and the outcome. The needs deliverable describes the key aspects of virtual campus from the user’s point of view and will also include new technologies that can be applied to e-learning. These needs will be grouped following the functional areas of the virtual campus: learning materials, learning tools, communication tools, planning tools and support tools.

3.2 User testing and prototypes

This second work package, user testing and prototypes, is centered on the evaluation of designs and the production of design solutions. In order to accomplish this goal, the following steps have been defined for the package:

- Develop accessibility, usability and style guidelines.
- Define wireframes for the basic application and modules.
- Conduct usability and accessibility testing.
- Give support to the development teams in the application of usability and accessibility criteria.

The accessibility guidelines will be an adaptation of the newest draft of the Web Content Accessibility Guidelines (WCAG) [17] to our needs. The usability guideline will also follow the structure of the WCAG (principles, guides, and checklist) and will be created with the input from the user analysis deliverables. A third guide defining the style and interaction of the virtual campus will be created. On top of these guidelines, there will be an iterative evaluation process for all campus modules. This process can include heuristic evaluation, low fidelity prototype user testing and high fidelity prototype user testing depending on the development stage of the module. All evaluations will result in a document with changes and improvement suggestions. Each development team will be in charge of implementing the changes.

4. Virtual classroom redesign process
The new virtual classroom is one of the main and most important elements in the virtual campus project and we have used its redesign to apply our UCD approach, more specifically the user testing and prototyping phase. We have worked close to the users (students, faculty and staff) to understand their needs and desired improvements. The project started in September 2005 with the user requirements phase and was followed by the iterative design and evaluation of prototypes. Five pilot classrooms were launched the Fall semester 2006 to evaluate the redesign in a real virtual learning environment.

4.1 User requirements phase

The goal of the user requirements phase was to gather information about the usage of the current classroom at that moment as well as its’ positive and negative aspects from a student’s point of view. In order to do so, we run 5 focus groups and 21 user tests with faculty and students. The focus groups were used to obtain opinions and impressions both from students and faculty about the virtual classroom and how it should be improved. The user tests showed us how students and faculty really used the classroom since they were asked to accomplish real tasks. From the analysis of the results we found three main conclusive ideas:

- The current classroom works and is easy to use.
- The current classroom is improvable and the students are expecting this improvement.
- A radical change would be inconvenient.

Therefore, although students are used to the current classroom and can use it without problems; this does not mean that they do not want a change in its design. The fact that they are used to it does not imply that it can not be improved. Students want a new classroom with added value in comparison to the current one at the same time that it should not require them to learn how to use it again.

The list of improvements obtained was grouped in three categories: efficient interactions, flexibility and new technologies. With these improvements as guidelines, we designed and constructed the prototypes for the next phase.

4.2 Iterative design and evaluation of prototypes phase

This phase began with the design and definition of a first low-fidelity prototype that translated the user requirements into a new virtual classroom design. The design was iteratively evaluated and refined by an in-house interdisciplinary team, formed by UCD specialists, developers, instructional designers, academic staff and managers. The prototype was improved with each iteration so that at the end we had a high-fidelity prototype that could be tested.

We run 30 user tests with students from different majors and in different school years. Three different prototypes were tested in order to compare their performance and acceptance among the students. Independently of the prototype, all students were asked to accomplish the same tasks. The analysis of these tests gave us information on how to improve the prototype. However, aware that a user test even when the tasks are real could not provide information about how the new design helped the student’s learning process; we decided to run 5 pilots during Fall semester 2006. Figure 1 shows the evolution from the current classroom homepage (top-left image) to the homepage (bottom-right image) now being tested with 5 pilots. Since a radical change is not desired by students, we have opted to keep the same classroom structure of 4 tabs but have added a new homepage that summarizes what is important for the student at that point in time.
4.3 Pilot test groups phase

The main goal at the pilot test phase was to analyze whether the new virtual classroom helps students in their motivation and learning efficiency, effectiveness and satisfaction, as a consequence in their learning experience. Five pilots with the new classroom interface were launched at the beginning of the Fall semester 2006. In order to do that, we defined two checkpoints: a user test at the beginning of the semester, a set of focus groups at the end of the semester.

We run 30 user tests with students participating in the pilot group but also with people unfamiliar with the old classroom. From these tests we gathered that the new classroom is an improvement from the previous one, it is easy to use and students feel comfortable with it. The goal of running three focus groups was to learn about the perception students and faculty had of the new classroom. From the user tests, we know it is usable, but do they like it? Is it improving their learning experience? The feedback obtained from these focus groups varied depending on the characteristics of the student.

Students that have been using the old classroom for several semesters feel lost in a new environment; although it didn’t show in the user tests, therefore, not exactly true, that is how they feel. On the other hand, new students value the new virtual classroom more than the old one. Overall, even though the new classroom provokes mixed feelings, the general impression both from students and faculty is that although still needs to be refined, the new design is a big improvement.

5. Conclusions

User-centered design is a process in which the needs, wants and limitations of the end user of a product are the focus of each stage of the design process. By following this approach, we have gathered enough information to know that we are moving in the direction desired by students and faculty but that it is not enough. The application of a UCD process in an e-learning system requires adapting the standard methods since users are in fact learners that have a very concrete goal: learning. These differences are shown in the fact that although students didn’t want a radical change, they still perceived a small change a radical one. Only an interface and information architecture change was
made, however, since students are not very familiar with the classroom, they have perceived this as a radical change. On the other hand, professors consider that the change has been too small.

The virtual classroom re-design following a UCD process has provided us with enough information to begin to construct a LCD model that considers the pedagogical and e-learning characteristics specific to UOC. This model facilitates the identification of the elements that help us design better and create positive learner experiences for our students. One example of this is the fact that for communication purposes among professors and students, the classroom environment needs to be unchangeable. Otherwise, when a student has a problem or doubt, the professor cannot guide him/her in the environment. Nevertheless, students expressed the need of making the environment theirs, so in the new pilot they can change the color of the classroom elements but not its disposition. This gives students a sense of control without interfering with the learning process.

We are aware that building the learner experience is an iterative process, where in each step designs are improved. At present we are working on a more deep change both in terms of design and content organization to implement a second set of pilots for next semesters. We are aware that it will require a learning process for students but we also know that the end product will answer their needs; therefore this process will be perceived positively, thus as a learner experience improvement.

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References