

Improving the Usability in Learning and Course Materials

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INTRODUCTION

Human-computer interaction (HCI) is a discipline concerned with the study, design, and development of high-usability interactive systems (ISs) focusing on users' needs and their experiences with technologies, among others. In a simplified way, the usability of an IS refers to how easy it is to use and to learn. HCI is a very broad discipline that encompasses different specialties with different concerns regarding computer development: software engineering (SE) is concerned with the design and development of high-quality ISs focusing on schedule, budget, communication, and productivity. The quality of an IS refers to how satisfied the system clients and/or users are, verifying whether the system is performing exactly what was requested.

In order to achieve both IS usability and quality, it is necessary to go beyond designing user interfaces (UIs) and that they are easier to use and learn. It is important to define methods and use techniques (as ethnographic, semi-otic, prototypes), which help designers to understand HCI concepts and build better interactive artifacts (as widgets) and to understand the effects that systems will have on humans (Cooper & Reimann, 2003). Some HCI concepts are characteristics of users (such as their preferences, language, culture, and system experience) and their contexts of use (such as great familiarity with a device, easy accessibility, and good luminosity of the environment).

In the interactive learning context, it is necessary to consider HCI concepts into an interactive learning system development method. The pedagogic usability of an interactive learning system is related to how easy and effective it is for a student to learn something using multiple devices (such as palm, camera, cell phone) to interact with the system. For these reasons, it is important not only to think about the IS quality, but about its usability as well. In this text, an interactive learning system is composed of a virtual learning environment (VLE), with tools to support a collaborative learning and interactive course materials available for the users through this environment. So, it is important not only to think about the VLE usability, but also about the interactive course material usability.

We have identified some problems to achieve a successful deployment of interactive learning systems (Furtado, Mattos, Furtado, & Vanderdonckt, 2003):

- **Lack of learning quality:** Many academic staffs are worried about the learning process quality through the course materials available in VLE. However, the material of a face-to-face course is hardly ever adapted to the students' needs and experiences. This way, it is expected that a VLE allow students exploring possibilities brought by new technologies in order to participate in the elaboration of this material.
- **Lack of adaptive tools:** Learning systems are very useful, but most of them are not adaptive and neither consider the user experiences with technology. Interactivity and personalization are factors that help for allowing a user participating in the community, which he or she makes part of (McCarthy & Wright, 2004).
- **Lack of training in modern and collaborative technologies:** Any academic staff (such as a teacher), as part of his/her professional development, needs continuous and sophisticated training. Such training should help overcoming the limits found by this community in accessing to digital technologies for the creation of interactive information and multimedia content, in a collaborative way with their own students. It is necessary to fulfill these needs by adopting an integrated pedagogical-technological content (Perrenoud, 2001).

All of these issues have a critical impact on the usability and quality of interactive learning systems. Thus, we developed a general architecture for such systems, which aims to show the concepts that must be considered to increase the quality of the learning process and to increase their UIs usability.

The remainder of this article is structured as follows: in the next section, we explain the main concepts that helped us to develop such general architecture. Then, we provide the best practices used in a development cycle of an IS, focusing on the usability issue. Finally, we summarize the main points of this text.

BACKGROUND

There is a trend about technological convergence, which companies are thinking in providing users common access to content by using any device in any place. It involves dif-

ferent technologies such as mobile phones interconnected with other surrounding interfaces (e.g., i-TV, PCs, PDAs, in-car-navigators, smart-house appliances, etc.) (Roibás, Geerts, Furtado, & Calvi, 2006). This technological convergence will be decisive in the creation of pervasive virtual learning environments. Many HCI researchers focus on the interaction design process in order to build UIs to these environments with which the users (students) can interact with no usability problem. In this process, several design decisions are made concerning the system navigation, the feedback mechanism, and the information organization and by taking into account the users' device and their context of use. However, it is important to point out that the user controls a VLE for the purpose of learning the content (course material). Then improving the usability of these systems is also to improve the usability of the multimedia content. A system UI should ideally be designed to be an integral part of the content (Garrett, 2003). It means that the UI design paradigm involving the task efficiency concepts (such as response time, errors control, task completion) must be extended to involve the content efficiency concepts (such as to allow users to read a content again, to stop of seeing it and to return when they want, to show someone an interesting content, to add a comment, etc). By combining these efficiency concepts, users can have more control of the systems and consequently, they can change their posture of passive learner to a more active one. In Chorionopoulos and Spinellis (2006), a UI evaluation approach was described in which the content quality is a relevant part to the quality of interactive television systems. Mattos (2005) described an approach, which can be used by teachers to persuade and motivate their learners to define their own contents.

VLE AND INTERACTIVE COURSE MATERIAL BACKGROUND

As we have mentioned before, an interactive learning system is composed of a VLE and tools for creation in a collaborative way of interactive course instructional materials.

A VLE has to provide students with spatial freedom and time flexibility. It has to be flexible enough so that every student may profit from his or her own skills and abilities, use his or her previously developed idiosyncratic characteristics (cognitive, social, or emotional), and apply his or her previously gained experience and expertise (Karoulis & Pombortsis, 2003). Some tools available in a VLE are links to tutorials and course materials, collaborative tools (as blog, skype), evaluation tools, and administrative tools.

There are some authoring tools, which users (students and teachers) can use to develop their own contents and make them available and accessible in various devices (such as palmtop, digital television, kiosks, and mobile

phones) (Maia & Furtado, 2006). The user of this system follows a flow of activities to edit and update the Web content and to design the UIs of these contents. During UI design, HCI patterns are made available in order to assure the consistence between user interface objects of different devices. We can define HCI patterns as a tested solution for a usability problem (such as lack of orientation, difficulty in finding information) that happens in a certain context (search, visualization, etc.). Other tools, such as those for specific programming languages (HTML, FLASH, SVG), are only used by specialized teams.

BASIC CONCEPTS RELATED TO USABILITY IN INTERACTIVE LEARNING SYSTEMS

The general architecture initially proposed in Furtado et al. (2003) but updated here in Figure 1 aims at the development of VLE and interactive materials, taking into account some concepts studied in different areas (human-computer interaction, cognitive sciences, ergonomic, artificial intelligence, and pedagogy).

According to Figure 1, an interactive learning system's usability can be assured when its components have been built with quality and when users' needs have been taken into account. Quality of a component means: (1) quality in the application that corresponds to content, which refers to the information and knowledge involved in the system. Information (such as learning stories and objects) is related to the development of instructional materials, and knowledge (such as cases) is especially related to the collaborative practices; (2) usability in the UI, which refers to a good specification of the interactive information of the system (its windows, its buttons, etc.); and (3) usability through interaction devices, which makes the interaction with different media (sound, text, image) possible through different interaction resources as pen for palmtops, cameras and microphones, remote control for iTV, and so on. The quality of the user refers to his or her ability to use new interaction devices and technologies, experience with technologies, and acquaintance of the domain in question.

The concepts related to usability in an interactive learning system are:

- Utilization of ontology to assure the flexibility in modeling learning applications. The ontology notion comes from the artificial intelligence area where it is identified as the set of formal terms with one knowledge representation, since the representation completely determines what "exists" in the system (Guarino, 1995). During an application modeling, models (such as the user model), knowledge (such as cases studies), and

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