Open to the users' needs: combining user-centered design, standards and open source software

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Abstract
This case study introduces our continuous work to enhance the virtual classroom in order to provide faculty and students with an environment open to their needs, compliant with learning standards and, therefore compatible with other e-learning environments, and based on open source software. The result is a modulable, sustainable and interoperable learning environment that can be adapted to different teaching and learning situations by incorporating the LMS integrated tools as well as wikis, blogs, forums and Moodle activities among others.

Keywords
Technology Enhanced Learning (TEL), user-centered design, interoperability, Learning Management System (LMS), Virtual Classroom, standards, Open Source, IMS Basic LTI, e-learning tools, service oriented, SOA, learning technologies

Recommended citation:
Garreta, M.; Santanach, F. (2010). Open to the users' needs: combining user-centered design, standards and open source software. In *Open ED 2010 Proceedings*. Barcelona: UOC, OU, BYU. [Accessed: dd/mm/yy].< http://hdl.handle.net/10609/4865>

1. Introduction

This case study explains how to create a flexible environment to answer the users' needs. A user-centered design methodology is followed to work closely to the end users – both faculty and students - and be aware of their needs, wants and limitations. Open source software and standards are the basis of the technological approach. This model results in a sustainable and adaptable environment both for the present and the future needs.

The Universitat Oberta de Catalunya (Open University of Catalonia, UOC) is a fifteen year-old completely online university with more than 50,000 students and 2,500 lecturers. The UOC offers more than 20 undergraduate degrees as well as several graduate programs in fields such as Business, Humanities, Computer Science, Psychology and Asian Studies among others.

The UOC virtual campus is an integrated e-learning environment that allows students to pursue their studies completely online with the exception of taking final exams. The UOC's Learning Management System (LMS) is a in-house product and has been used as an e-learning platform at UOC for more than 14 years. This LMS has evolved with the University and the pedagogical and technological needs. A critical success factor of a LMS is flexibility to meet evolving standards and new conceptual requirements, so, in 2006, it was decided to start a UOC's new virtual campus version following user-centered design (UCD) and Service Oriented (SOA) approaches and standards. The first part to be adapted and developed according to these new requirements was the virtual classroom.

In large educational communities like the UOC, different user types can be found, each of them with their own interests, needs, preferences and limitations. UCD techniques allow to discover such user types and provide methodologies that ensure that design and software development takes into account these user profiles and needs. Thus, the use of a UCD process and methods are key to define the features, tools and characteristics of the virtual classroom.

Nevertheless, new requirements come also from the evolution of Internet and technology in general, as well as from the University stakeholders. As new applications such as wikis, blogs, microblogs and others appear and are improved, users demand more available tools for the teaching and learning process. The University as an institution also demands innovation and diversity as key drivers. New educational programs are being opened and new target users are being aimed; including different user types but also different regions and countries.

This results in an increasing diversity of users – both faculty and students – and of educational needs that require a flexible model both from a functional and pedagogical standpoint and from a technical perspective. Ensuring that any new application meets the users' needs is essential for its success. Having an interoperable virtual campus is also mandatory to allow the integration of these applications.

The present article introduces the different key factors of e-learning tools integration process: 1) the user-centered design approach to guide the functional, visual but also technical characteristics of the end product; 2) an interoperable, specifications and standards based approach to guide the software and technical development in order to create the basic technological layer to ensure that the

UCD requirements are met; and 3) an open and flexible integration process for new e-learning tools as a result of the previous aspects.

2. The User-Centered Design (UCD) Approach

Technology Enhanced Learning (TEL) is by default technological but the focus is still on the learning and teaching processes. In order to provide a good TEL experience, a user-centered design (UCD) process is key to understand the users' needs and limitations. At the UOC, UCD methods are used to choose and design the best learning tools and environment.

User-centered design is a design philosophy and a product development approach that places the end user of an application in the center of each design phase in order to ensure that the end product will answer to the users' needs, wants and limitations. The redesign of the UOC virtual classroom project followed such an approach so as to provide a better user experience to our users as well as to facilitate the teaching and learning processes of students, tutors and faculty members.

The ISO 13407 (Human-centred design processes for interactive systems) [6] is an international standard that provides guidance on achieving quality in use by incorporating UCD activities throughout the life cycle of interactive product. The standard defines four activities that need to start at the earliest stages of a project: 1) understand and specify the context of use; 2) specify the user and organizational requirements; 3) produce design solutions; and 4) evaluate designs against requirements.

Therefore, a classic UCD process includes all these steps for each project. Nevertheless, within the UOC environment we have separated them. First, because our target users are always the same and, although we have seen an increasing diversity of user types, we do not need to create user profiles and personas for each project. Second, to be able to follow agile software development methodologies, which are the best suited for integrating new e-learning tools, we need to start the design process earlier and we manage to do so by reducing the user requirements phase.

In sum, if we take the ISO 13407 activities as a reference, we have the first two activities - understand and specify the context of use and specify the user and organizational requirements – which are done at the UOC as a project per se, mostly independent of the implementation of new tools. And, on the other side, the two following activities - produce design solutions and evaluate designs against requirements – which are done on a project basis. The designs are therefore evaluated against the requirements that come from the general user gathering requirements and the specific requirements which are defined for each e-learning tool.

3. Interoperability, Specifications and Standards

Learning standards such as IMS Basic Learning Tools Interoperability (IMS Basic LTI) [5], IMS Question and Test Interoperability (IMS QTI) [4], IMS Learning Design (IMS LD) [3], Open

Knowledge Initiative Open Service Interface Definitions (OKI OSIDs) [10] and The Sharable Content Object Reference Model (SCORM) [1] are used to promote and facilitate interoperability. These standards help 1) guide the definition of the virtual classroom and tools as well as 2) define the development components to ensure connection among internal modules and external software and environments.

Most e-learning systems use a combination of three kinds of standards or specifications: data representations specs, communication specs and interfaces specs; each providing particular interoperability and integration benefits.

Data representation specifications covers: the structures, meaning, and particular vocabularies associated with data. Current examples of this are: SCORM, IMS QTI and IMS LD. Data representation allows two systems to import and export data.

Communication specifications define the manner in which two systems or machines communicate with each other. Current examples of this are: SOAP, REST or HTTP. If an application supports a particular protocol, it will be able to communicate with another system or service if they also use this protocol.

An Interface specification is a contract that defines and separates the responsibilities between the two sides. Current examples of this are: OKI OSIDs and IMS Basic LTI. Using interface specifications allows the use and substitution of different service implementations and can be used to cover up underlying changes in technology.

A high level architecture could help people understand how all the individual specifications surrounding educational systems fit together. This would provide some common context for interpreting the individual pieces and promote adoption for all the specifications. The UOC's virtual campus architecture is based on a service oriented model (SOA). In SOA, the system is modeled around a set of modules with a public functionality and responsibility and a set of mechanisms that allow interaction between the services [9]. Under this architecture model and using standards, heterogeneous tools (Java, PHP and others) can interact with some services of an also heterogeneous platform: Moodle (PHP), Sakai (Java), UOC Virtual Campus and others. The tools connect to the system using a set of basic services, which act as a bridge and a link. Each tool has its own internal architecture and the most appropriate technology to solve its business logic.

The UOC Campus Services are compatible and use the IMS Basic LTI mechanisms as basis. IMS Basic LTI specifies the LMS data that needs to be transferred to an external tool so it may be executed into the LMS without putting the system into risk. There are IMS Basic LTI implementations for many of the LMS – such as Moodle, Sakai and Blackboard –, and a number of plug-ins for a good set of tools like wikis, blogs and others. IMS Basic LTI covers the basics of authentication and authorization services, but does not allow yet other key issues like transferring tool tracking information to the LMS (see Logging Service below), or managing tool user interface translation to other languages (see Internationalization Service below). So the UOC Campus Services extend the IMS Basic LTI functionality to cover the aspects not yet included. In spite of this, it has been decided to use quite a reduced set of services. A limited number of services facilitates the integration of external tools. Therefore, the tools integrated can communicate with the LMS using five services:

The **authentication** service not only allows the user to log into the system but also finds out if the user is logged in. This is a mandatory service in any computer program with user registration.

The **authorization** service allows to know if the user is authorized to act on certain resources and contexts. This is mandatory in any system in which the users play different roles.

The **logging** service allows program activity data to be stored. Log data allows, for example, a lecturer to see what use students make of classroom resources and learning tools.

The **internationalization** service supports learning tools declaring their interface literals. This makes it possible to provide translations to other languages in the LMS. Subsequently, the literals can be displayed in any of the languages available in the tool.

The **configuration** service supports defining, assigning and transferring parameters between tools and the LMS.

4. Integrating New e-Learning tools

The richness of a virtual classroom depends on the availability of e-learning tools. Its success depends on how easy they can be administrated and used. Both aspects are especially relevant to support various course typologies as well as different pedagogical models. Generally, educational models are implemented by using and combining different tools ruled by a certain pedagogical approach. Also the course typology defines the need of specific tools. As a consequence, the diversity of tools available for faculty to facilitate the teaching and learning processes is a fundamental factor with great impact on the quality of learning.

These tools are becoming increasingly diverse and complex. In recent years, there has been a growing tendency to use non educational-designed resources as educational ones (e.g., blogs and wikis). Complex tools such as broadcasting and video conferencing via the Internet have also become even more common in e-learning. Not to mention the need to integrate a growing list of services to be found in the Internet cloud, like Facebook, Twitter, Youtube and others.

As previously mentioned, we have several factors that lead to the integration of new e-learning tools as a common model. The primary criteria for doing so is to provide a better teaching and learning experience by working closely with faculty and students. Open source software is the first option to consider when selecting a new tool to be integrated, however it is not a mandatory requirement. Following are 4 cases regarding the integration of new learning tools:

The blogs solution. The WordPress platform [14] was the first blog application installed at the UOC virtual campus and it is the solution that we currently have. WordPress facilitates the integration and extension of the application features via plug-ins. This solution works perfectly within our environment and several plug-ins have been developed in-house in order to answer the different faculty needs and requirements. Nevertheless, after several semesters with this solution running, we came across a limitation of the WordPress solution: that is the amount of blogs that it can support (the performance problems appeared with over 2,000 blogs and 20,000 users). Since hundreds of new blogs are created each semester., we have had to create separate installations: one for permanent blogs and for semester-long blogs.

The wiki solution. We initially integrated two open source wikis: MediaWiki [7] and Tikiwiki [12]. We had about 5 courses using them but the adoption rate was very low. In order to use these wikis, both faculty and students were required some previous knowledge thus leading to a high learning curve to use the tool within the virtual classroom. Besides, there are cases in which faculty

want the benefits of using a wiki but this does not include learning the wiki grammar. As a consequence, we decided to integrate a commercial solution (Wikispaces [13]) and the results have been amazing. After a semester of usage, we have more than 500 wikis created and 4,500 user registered. The advantages for the users are that Wikispaces is a very simple tool that has been designed for educational purposes. From a technical perspective, the integration has also been very successful. The APIs solution provided by Wikispaces has allowed for the necessary integration (specially single sign-on and autonomous creation of wikis by faculty members) and has resulted in a very low level of incidences.

The forums solution. In-house forums were developed with the creation of the virtual campus 14 years ago. The forums were updated in 2002 but over the years have become obsolete. We are currently piloting a new solution based on the open source phpBB forums [11]. Nevertheless, we are already aware that we will not be able to use the current adapted version for a long time. The error has been that the code source of the application was changed to deeply preventing from being able to update the forums version without having to redo must of the adaptations we have done. This is a case in which an open source tool provided a good solution but the adaptation process to meet the education needs has resulted in changes that are to tied to the adapted version of the application.

Moodle's activity modules integration. Moodle's activity modules [8] have been integrated into the UOC classrooms. The faculty at UOC have a classroom configuration tool that allows them to select the most suitable e-learning tools to be used throughout the course. With this development, lecturers can choose the tools available in the UOC classroom as well as any activity module available in Moodle like quiz, forums, wikis and others.

In summary, open source software is not the only application type available in the virtual classrooms, since our faculty and students needs are the primary criteria to choose a learning tool. Nevertheless, as long as possible, open source software (OSS) solutions are considered and adopted as their benefits for learning are well known. Coppola and Neelley explained them as follows [2]: the software evolves more rapidly and organically; users' needs are rapidly met as the OSS model harnesses their collective expertise and contribution; new versions are released very often and rely on the community of users and developers to test it, resulting in superior quality software tested on more platforms, and in more environments than most commercial software; the development "team" is often largely volunteers, distributed, many in numbers, and diverse; and security is enhanced because the code is exposed to the world.

As we have illustrated with our current integrations, in order to get the most out of applying OSS and make it a sustainable model, a fine balance needs to be found between updating these open source tools to incorporate the improvements from the community and adapting each version to our users' needs and environment.

5. Conclusions

According to our experience, a critical success factor of a LMS is flexibility to meet new conceptual and users' requirements and to integrate evolving technology. In order to create such an environment, we have separated the core classroom structure from the different learning tools. Our users want a constant environment – they do not want to learn how to use a specific classroom for

each course – as well as the option to include the tools needed for each learning and teaching situation.

In order to select, adapt and integrate the best learning tool we work very close to faculty and students by following a user-centered design methodology. This means, on one side, knowing who they are, what they need and want, and their limitations. On the other side, it also means placing them at the center during the specific projects aimed at providing the classroom with a new learning tool.

From a technological point of view, an environment based on standards and prepared for interoperability is essential to guarantee the flexibility and modularity demanded by our users.
Open source solutions offer many advantages and allow for the integration of different and diverse tools. At the same time, in order to really benefit from these advantages and make them a sustainable option, the source application needs to be adapted and integrated without changing its core. Otherwise, when a new version comes out, all the work has to be started from scratch.

On the other hand, sometimes the adaptations of the open source tool required by our users are so many, that alternatives solutions – even if commercial – need to be considered.

Bibliographic references

Advanced Distributed Learning Initiative. (2009). *SCORM 2004 4th Edition Version 1.1 Documentation*. Retrieved from http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/2004%204th%20Edition/Overview.aspx

Coppola, C. & Neelley, E. (2004). *Open source open learning: Why open source makes sense for education*. Retrieved from http://www.rsmart.com/assets/OpenSourceOpensLearningJuly2004.pdf

IMS Global Learning Consortium. (2003). *IMS GLC Learning Design Best Practice and Implementation Guide*. Retrieved from http://www.imsglobal.org/learningdesign/ldv1p0/imsld_bestv1p0.html

IMS Global Learning Consortium. (2006). *IMS GLC Question and Test Interoperability Overview*. Retrieved from http://www.imsglobal.org/question/qtiv2p1pd2/imsqti_oviewv2p1pd2.html

IMS Global Learning Consortium. (2010). *IMS GLC Learning Tools Interoperability Basic LTI Implementation Guide*. Retrieved from http://www.imsglobal.org/lti/blti/bltiv1p0pd/LTI_BasicLTI_Implementation_Guide_v1p0p1pd.html

International Organization for Standardization. (1999). ISO 13407. *Human-centred design processes for interactive systems*. Retrieved from http://www.iso.org/cate/d21197.html

MediaWiki. (2010). *The MediaWiki Website*. Retrieved from http://www.mediawiki.org

Moodle. (2010). *Moodle. Getting started for teachers. Activity modules*. Retrieved from http://docs.moodle.org/en/Getting_started_for_teachers

OASIS. (2006). *OASIS. Reference Model for Service Oriented Architecture 1.0*. Retrieved from http://docs.oasis-open.org/soa-rm/v1.0/soa-rm.pdf

Open Knowledge Initiative. (2004). *Open Knowledge Initiative Open Service Interface Definitions*. Retrieved from http://www.okiproject.org

phpBB. (2010). *phpBB Forums Website*. Retrieved from http://www.phpbb.com/

Tikiwiki. (2010). *Tiki Wiki Website*. Retrieved from http://tikiwiki.org/

Wikispaces. (2010). *Wikispaces Website*. Retrieved from http://www.wikispaces.com/

WordPress. (2010). *The WordPress Website*. Retrieved from http://wordpress.org/

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