

Why using dotLRN? UNED use cases

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Abstract. UNED uses dotLRN learning management system (LMS) in two different scopes i) Exploitation and ii) Research due to the integration capabilities, adaptivity, reusability and accessibility support. The paper introduces the main features of OpenACS/dotLRN architecture and provides an historical overview of the usage of dotLRN in Innova (exploitation) and aDeNu (research) groups. It details the reasons why OpenACS/dotLRN was chosen in both groups and presents a comparison among dotLRN and other LMS, with special emphasis on Moodle (the most commonly used open source LMS) to show their pros and cons. The paper describes how it is being used in each group and what contributions have been done to the community so far.

Keywords: Learning management systems, dotLRN, Moodle, adaptivity, accessibility, resusability, standards, personalization, use case, eLearning, universities, higher education.

1. Introduction

The Spanish National University for Distance Education (UNED) uses dotLRN learning management system (LMS) in two different scopes i) Exploitation and ii) Research. On the one hand, from the institutional side, back in 2000 Tec-InFor (Technical Unit for Research and Training in Technological Resources) proposed the use of computer supported collaborative learning (CSCL) for training faculty staff and tutors in online learning and also to promote new ways of communication and collaboration among students, tutors and staff. To develop the wide variety of required services for an increasing number of potential users (180.000 at UNED) Tec-InFor selected ArsDigita Community System (ACS) developed by the Massachusetts Institute of Technology (MIT) under GPL license. ACS was customized to UNED's needs and called aLF (active Learning Framework) [1]. In turn, ACS evolved on time and diverse circumstances led to the creation of OpenACS, an open source community around ACS platform. On top of OpenACS, dotLRN application for

learning management was developed. At UNED, aLF usage increased over the years, and in 2002 Innova Group was created to support the demands on course hosting and functional development. Three years later, aLF core (based on ACS) was migrated to aLF3 (based on OpenACS with dotLRN application on top) [2]. aLF offers an open architecture of services based on technological and educational standards upon which support the integration of ICT services and provides a set of tools for supporting courses and collaboration communities of varied nature (from administrative to research).

On the other hand, in 2003 aDeNu (Adaptive Dynamic online Educational systems based on User modelling) Research group at UNED chose dotLRN both as the platform to manage the collaborative work of aLFanet (IST-2001-33288) and SAMAP projects, and as the kernel to support the Interaction Module of aLFanet project [3]. dotLRN has been chosen for its support for adaptivity, reusability and accessibility [4, 5]. Moreover, within dotLRN infrastructure (i.e. OpenACS framework) several new packages¹ have been recently developed to support web services (e.g. XoSOAP, TWiST and SOAP-DB) which facilitates the integration of external components in the architecture. Currently, dotLRN platform goes on providing both the collaborative support and the technical infrastructure for the developments of aDeNu group research projects (FAA [6], ADAPTAPlan [7], EU4ALL [8], ALPE [9]), some of them focused on accessibility and diverse functionality issues. Moreover, the developments of these research projects are expected to provide new features to OpenACS/dotLRN following a standard-based, accessible open source approach.

The paper introduces the main features of OpenACS/dotLRN and provides an historical overview of the usage of dotLRN in Innova (exploitation) and aDeNu (research) groups. Next, the reasons why OpenACS/dotLRN was chosen in both groups are given. A detailed comparison among dotLRN and Moodle is done to show their pros and cons. The paper describes also how dotLRN is being used in each group and what contributions have been done to the community so far.

2. dotLRN Learning Environment

A wide variety of integrated solutions for learning management systems (LMS) are developed and listed elsewhere (e.g. EdTechPost or EduTech). In particular, EduTech has been performing several evaluations in the last years. In year 2003 the evaluation considered only commercial products. However, due to that many open source products have improved in quality and gained considerable acceptance in higher education organization, the 2005 the EduTech group was repeatedly asked to report on the quality of current open source e-learning and course management systems. In order to select the most relevant LMS, the 2005 evaluation [10] defined the following 7 killer criteria: 1) Support for multiple languages, 2) Multiple operating systems, 3) Integrated/homogeneous learning environment, 4) Active development, with at least 2 full time developers, 5) Active community, 6) Basic e-learning tools are available and 7) Basic documentation is available.

According to this evaluation, only six LMS fulfill these criteria: ATutor, Claroline, dotLRN, Ilias, Moodle and OLAT. All these systems provide basic functionality such

¹ http://openacs.org/forums/message-view?message_id=595597

as learners' tools (communication, productivity, students involvement) and support tools (administration, course delivery, content development) according to the features categorization defined by EduTools.

However, there are three key elements of major importance for higher education institutions that are not considered in these evaluations: adaptivity, reusability and accessibility. Regarding adaptivity, there is not currently any system that supports full adaptiveness. Nevertheless, according to [4] Moodle and dotLRN seem to be the LMS better prepared to support adaptivity. Moreover, a state-of-the-art analysis regarding accessibility and reusability (in terms of educational standards support) was performed in [5]. This review concluded that only dotLRN supports the wider range of educational standards (SCORM, IMS) and can guarantee that the functionality meets accessibility requirements.

The above works justify the selection of dotLRN instead of other LMS. Nevertheless, more detailed reasons on why dotLRN was chosen at UNED are given in the next section. Now, we present the framework and the main features of dotLRN, the support for developers and the security features.

2.1 dotLRN framework: OpenACS toolkit

dotLRN is an enterprise-class software for supporting e-learning communities developed on top of OpenACS toolkit for building scalable, community-oriented web applications. In particular, OpenACS (Open Architecture Community System)² is a n-tier architecture web application toolkit built on 1) OpenACS toolkit (OpenACS subsystem), 2) An interpretive markup language (TCL), 3) A robust HTTP server (AOLserver), 4) A mature relational database management system (Postgresql or Oracle) that follows the SQL standard and uses a procedural language (PL/SQL or PL/pgSQL) and 5) Unix-like operating system (os-nix). It works well with minimum hardware requirements (256MB RAM and 1GB hard disk space free). More information is available on the OpenACS wiki³.

OpenACS is an advanced, robust toolkit for building scalable, community-oriented web applications, dynamic content driven sites and enterprise-level web applications. It consists on a collection of pre-built applications and services upon a custom web-site or application can be built. It is derived from the ArsDigita Community System (ACS). ArsDigita (now part of Red Hat, Inc.) kindly made their work available under the GPL, making all of this possible. Through a modular architecture, OpenACS has packages for user/groups management, content management, e-commerce, news, FAQs, calendar, forums, bug tracking, full-text searching, etc.

OpenACS/dotLRN strengths can be summarized as follows:

- Ready "out of the box" for common features of collaborative web sites.
- Proven architecture since components of the OpenACS/dotLRN are proving themselves in the most demanding of applications.
- Proven in the field since OpenACS/dotLRN is working well, deployed at sites that have upwards of 40.000 users.
- Responsive Community.

² <http://openacs.org/xowiki/docs-end-user>

³ <http://openacs.org/xowiki/openacs-system>

- **Commercial Support.** In this sense, a collection of commercial providers work together to maintain OpenACS/dotLRN in addition to competing for clients. Sometimes vendors work together for the same client. Most importantly, no client is ever left without support, even if his or her original provider goes out of business. There are also many independent consultants available for hire.
- **Documentation** is continually evolving and improving.
- **Institutional commitment**, including MIT Sloan School of Management which has initiated and led the development of dotLRN and many other institutions⁴.

2.2 dotLRN features

dotLRN covers a wide range of functionalities, as it can be looked up in EduTools website. EduTools is owned and operated by the Western Cooperative for Educational Telecommunications (WCET). It provides independent reviews, side-by-side comparisons, and consulting services to assist decision-making in the e-learning community. EduTools reviews are submitted typically by the product developers but EduTools reserves the right to choose whether the review is published or not, and whether changes are to be made if incorrect statements exist. They are created using a structured format to help the carried out of comparative analysis of learning systems across multiple products. The structured format was created and is maintained by the EduTools team, and has been developed and tuned since 1997.

In the case of dotLRN, the current review was submitted by the dotLRN Leadership Team⁵ on January 2007[11], corresponding to the latest release of dotLRN 2.2.1 by Jan 3, 2007. A short description of the functionality provided is presented next following EduTools structured format:

A) Communication Tools

- **Discussion Forum:** students can enable or disable posts to be sent to their email, receive posts by email as daily digests of subject lines or whole posts and subscribe to forum RSS feeds. Moreover, a spell-checker is available for student and instructor responses.
- **Discussion Management:** instructors can set up moderated discussions where all posts are screened.
- **File Exchange:** students can submit assignments using drop boxes and share the contents of their personal folders with other students. In turn, administrators can define disk space limitations for each user.
- **Internal Email:** students can use the built-in email functionality to email individuals or groups. Instructors can email the entire class at once at a single address or alias. Both can select to forward their mail to an external address.
- **Online Journal/Notes Real-time Chat:** the chat tool supports unlimited simultaneous group discussions and archive logs for all chat rooms are created.

B) Productivity Tools

- **Bookmarks:** this feature is available in OpenACS and could be used in dotLRN with minimal effort.
- **Calendar/Progress Review:** Instructors and students can post events in the online course calendar and subscribe to RSS feeds to be notified of changes to materials.

⁴ <http://www.dotlrn.org/users/>

⁵ http://openacs.org/xowiki/%2eLRN_Leadership_Team

Instructors can post announcements to a course announcement page. A personal home page lists all courses in which the student is enrolled, new email and course and system-wide events.

- **Searching Within Course:** students can search all course content and all discussion threads.

C) Student Involvement Tools

- **Groupwork:** instructors can assign students to groups which have its own discussion forum and chat. Groups may be private or instructors can monitor groups. Students can also self-select groups.
- **Community Networking:** students can create online clubs, interest, and study groups at the system level. Moreover, students from different courses can interact in system-wide chat rooms or discussion forums.
- **Student Portfolios:** The portfolio is site wide. A student creates a personal page that can be used for any materials, not course specific. Moreover, dotLRN can integrate dotFolio, an open source e-portfolio system to support lifelong personal learning and development, also built on top of OpenACS web application framework.

D) Administration Tools

- **Authentication:** the system can support multiple organizational units and virtual hosts within a server configuration. Administrators can allow guest access to all courses. The system can authenticate against an external LDAP server. Administrators can set up fail-through authentication against a secondary source (e.g. the system's own database) in the event that the primary source (e.g. LDAP server) fails.
- **Course Authorization:** the system supports restricting access based on roles and roles can also be customized by the service provider. Administrators can create an unlimited number of custom organizational units and roles with specific access privileges to course content and tools and can distribute the permissions and roles across multiple institutions or departments hosted in the server environment. Instructors or students may be assigned different roles in different courses.
- **Registration Integration:** instructors can add students to their courses manually or allow students to self-register. Administrators can batch add students to the system using a delimited text file and transfer student information bidirectionally between the system and a student information system using delimited text files or IMS Enterprise Specification v1.1 XML files via web services.
- **Hosted Services:** there exist hosting and support services from Commercial Affiliates.

E) Course Delivery Tools

- **Test Types:** Different types are supported e.g. multiple choice, multiple answer, short answer, survey questions, essay. Moreover, questions can contain other media elements (images, videos, audio) and custom question types can be defined.
- **Automated Testing Management:** instructors can create self-assessments, set a time limit on a test, permit multiple attempts and specify whether correct results are shown as feedback. Students are allowed to review past attempts of a quiz.
- **Automated Testing Support:** the system can randomize the questions and answers. Instructors can create system wide test banks or import questions from external test banks that support IMS QTI 1.2.1.

- **Online Marking Tools Online Gradebook:** instructors can add grades for offline assignments, export the scores in the gradebook to an external spreadsheet and create a course grading scale that can employ either percents, letter grades, or pass/fail metrics.
- **Course Management:** instructors can personalize access to specific course materials based on group membership.
- **Student Tracking:** usage statistics can be aggregated across courses or across the institution.

F) Content Development Delivery Tools

- **Accessibility Compliance:** Self-reports show that the software complies with the WAI WCAG 1.0 Level A guidelines⁶. Moreover, currently dotLRN is working on the dotLRN Zen project⁷ to achieve level AA.
- **Content Sharing/Reuse:** instructors can share content with other instructors and students through a central learning objects repository. Moreover, tools are available to enable version tracking and linking to specific versions as well as the creation and management of workflows for collaborative content creation and review.
- **Course Templates:** course content may be uploaded through WebDAV. The system allows administrators to use an existing course or a pre-defined template as a basis for a new course.
- **Customized Look and Feel:** the system provides default course look and feel templates, and instructors can change the order and name of menu items for a course. The system can support multiple institutions, departments, schools or other organizational units on a single installation where each unit can apply its own look and feel templates as well as institutional images, headers and footers.
- **Instructional Design Tools:** instructors can organize learning objects, course tools, and content into learning sequences that are reusable. Assessment package includes the possibility of creating questionnaires and within the Evaluation package learning sequences can also be defined.
- **Instructional Standards Compliance:** several standards are supported, such as IMS Content Packaging 1.1.4, IMS QTI 1.2.1, IMS Enterprise 1.1, SCORM 1.2, IMS Metadata 1.2.1 and IMS Learning Design (levels A, B and C)⁸.

G) Hardware/Software

- **Database Requirements:** the system supports Oracle and Postgres databases.
- **UNIX Server:** a Unix version is available that runs in multiple distributions⁹.
- **Windows Server:** a Windows XP version is available¹⁰.

H) Company Details/Licensing

- **Costs / Licensing:** GPL
- **Open Source:** the software is distributed under one of the OSI-approved licenses.

⁶ <http://openacs.org/xowiki/Accessibility>

⁷ <http://openacs.org/xowiki/dotlrn-zen-project>

⁸ http://openacs.org/xowiki/Educational_Standards

⁹ <http://openacs.org/xowiki/os-nix>

¹⁰ <http://openacs.org/xowiki/openacs-system-install-xp>

2.3 Developers support

From the developers point of view OpenACS framework has the following enterprise-quality features¹¹:

- High-performance XML data processing with easy, powerful Tcl scripting functionality using tDom
- XoTCL object-oriented scripting, which combines the ideas of scripting and object-orientation in a way that preserves the benefits of both
- Automated testing (Selenium and TclWebtest)
- Flexible and easy caching, for improving the performance of websites
- Programming in Tcl with AOLserver, a lightweight, simple, extremely fast scripting language that features a clean, easy-to-understand API (Application Programming Interface) for generating websites from the database
- Pooled database connections (which reduces database connection startup and teardown time), much like the technique JDBC uses, but predating it by many years
- Component package system for easy installation and upgrading of packages
- Upgrade paths for code and database schemas
- Full internationalization, including an excellent workflow for translating content into new languages
- Fully functional content repository and content management system
- An elegant templating system that separates code from presentation of content
- An object system that resides on top of the database, permitting site developers to create complex applications using an object API. Examples include an object level permissions system, audit trails, and ability to relate one object to another
- OpenACS is released as open source under the GPL license, with millions of lines of open-sourced applications available to use as examples. There are also pre-written packages to use or adapt

2.4 Security features

OpenACS/dotLRN implements several important security features such as sophisticated authentication procedures, a role-based security model, scripting language, page contracts and SQL variable "encapsulation". A brief description of each of them is provided next:

- a) Authentication procedures. The security system must authenticate users in both secure and insecure environments. The security model implements:
 - **Cookies** (RFC 2109, HTTP State Management Mechanism): Cookies provide client side state. They are used to identify the user. Expiration of cookies is used to demark the end of a session.
 - **SHA-1**: This secure hash algorithm enables to digitally sign cookies which guarantee that they have not been tampered with. It is also used to hash passwords.
 - **SSL with server authentication (SSL v3)**: SSL establishes a secure connection between two parties and provides the client with a guarantee that the server is actually the server it is advertised as being. It also provides a secure transport.

¹¹ <http://openacs.org/xowiki/docs-eng>

b) It supports a fine-grained, role-based and flexible permission scheme, allowing configuring access permissions to critical information sources based on roles or profiles of users, including external project members.

c) Scripting Language. The code is written in a scripting language (TCL). Software written in such scripting languages is immune against "buffer overflow" errors, the most frequent source of software vulnerabilities that make up the vast majority of all Internet security holes. This is because the management of buffers is handled by the system and outside of the control of the programmer. So programmer mistakes cannot cause buffer overflows.

d) Page Contracts. A "page contract" is a formal description of the input variables of an application page, similar to the procedure or method header in a procedural programming language. The reason for page contracts is that every application page is exposed to a "hostile environment" (the Internet). Every input parameter could be manipulated by malicious users. So it is important to check the type in a comfortable way for the developers.

e) SQL Variables. Another frequent source of security holes in Internet applications are variables values that are included in SQL statements. Such variables can be altered by a malicious user to contain additional SQL statements in order to extract information from the DB or to cause damage. As a solution, "SQL Variables" are evaluated by the database driver. This way, the variable value is taken as a whole, effectively avoiding this type of vulnerability.

Moreover, the application service is provided using AOLServer, a leading Internet and application server for large online communities. AOLServer provides a much higher degree of security compared to popular web servers such as Apache or Internet Information Server because of its origins as the platform of America Online and the fact that AOLServer is not popular in the home user segment. This makes it less attractive to virus and worm writers. There was only a single vulnerability of AOLServer in the last four years, while there were hundredths of such incidents for the Microsoft IIS and Apache web servers. But even this vulnerability did not have an "exploit" (=computer program to exploit the vulnerability).

3. Use cases at UNED

This section describes the chronological path that led to the current usage of dotLRN at UNED. The technical reasons for these choices are based on the features provided by the tool and already described in the previous section. This section complements that justification with the specific criteria used by Innova and aDeNu groups to choose dotLRN. Moreover, this section presents also the developments that have been contributed back to the OpenACS/dotLRN community from these two groups.

3.1 Exploitation: aLF platform

aLF platform chose initially ACS and evolved to dotLRN as the kernel because of the following reasons:

- **Virtual community approximation.** All the operations made in the dotLRN LMS are around the concept of group and use cases. These use cases define the way of structuring and using all the available tools (services and applications in dotLRN language). For instance, a course in a group of users that are involved in the learning process with different roles (student, teacher, assistant teacher, tutor, on line tutor) and tools like news, grade book, evaluation, assessments, IMS/SCORM content, file storage, forums, etc.
- **User centered space** (named user portal) which contains all the personal context of user in the platform (news from courses, new messages from forums, new events in the groups calendars, open and answered assessments in courses, statistics of usage in communities, etc). Also, the user portal is customizable and can be used like a personal agenda and virtual hard disk over the Internet due to the possibility of using the calendar and file storage tools.
- **Collaborative spaces** (Communities). Another scenario that covers dotLRN is the use of different tools in a more democratic space called community. In this space there are different roles like administrator and members who can use the tools in a more collaborative mode, thanks to the permissions system of dotLRN. For example, a community with a file storage is configured to allow all members to write and create file and folders, so they are automatically shared with the rest of members (providing the generation of shared reports via version control of documents -WebDAV-). There are other typical tools for a collaborative environment like wiki or weblog components.
- **Email centered work.** All the actions and events in dotLRN can be emailed by the use of notifications. All the objects (messages, forums, documents, events) have notifications incorporated in the programming model, so the platform can inform about every user actions in a group (write a message, download/upload a document, etc.) in personal notifications. This means that all the work in dotLRN can be supervised by email (the massive communication method), a very important feature in a distributed environment like UNED.
- **Technical efficiency.** All the components of dotLRN application are very robust and efficient (AOLserver, Oracle/PostgreSQL and TCL programming language). Also dotLRN is running as an OpenACS application, so a web application programming framework is giving support to the new tools developed in OpenACS and incorporated into dotLRN. OpenACS gives the software infrastructure (Web Services, LDAP/Kerberos authentication, IMS Enterprise support, etc.) to build several packages over it. This feature allows to build a good quality software using the general API provided by OpenACS,

Statistics show that since 2000, aLF platform usage has increased according to UNED needs in terms of users and sessions but also of functionalities provided by the tool. aLF is currently hosting more than 350 courses and communities, providing services to 55,000 students, professors and tutors. The number of users is increasing year after year on 22% average. On the other side, the number of sessions is increasing more significantly, 33%, with an average of 4 millions transactions per day.

Contributions from Innova group to OpenACS/dotLRN community

Innova has been working with the community of developers since 2000. The main work load is used on porting several packages and applications to have complete Oracle support for main core distribution of dotLRN. It also provides for the

community test servers both for PostgreSQL and Oracle databases, in order to do bugs sessions (necessary for code errors resolution). Moreover, several improvements have been added in different packages (forums, file storage, calendar, user tracking, learning object repository system) and new packages like portlets for new forum messages, new calendar events and new documents/hiperlinks created in the file storage.

Due to the particularities of UNED, new portals named Faculty and Department spaces have been developed which replicate the organizational structure of the university. These spaces allow professors and staff to have a common virtual community in which they can exchange information using the documents space (with version control, individual and group permissions, folders structure, files and hiperlinks storage) , forums and calendar. The calendar is very useful to the staff member in order to communicate to professors events related to the administrative work in the faculty or department (like official meetings for discussing faculty problems and make the corresponding decisions). All the calendar events are programed to send email automatically, a predefined time before the event (defined by the administrator user). Of course the complete integration of UNED structural model has been achieved: automatic student enrollment, teachers teams enrollment and administration, tutors enrollment, course portals customized to the UNED pedagogical model, faculty and department portals accessibility from UNED members intranet, collaborative communities for different staff departments of UNED (vice rectors offices, rector government team, government team UNED, Innova, USO-PC, COIE, IUED, etc.).

3.2 Research: aDeNu platform

aDeNu research work focuses on how to cope with adaptivity, reusability and accessibility issues in learning management systems to improve the learners experience at eLearning settings. In 2003 aDeNu (Adaptive Dynamic online Educational systems based oN User modelling) Research group at UNED chose dotLRN both as the collaborative platform to manage the workload of aLFanet (IST-2001-33288) and SAMAP projects, and as the kernel to support the Interaction Module of aLFanet project [3]. On the one hand, the following features were demanded to manage the development of the project:

- Common space to work on the project reports, with support for different versions of the same document
- A file storage where permissions could be easily administrated to control the scope of the deliverables of the project
- Discussion forums where project decisions were taken
- Notifications send to users' e-mail of the messages posted in the forums to be aware of new contributions
- Event management in a calendar to coordinate the project milestones
- Subgroups to manage, in an independent way, the different packages of the project
- An integrated view of the contributions provided in the different subgroups
- An easily configurable community interface, to distribute the functionality in the community space in a way that better suits the members' needs

- Permissions to grant different access rights to the project coordinator and workpackage responsables

On the other hand, aLFanet Interaction Module had to provide the different educational services that allow the learners to perform a course in the system, using both modes: individual learning and collaborative tasks. In particular, it should deal with collaborative services in three different context: the personal area (workspace), the course area and the activities area. For the personal area it had to provide an integrated vision of each one of the services and contents the user has access in the different courses s/he is enrolled, and the contributions performed in them. The course area had to provide the services that have to be used each course, both if they are specified at design time by the author or at run time by the tutor or professor. The activity area had to be similar to the course area, but under the scope of an activity inside the course (some activities may require additional and specific services to be performed, such as collaborative activities). The collaborative functionality to be provided was: Forums, File Storage, Calendar, Notifications, Comments, News and FAQ's. For the tutor, (an administrator of the course), the Interaction Module had to provide administration functions for each one of the services. All this functionality was available in dotLRN. Other functionality, not provided by dotLRN, had to be developed in aLFanet, such as Ratings and Access to information about Learning Objects.

The management of aLFanet in dotLRN was a great success, with more than 500 files uploaded, near 30 forums created, 70 members and 10 subgroups. For the following research projects, dotLRN was migrated to version 2.2, to benefit from the following functionalities: internationalization, support for educational standards, friendly interface (more usable and accessible), user tracking, blogs, RSS, feeds and wiki pages. Currently, there are 8 active communities in aDeNu platform to manage the different projects aDeNu member are involved. 165 users are taken part in them, contributing to more than 150 forums and 100 top level folders.

Apart from the usage for the coordination of current projects (FAA [6], ADAPTAPlan [7], EU4ALL [8], ALPE [9]), OpenACS/dotLRN framework is also being used as the basis for the project developments, which deal with adaptation, accessibility and educational standards support. In the next subsection, we present the contributions to OpenACS/dotLRN communit from aDeNu group. The support for SOAP services is being used to integrate existing web service systems developed by other project members.

Contributions to OpenACS/dotLRN community from aDeNu group

aDeNu group has contributed and continuous contributing to OpenACS/dotLRN community in several ways, mainly consultancy (bug reporting¹² and accessibility evaluations¹³), workload (release management¹⁴ and bugs fixing¹⁵, participation in periodic Board¹⁶ and Leardership team¹⁷ meetings), dissemination (presenting dotLRN

¹² <http://openacs.org/bugtracker/openacs/>

¹³ <http://openacs.org/storage/view/openacs-dotlrn-conference-2006/dotLRN-accessibility.ppt>

¹⁴ http://openacs.org/xowiki/%2eLRN_2%2e3

¹⁵ http://openacs.org/xowiki/%2eLRN_2%2e2_bugs

¹⁶ http://openacs.org/xowiki/%2eLRN_Board_of_Directors

¹⁷ http://openacs.org/xowiki/%2eLRN_Leadership_Team

functionality and usage at international conferences¹⁸ and journals) and source code delivery. Regarding this last item, the main contributions produced by aDeNu research works to the community includes:

- aLFanet Interaction Module [3]:
 - The first support for IMS Learning Design (*course-install package*) was developed at aLFanet project¹⁹.
 - Comments and ratings to learning material
 - Access to IEEE-LOM metadata in *imsl-d-lo package*
- Development produced by students under the direction of aDeNu members:
 - Logic Framework Approach²⁰. The standard version is already implemented, and the collaborative extension is under development.
 - Implementation of Felder Learning Styles Index (to be tested in Oracle)
 - Support for IMS QTI Selection & Ordering features (still at initial stages)
- dotLRN Zen project. aDeNu members are very directly involved in this project to improve the accessibility level of dotLRN²¹, working on the clean up of HTML code.
- Improvements of educational standards packages. Several functionality tests have been performed for the functionality offered (e.g. LORS²², IMS-LD²³ and Assessment²⁴), as well as external accessibility evaluations [12].

4. dotLRN vs. other LMS

In 2006 a internal report was written in order to compare several approaches of LMS. The report includes a commercial LMS (WebCT, also used at UNED) and two FLOSS LMS: dotLRN (in particular, aLF, the UNED customization of dotLRN) and Moodle. The comparison analyzed the following LMS: WebCT (versión 4.1), dotLRN (version 2.2.0) and Moodle (version 1.6). The first two were chosen for being used at UNED ever since 2000, and Moodle for being an emergent LMS with a wide projection in the LMS market. To carry out the comparison, quality factors were chosen taking in account the different roles involved in using the platforms, namely managing and administrating courses/communities. The chosen criteria were defined so that they can be weighed according to the particular objectives that a given institution would like to apply at any given moment. The final purpose here is to support the decision making process on ICT resources to be included in the institution strategic plan. In Table 1 the chosen criteria (mostly technical) are shown with a valuation for dotLRN and Moodle. These valuations come from other comparisons performed by WCET and EduTech, which provide additional information on the most common features provided by current LMS.

¹⁸ <http://dotlrn.org/news/one-entry?entry%5fid=162850>

¹⁹ http://openacs.org/forums/message-view?message_id=325767

²⁰ http://openacs.org/forums/message-view?message_id=499254

²¹ http://openacs.org/xowiki/dotlrn-zen-project_packages

²² http://openacs.org/forums/message-view?message_id=590351

²³ http://openacs.org/forums/message-view?message_id=578693

²⁴ http://openacs.org/forums/message-view?message_id=444217

Table 1. Comparison table for dotLRN and Moodle

Criteria	dotLRN	Moodle
Development support	High, complete customization	High, complete customization
Usability	User centered approach focused in collaborative work (forums, blogs, shared document space, calendar), need an special usability model for courses	Pedagogical approach centered in activities controlled by teacher, very intuitive for courses
Software Enterprise Architecture Applications availability	Web Framework based (OpenACS). Multilayer services oriented for enterprise development. A lot of services and applications, used in several domains: courses, communities, e-business, electronic administration.	Scripting based, with no software infrastructure model, multiple maintenance and security problems. A very high number of modules, all to be used only for courses.
E-Learning Standards support	IMS-CP, IMS-QTI, IMS-LD, SCORM, IMS-MD	IMS-CP, IMS-QTI, SCORM
Development Control	Consortium based, all the releases are controlled by a leadership team elected by the consortium members	Managed by a person, with a group of collaborators. All the officials release decisions are personal.
Quality Level of Security	High, the multilayer services model allows to isolate the security problems (security vulnerabilities are located easily)	Poor, the php scripts based infrastructure forces to update or patch a lot of code
Collaborative support	There are specific spaces for collaborative work (communities), among specific tools (wiki, blogs, shared documents space,...)	No direct support for collaborative work, but it can used several tools inside the courses for collaborative learning.

Another detailed comparison among OpenACS and LAMP (Linux-Apache-MySQL-Php) applications is available at the OpenACS wiki²⁵. That comparison covers the following issues: a) AOLserver vs Apache, b) PostgreSQL or Oracle vs MySQL, c) OpenACS Business Logic and Data Model vs Perl/PHP/Python, and d) OpenACS vs LAMP communities to show why OpenACS is a preferred approach to developing scalable, complex web applications instead of LAMP approaches.

5. Discussion

Higher Education reforms aims at supporting a “student-centered approach” for lifelong learning based on ICT applications which integrate educational, management and research services. To make such personalized framework sustainable universities are selecting the best combinations of open source software (OSS) solutions and standard-based service architectures to supports application integration and cost reduction. Current challenges go beyond implementing learning and teaching strategies which focus on the promotion of students’ learning in a personalized way

²⁵ http://openacs.org/xowiki/OpenACS_Lamp_Comparison

and insist on addressing the lifelong learning (LLL) paradigm, where students are to be equipped, following a student-centered approach, with the attitudes and skills to learn for themselves both in formal education and long after they have graduated [13]. Furthermore, instead of relying on a single technology platform or a few proprietary software vendors, universities should be able to select the best combinations of available software, where open source software and an open architecture supports application integration and cost reduction [14].

Current efforts are being made, especially in mega-universities with thousands of users and a wide variety of services, to provide a more integrated provision of ICT services. This objective is quite relevant considering the interoperability required to provide many functionalities. For instance, depending on the profile of a particular student (i.e., background knowledge, special needs, preferences, etc.) alternative sources of information and consultancy services can be provided. Likewise, for instance, a lecturer can develop contents, syllabus, and course calendars in a non-proprietary standard format that could be eventually delivered via alternative means (web, printed study guides, books, etc.).

These objectives are essential at UNED, and therefore since 2000 our institution has relied on the combination of open software tools, like dotLRN with the rest of the provided ICT services. aLF platform usage has increased over the years according to UNED needs in terms of users and sessions but also in terms of functionalities provided by the tool. The usage of the platform at UNED has evolved from the initial support of collaboration tasks in communities of varied nature and the eLearning training of tutors and faculty to a more global coverage of administrative departments, faculty units and university departments, as well as courses offered in different educational areas: PhD, undergraduate, ongoing education and occasional courses came from institutional agreements with other institutions worldwide, specially with educational institutions in Latin America.

6. Conclusions

Ever since 2000 UNED's headquarters and aDeNu research group at UNED have been using dotLRN and its predecessors for exploitation and research purposes. The former covers two types of issues. First, collaboration support for a wide variety of uses: study groups, users' associations, administrative services, faculty groups, research projects, etc. Second, eLearning services for end-users and for the faculty and tutors as well. The latter focuses on how to cope with adaptivity, reusability and accessibility issues in learning management systems to improve the learners experience at eLearning settings.

The contributions of both groups to the community of developers have been also of diverse nature. On the one hand, the Innova group (i.e., the current headquarters' unit supporting dotLRN) has been working with the community of developers on porting several packages and applications to have complete Oracle support. It has also provided test servers both for PostgreSQL and Oracle databases, and several improvements have been added in different packages, as well as new packages for specific purposes. On the other side, aDeNu has provided an interaction module which first supported IMS Learning Design integration in the aLFanet project, which includes comments and ratings to learning materials and access to IEEE-LOM

metadata. More recently, with the collaboration of last year students of the Computer Science School at UNED, several modules have been developed: a CSCL framework called the Logic Framework Approach, implementation of Felder Learning Styles Index, and the support for IMS QTI Selection & Ordering feature, which is currently under development.

Throughout this paper dotLRN distinctive features have been introduced, comparing them with other well known LMS, stressing their respective pros and cons, and showing their usage by the aforementioned groups.

All these developments have been supporting a continuous improvement process in the delivery of ICT services at UNED, whose current challenges are framed within the so called European Higher Education Area, and in general, with a wider perspective aiming at supporting a personalized life long learning paradigm, which takes into consideration individual needs of ALL, including those related to accessibility and functional diversity issues.

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