

.LRN Consortium: International Collaboration for Developing a Learning Management System. Experience from the Universitat de València

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Abstract - This paper shows an active Collaboration Project: the .LRN Consortium, and the experience and results of this collaboration at the Universitat de València. .LRN is a global community of educators, designers, and software developers who work together to drive educational innovation. .LRN is backed by the .LRN Consortium, which ensures software quality by certifying components as .LRN-compliant, coordinates software development plans, and maintains ties with OpenACS (Open Architecture Community System), the open source toolkit which forms the basis for .LRN. The Universitat de València chose .LRN and joined the Consortium because it was looking for a learning management system to enhance the learning and communication processes for the whole University. Universitat de València conducted an exhaustive survey of the available platforms. After a successful pilot project, Universitat de València moved forward to widespread adoption, naming its project “Aula Virtual”, using the .LRN platform to enhance traditional classroom learning for nearly 50,000 students and 3,500 professors. Evaluation and conclusions are presented based on a two year experience of actual and campuswide use. Finally, future work lines are exposed in order to improve the learning process, included in the framework that represents the .LRN Consortium.

Index Terms - Learning Management Systems, Open Source Software, Technology Enhanced Learning.

INTRODUCTION

A Learning Management System (LMS) is something more than a set of isolated web applications. This is a term which is applied to those systems whose design integrates different aspects such as the tracking of interrelation between educative contents, and its management mechanisms. The main objective of a LMS is to provide and to manage all the resources of an educational system to the students, taking into account its progress and yield. The LMS are the result of the Computer Based Training evolution. This evolution was made thanks to the existence of new tools for the

management and tracking of community members and other communication tools, such as, calendar, assessment, groups, etc. The virtual communities' creation systems must be able to manage dynamic contents. This objective is obtained using a relational database and a programming language. Nevertheless, it's not affordable to repeat this work each time a new project is created, nor for the developer, because of the workload it implies, nor for the client, because of its high cost. So that the best form to take advantage of the work already made, is to conjugate the use of tools as open-source code or a framework, and to foment collaborative work.

A framework can be defined as a re-usable and “semi-complete” application, with capability of specialized production of applications with personal requirements [1]. Between the benefits obtained with the use of frameworks it can be mentioned modularity, reusability, extensibility, and software version control. A framework can be a solution to a general application or to solve a particular trouble in some concrete domain. It is appropriate to use the term web applications' framework to define development architectures specifically designed to be adjusted to a particular web application' needs in a determined domain, such it can be, the Learning Management Systems.

This paper shows an example of an active Collaboration Project: the .LRN Consortium. It represents a collaborative work whose objective is to obtain and improve a LMS. Firstly, the framework and its architecture will be exposed: OpenACS and .LRN; Secondly, collaboration philosophy will be explained: the .LRN Consortium; thirdly the experience of the LMS in the Universitat de València: the .LRN personalization and integration in the existing systems; the contributions to .LRN community, the utilization results and in course collaboration with members of .LRN community. Finally, future work lines are exposed in order to improve the learning process, included in the framework that represents the .LRN Consortium.

OPENACS FRAMEWORK

Philip Greenspun proposes a modular set of tools to give a generic answer to virtual communities' necessities (<http://philip.greenspun.com/panda/>), in the middle of 90's.

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The set of these modular tools was grouped under the Arsdigita Community System (ACS) name and were released with GNU General Public License (GPL) (<http://www.gnu.org/copyleft/gpl.html>). The first database which was chosen was Oracle and the programming language was Tool Command Language (TCL). ACS demonstrated from its beginning to be a very powerful tool and simple to use, with capability to support large projects. Arsdigita disappeared, but thanks to license liberation, the developers' community retook the project. It was in that moment when an ACS version based on the Arsdigita work named OpenACS (<http://www.openacs.org/>), was developed; using the open code database PostgreSQL (<http://www.postgresql.org/>). Nowadays it is a ripe project, with more than 7000 members and 10 companies that provide commercial support and development [2]. The present architecture does not depend on the relational database used: can operate with Oracle or Postgres; and has the possibility of operating with other databases, if it is necessary. The last evolution of OpenACS has been denominated dotLRN (<http://dotlrn.org/>), and constitutes an architecture reconstruction to improve the set of applications and the framework infrastructure.

OpenACS Architecture

The OpenACS Framework (OACS) is known as application server and it is integrated by a set of advanced tools that allow programmer to develop Web applications which are oriented to define users' communities [3]. In Figure 1, OACS Architecture's Infrastructure and services, and the components' distribution functionalities are shown.

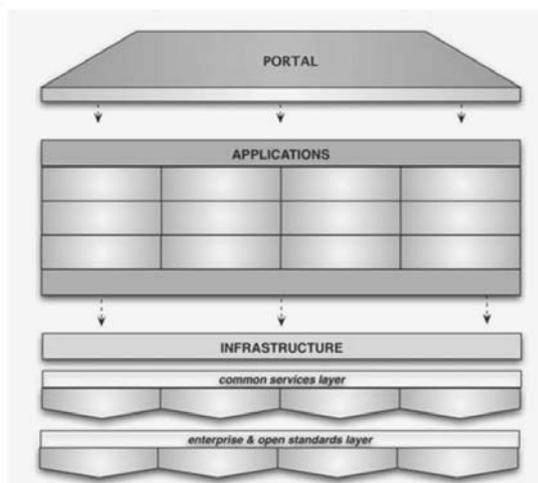


FIGURE 1
SERVICES IN OACS ARCHITECTURE

There is a common layer, named basic services or infrastructure layer, which is supported by the operating system and the relational database where the system information is stored. Linux is used as operating system, because it consumes very few resources and is a very stable and safe operating system. In addition, its cost is practically null and it is maintained by a very active developer community.

Persistency is obtained using PostgreSQL Database, an open code database whose robustness is similar to ORACLE.

In addition, PostgreSQL uses *Multi-Version Concurrency Control (MVCC)* to manage the database accesses. Thanks to this, different users can do simultaneous consulting without waiting to the finalisation of one process to start another. This fact adds agility to execution.

Applications use the Infrastructure Layer services: There are different modules which are available through the Web interface. These modules personalise the users' necessities. The modules programming is made by using TCL, Tool Command Language (<http://tcl.sourceforge.net/>). This is a multiplatform interpreted programming language which is oriented to applications Web generation. Some applications which are available are: forums, calendar, news, assessment, storage area, FAQs, Wimpy Point, etc. Figure 2 shows the available applications in the ACS core; the applications that can be installed and their organization in the architecture are shown on it.

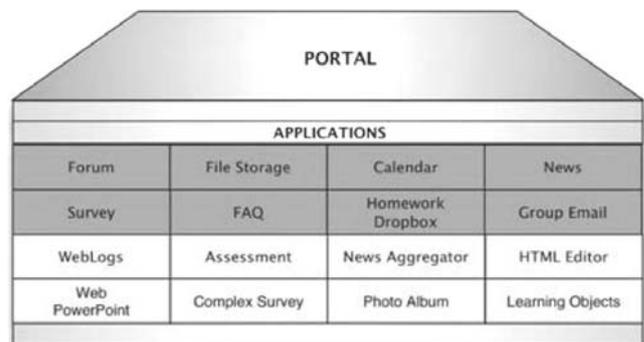


FIGURE 2
AVAILABLE APPLICATIONS IN THE ACS CORE

The portal component is located at the final layer. It is the Web server whose mission is to provide the operation interface and interact with application layer. The Web server technology is AOLserver (<http://www.aolserver.com/>). It is the software which uses America On Line, AOL, to serve its pages. This company is the greater Internet supplier in the world. This fact indicates that the server can support a considerable workload.

.LRN CONSORTIUM

OACS and .LRN Architectures are in continuous evolution and improvement. The implemented and developed modules and functionalities are studied not only by their programmers, but also by a large users' community. The users' community reports the failures they are found, the suggested improvements, the new functionalities to implement, etc. This is one of the open code strong points; and it is also the key of the LMS evolution: The large users' community existence improves the product, and this improvement causes that the LMS is chosen by a greater number of new institutions. In this section the philosophy and operation of the cooperation project and community .LRN is described.

.LRN is a global community of educators, designers, and software developers who partner together to drive educational innovation. Because the software is open source,

organizations can invest in people and curriculum development instead of licensing and support fees. .LRN is backed by the [.LRN Consortium](#). The .LRN Consortium is a tax-exempt, not-for-profit corporation focused on creating and supporting a freely available suite of web based educational applications to support learning communities. Its mission is to convene a global community of innovative people and organizations in educational technology to share knowledge and applications using open source principles. Consortium member institutions work together to support each other's deployments and to accelerate and expand the adoption and development of .LRN. The Consortium ensures software quality by certifying components as .LRN-compliant, coordinates software development plans, and maintains ties with OpenACS, the open source toolkit which forms the basis for .LRN. Some of the .LRN Consortium objectives are: to provide the premier toolkit for innovation in educational technology and research collaboration; to support education and research communities with advanced collaboration tools; to provide a scalable architecture based on open industry standards; and to create a sustainable and affordable platform adaptable to local languages and cultures.

In fact, .LRN provides to its community with a comprehensive suite of collaboration tools, a flexible toolset for innovation, and an enterprise-class infrastructure for scalable deployment. .LRN is a full-featured application for rapidly developing web-based learning communities.

Organisation

Figure 3 shows the Consortium organisation and members. The .LRN Board of Directors, representing Consortium members, sets strategy and has ultimate oversight responsibilities for the project. The .LRN Leadership Team manages operations, works with the open source community of users and developers, and executes the goals of the Consortium as defined by the Board. The .LRN Consortium is governed by member institutions and supported by public and private sponsors. In consultation with Consortium members, the Board of Directors sets strategic direction and provides financial and operational oversight. In its operations, the Consortium: ensures a reliable release process; supports quality assurance and certification; provides framework for legal due diligence; acts as a clearing house for communication; shares best practices with the community; and undertakes marketing and promotion.

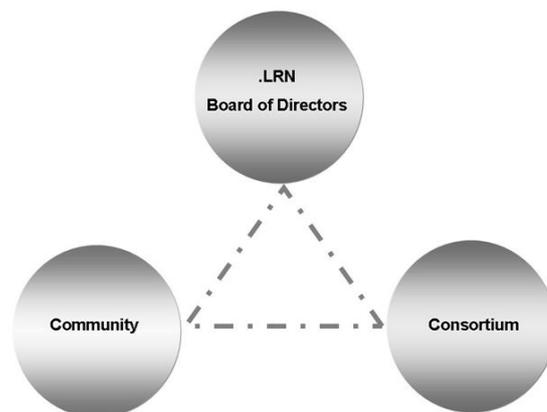


FIGURE 3
COMPONENTS IN .LRN CONSORTIUM

Members

Membership in the Consortium is not required in order to use the .LRN software or to participate in the worldwide community dedicated to developing innovative educational software. The principal benefit of membership is the ability to set priorities and influence consortium operations and goals. Any organization, regardless of its size or capability, may join the consortium for a very modest fee. .LRN is built using OpenACS (Open Architecture Community System) (<http://www.openacs.org>), an advanced enterprise framework for building scalable, community-oriented web applications. The OpenACS "core" has been in development for nearly a decade. This fact gives OACS a large reliability.

.LRN supports learning and research communities for over half a million users in higher education, K-12, and non-profit organizations; which are using .LRN to promote scalable innovation for collaborative education. Some of these organisations are: University of Bergen, UCLA, Galileo University, Harvard JFK, University of Heidelberg, University of Mannheim, MIT Sloan School of Management and Universitat de València.

UNIVERSITAT DE VALENCIA'S CONTRIBUTIONS TO .LRN

The "Universitat de València" (UV) (www.uv.es), one of the largest and most varied in Spain, offers classroom and laboratory learning to 50,000 students in 18 centers. Among them, 6,000 courses from 1,500 subjects are developed. Interested in enhancing the learning process with the use of Information and Communication Technologies, a learning management system has been selected, implemented and developed to improve the learning and communication process for the whole University. The University Computer Services (SIUV) were required, by the academicians of the university, to report on the implantation of an e-learning management system to support all the courses in the University. First, needed functionalities and minimum requirements to be accomplished by the evaluated platforms were identified. Minimum requirements are: Scalability, Integration; Reliability and Standards. After an exhaustive survey of the available platforms [4], Universitat de València joined the .LRN project [5] because .LRN better meets UV requirements for the learning process and also as information

and communication tool for research and administrative communities.

Personalisation and Integration

Aula Virtual is the name used for the UV installation and personalization of .LRN. As for the installation, applications available in the Aula Virtual are: documents, calendar, news, forum, email and notifications, evaluation-assessment, chat, Learning Object repository system, Wimpy Point (Web presentations), weblogs, photoalbum and FAQ's. The implantation of Aula Virtual has been developed progressively in several phases. During first phase: the analysis phase, workload tests were guided with all UV courses and users; other experienced members of the OpenACS community were asked for advising, specifically those who had study systems and plans similar to UV. The OpenACS and .LRN version that was initially installed corresponds to the branch oacs-5-1 of the CVS. The changes of the branch oacs-5-1 are tested with a weekly regularity in a development platform.

Users are authenticated by three different authentication authorities: LDAP, LOCAL and EXTERNAL.

- LDAP authority is verified in the UV LDAP server allowing the use of the accounts that users have created for all e-services in the university. LDAP Authority replaces the .LRN user management used in the rest of authorities.
- LOCAL authority is used to create local accounts by the professors and allow them to access their courses with a student role in order to carry out tests when needed.
- EXTERNAL authority is used to create accounts for external users who need to join communities supported by Universitat de València research projects.

Integration with other university applications that show public and private information on the academic courses has been developed using OpenACS packages and .LRN portlets for integration in the courses [6]. Also, batch programs were made, written in Perl, for the insertion of courses, groups and users, when professors requested it. These batch programs return, via "HTTP", the classes taught by a professor and the students registered in their courses, obtaining the information from the academic database. After collecting these data, a package made in OpenACS, named siuadmin, is invoked. This package uses the creation of courses and users API. Figure 4 shows an example of the *Asiginfo* package that connects the platform subjects' public part with the UV *Oferta de Curso académico (OCA)* application.

INFORMATION						
Curso: 2006-07						
Module: 12997 Parallel Algorithms . 6 Credit points (3 C.Teo. 3 C.Pra.)						
Degrees						
Degree	Name	Cycle	Objective	Course		
413	Computational Sciences Engineering	2	2	4		
		2	2	5		
Group: A						
Plazas Tit.			Plazas L.Opc.			Dates
Cap.	Num.Enr.Stud.	Lib.	Cap.	Num.Enr.Stud.	Lib.	From Until
39	37	2	1	1	0	25/09/2006 20/01/2007
Subgroups						
Tipo aula	Subgroup	Capacity	Num.Enr.Stud.	Plazas Libres	Language	
L	0	20	20	0	Spanish	
L	2	20	18	2	Spanish	
T	0	40	38	2	Spanish	

FIGURE 4
OPENACS ASIGINFO PACKAGE

Figure 5 shows an example of a .LRN portlet in the private area of a course.

BRIEF INFORMATION						
Curso: 2006-07						
Module: 12997 Parallel Algorithms . 6 Credit points (3 C.Teo. 3 C.Pra.)						
Group: A						
Plazas Tit.			Plazas L.Opc.			
Cap.	Num.Enr.Stud.	Lib.	Cap.	Num.Enr.Stud.	Lib.	
39	37	2	1	1	0	
Dates			Exams			
From		Until	Exam date(1t op.)		Exam date(2d op.)	
25/09/2006		20/01/2007	08/02/2007		05/07/2007	
Subgroups						
Tipo aula	Subgroup	Capacity	Num.Enr.Stud.	Plazas Libres	Lan.	TimeTab.
L	0	20	20	0	Spa.	Mor.
L	2	20	18	2	Spa.	Aft.
T	0	40	38	2	Spa.	Aft.

FIGURE 5
BRIEF INFORMATION PORTLET

Contributions to .LRN Community

The users demanded new functionalities and tools, and this fact motivated their development. Among them, we can emphasize the following ones:

- Implementation of the interface translation to the Catalan-Valencian and Spanish languages.
- Technical support for teachers and students (Technical reference manuals and on-line help)
- Development of a space within the .LRN courses where each student has a personal file, replacing classical student cards that professors traditionally asked [7], which was developed from the education Equipment portlet. In this personal file professors can access student data, including his/her photography. The file also allows professors to include commentaries, private or public, referred to the student. Figure 6 shows a Personal File and the way to access to the student file information.

Student: [redacted] Javier
 SUBJECT: Algor.Paralels Gr.A (12997) 2006-07

Personal info Private Comments Grades

Personal info

Student: [redacted] Javier
 E-mail: [redacted]@alumni.uw.es
 Web:
 Address:
 Phones:

Communication

Student Comments:
 Teacher Comments: ok

FIGURE 6
PERSONAL FILE

- OpenACS Chat package integration in the .LRN courses. Figure 7 shows a course portlet, where a Chat room has been created by the professor where only members of the group are admitted.

Chat de ALP

My Space Class Home Calendar Resources Communication Activities
 Information Control Panel

Log off Transcript HTML

[10:44:56] Vicente Cerveron Lleo: auto logout
 [10:53:31] Vicente Cerveron Lleo: has entered the room
 [10:53:45] Vicente Cerveron Lleo: Hi, all
 [10:53:58] Vicente Cerveron Lleo: Any question?

Vicente Cerveron Lleo 00:00:30

FIGURE 7
CHAT PORTLET

- Possibility of mathematical formulation insertion, introducing symbols, in LaTeX or in ASCIIMath (based in MathML). Figure 8 shows a formula insertion using ASCIIMath.

Body*

Read

```
`x_(1,2) = (-b+-sin(pi*r^2)/T)/(2*a)`
```

FIGURE 8
LATEX FORMULAE

whole University,- an easy and intuitive environment, that has allowed to improve the learning process- [8]. However, some negative aspects have been detected. These aspects are typical in platforms that are in continuous development and improvement: difficulties to determine the optimal system configuration for the expected workload and application bugs.

After three years of the LMS use, two of them of generalized use in the whole university [9], [10], an in depth study of the obtained results of use is being made. The main objective is to detect the best practices and those modules that can be improved and to fix the future work lines. The analysis has been carried out by evaluating two academic years. In the **2004/2005 academic period**, blended learning courses were activated on requests (after explicit expression of interest from the involved professors and lecturers). 600 requests were received which generated the creation of 2,662 courses with 1,890 groups and 35,400 users with a student role. Beside 18 communities (collaborative groups) associated to research projects were opened. Simultaneously connected users' average between 8:00 and 24:00 hours was 40 with peak values of 80 users. For the **2005/2006 academic year** all courses in the Universitat de València were opened for blended and technology enhanced learning, giving a personal account to all students and professors and lecturers. In addition, a utility to import the previous course contents was implemented. Figures from this academic period were: 48,199 students involved, 3,256 professors and lecturers, 8,197 courses, 41 communities (research groups sharing information and communication resources). General activity results indicate that 1,420 professors and 29,553 students had acceded to the platform more than 10 times; 871 and 18.604 had done it more than 30 times. This fact represents a utilization of 55% basic users and 33.5% habitual users (There are study centers where percentage bent). These data are specially valuable considering that the use of the Aula Virtual is voluntary as much for the teaching staff as for the student, who has alternative ways to follow and pass the subjects, courses and activities. In fact, the use of "Aula virtual" is not mandatory but improves traditional teaching [7], [8]. Statistics of use of different modules show that the more used tool is **Documents** and the less used is **Activity-Evaluation**, as it can be observed at Figure 9.

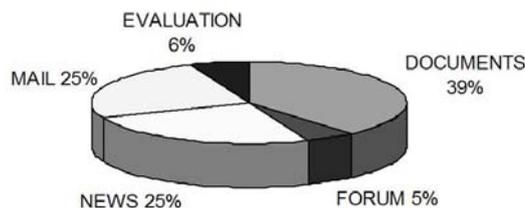


FIGURE 9
COMPARATIVE USE OF TOOLS

COLLABORATIONS IN PROGRESS

Analysis made at Universitat de València shows that Documents is the more used tool. Nevertheless, .LRN has not the possibility of dynamic content creation, which could

be visualized, and edited at the platform. At present, an active collaboration between two consortium members, University of Galileo and Universitat de València, is maintained, in order to create a content creation tool for Learning Objects, related to the .LRN LORS package. The use of this package will allow to create adaptative and collaborative learning models, and, on another hand, to create re-usable contents; not only in different courses and groups of one institution, but also in other LMS. This interoperability will be guaranteed by using standards in contents creation.

It can be mentioned some short term objectives of this collaboration as it can be: to provide a simple interface to create web pages, and easily include and manipulate web assets such as flash, videos, images, etc.; to provide a set of web templates, easy to manage, like PPT templates; to provide collaborative content creation tools while being able to set up roles easily; which has folder, subfolders, pages ordering and is free of "standards" approaches, so professors with basic text edition knowledge can use it. If the created tool make use of already existing content creation tools, it is important try to keep it as customization rather than a fork. Mid and Long Term objectives have been also fixed. Some of them are: to automatically export to SCORM or IMS-CP; to import and publish to LORS with one click feature; to define workflow ; and to integrate third parties API or resources as it can be Flickr, Google, Amazon, YouTube and others.

To reach the objectives, the way is to start making a full review of the tools available, possible approaches, etc; and to build a prototype that gets near to the short term objectives. The start point has been an in deep study of such type of tools: XOWiki, LORSM, LORS Central built-in editor, etc...The work on course can be seen at http://openacs.org/xowiki/Simple_Content_development_tool.

CONCLUSIONS AND FUTURE WORK

At Universitat de València it's remarkable the experience with an open source tool and the collaboration work in a world-wide developing community. In this aspect it must be said that the Universitat de València is the largest in Spain adopting an open source platform linked to educative innovation for blended learning, and the world largest .LRN implementation fully open source (.LRN on top of PostgreSQL). The evaluation process shows a high degree of use of Aula Virtual, even being voluntary. This fact makes patent that both, professors and students, have found real utility and new possibilities using the LMS.

After three courses of generalized use of Aula Virtual, the collaboration with .LRN and OpenACS community is going to be continued in aspects such as: a new module creation to improve the data management (collaboration with E-LANE project and INNOVA group of UNED) and to copy objects between different courses (forums, FAQs, evaluation, etc.)

Future work is as much technical as pedagogical. Some technical tasks are: to adjust AOL and PostgreSQL servers and to resolve the main application errors. It's also

interesting to continue with work in integration with existing information systems, such can be: the improvement of synchronization with the academic data bases, the automatic import of classes schedule to the calendar module and the connection with the librarian data base. All these improvements can help other institutions in .LRN Community to solve its problems.

Finally, the generalization in use of the blended learning and ICT in the teaching activity will depend decisively on the pedagogical work. This means that it must be developed new courses and activities to instruct in the use of the tool; and also to inform all the university community about ICT use and LMS environment didactical potentialities.

ACKNOWLEDGMENT

The authors wish to thank the SIUV (University of Valencia Computing Services) and all the people involved in the .LRN community and its board of directors.

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