INFORMATION TECHNOLOGIES SUPPORTING LEARNING

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Abstract: The massive, simultaneous redesign of all degrees in European Higher Education Area presents daunting challenges but also offers unprecedented opportunities. All degrees must be simultaneously redesigned; synergies among them can be effectively exploited, thus encouraging the re-utilization oriented approaches discussed in this paper (LCMS, standards like LOM, Dublin Corem QTI, IMS, SCORM, etc.). On the other hand, shifting the unit of academic measurement to student hours (through the ECTS) facilitates the seamless combination of face-to-face, distance and blended learning in academic degrees.

1 INTRODUCTION

Higher Education in Europe has been profoundly modified since the declaration of Bologna (1999) (European Union, 2008) and their later road to start-up their implementation before 2010. The introduction of new technologies have also changed the methodology and use of technology in education itself.

The new European Area (Castro, 2007) and its convergence in education designed a model closer to what today is conducted in North America and Japan. In such systems is given greater importance to the practice load during the conduct of a subject. By providing an orientation toward more experimental tasks, and a clear direction to the working world, students develop a range of skills than in degrees with less experimentation do not have.

The idea of creating a common space of Education across Europe boosts mobility both within and outside the member countries. Member countries could move to any other continuing their studies there, just so uniformity and novelty attract the interests of other countries outside the European wishing to study in this new education plan. This mobility of people has as its immediate translation increase the economy and generates jobs uniform.

This new model is voluntary and while at first was accepted by the countries present in Bologna, there have been countries that have signed up later and others who for reasons of the countries themselves have been rejected.

Of course the adoption of this new model brings a number of negative aspects that is the view of each of the countries that are trying to adopt if it is greater than the benefits it can bring.

The clear disadvantages common in most countries are:

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- Economics aspects in the change of the educational system of each country and their own interests.
- Academic aspects, this is the part most important or at least should be. Studies aimed at the more practical or vocational clashed with the design of some careers in particular with the ancient engineering.

More than these commonalities each country deals with the various obstacles that its educational system differs from the new European model. In Spain, the current model had mainly two types of degrees: “diplomaturas” and technical engineering (3-year); and “licenciatura” and engineering degree (5 or 6-year). Degree of 3-year would be a BS/BSc and degree of 5-year would be a MA/MSc. The problem these degrees are not exact equivalent. 3-year degrees are more oriented to vocational and experimentation tasks while 5-year degrees are more theoretical knowledge.

But taking a step closer to the problem within the own country, levels of similarity between universities in the curriculum of a particular degree are scarce and each of the universities could give a different importance on the same subjects, including subjects exist only in selected universities.

One could imagine that this amount of hegemony to reach a common consensus within the country itself is already a first step. However, the process goes on changing and all the universities and countries trying to adopt the new model by the deadline.

In order to understand how this "Bologna process" (the convergence towards the Common European Higher Education Area, EHEA) sets the framework within which the IT-based approaches analyzed in this paper must operate, as well as the ultimate goals they must support, it is necessary to differentiate the two major interrelated sets of changes it involves (Moon and Duran, 2008).

The most visible set of changes involves the abovementioned adoption of a US-like unified cycle structure involving graduate-master-doctoral cycles, as well as the adoption of a single unit of measurement, the ECTS (European Credit Transfer Systems) credit (which refers to 25-30 student hours of total effort, rather than being measured in hours of face-to-face lessons as before). In many countries (such as Spain), this involves the re-design and thus the (re)accreditation of all the degrees, under the quality certification system required by the EHEA.

This massive, simultaneous redesign of all degrees presents daunting challenges but also offers unprecedented opportunities. On the one hand, since all degrees must be simultaneously redesigned, synergies among them can be effectively exploited, thus encouraging the re-utilization oriented approaches discussed in this paper (LCMS, standards like LOM, Dublin Core, QTI, IMS, SCORM, etc.). On the other hand, shifting the unit of academic measurement to student hours (through the ECTS) facilitates the seamless combination of face-to-face, distance and blended learning in academic degrees.

The other, maybe even more significant but more subtle set of changes are those aimed at shifting the focus from instructor-centered “teaching” to student-centered “active learning”. It involves methodological changes such as continuous evaluation, de-emphasizing theoretical lectures to focus more on assignments and projects, higher practical focus, allowing students higher flexibility to design their own curricula. When combined with budget limitations, this methodological shift strongly supports the introduction of effective IT based approaches to alleviate the burden on the instructor’s resources. These should facilitate the educational equivalent of the current manufacturing trend towards “mass-customization”, thus allowing individually tailored learning paths with a level of resources similar to that required by standardized education.

In addition, several countries are taking this opportunity to introduce far-reaching modifications in their educational systems, which further strengthen the case for the introduction of IT based educational innovation. For example, in Spain, until now, all “official” degrees were listed in a catalogue compiled by the Education ministry (universities could also grant their own degrees on whatever they wanted, but those did not have official recognition). This catalogue included the name and the degree curriculum (structure), up to certain level of detail. The new system, however, breaks away from that closed catalogue approach and just issues some very generic guidelines to which new degrees should conform. Within this framework, universities (both private and public) are free to propose whichever degree titles and supporting curricula they want. Once the proposal is cleared from a quality criteria point of view (general quality criteria, such as the faculty CVs, cohesiveness of the proposed degree curriculum and appropriateness of the supporting IT infrastructure) the new degree is inscribed in a national registry, and the university is free to offer it (subject, again, to periodic quality evaluations).

One last aspect worth highlighting regarding the EHEA is its emphasis on promoting mobility and the

international dimension in education (through joint international degrees or through mobility in selected subjects of end term Thesis). Again, achieving this objective would be assisted by the adoption of standards-based, location independent IT-based educational solutions. These should support both distributed provision of learning services (e.g. in degrees offered by consortia of universities) and their consumption by distributed student groups, facilitating not just the interaction between students and instructors, but also the increasingly critical interaction among participants in distributed teams.

2 e-LEARNING EVOLUTION

The task of finding this convergence is present in every country. There is a clear desire for a common area of higher education. As well as seeking solutions and models to conform to European, the technology also gave a fairly noticeable change in the methodology on the side of teachers and on the side of students. Teachers can communicate synchronously with students and they can have colaboratives tools, documentation, opinion board, etc., which are renewed every day.

E-learning (EIfEL, 2008) has changed considerably during the last 15 years, when it only offered digital content (in text files, or in the best cases through hypermedia documents). Nowadays, the e-learning concept (APEL, 2008) involves an everyday wider range of technologies, table 1.

Table 1: Different Technologies in nowadays.

Technologies			
Wiki & Blogs	Discussion boards & Chats	Educational animation	e-mail
ePortfolios	Games	Hypermedia	LMS
MP3 Players	Multimedia CD-ROMs	Screencasts	Simulation
Virtual & knowledge based classrooms	Websites & Web 2.0	Podcast & videocast	Remote & vlabs, Etc.

Obviously, the backbone of this e-learning evolution is the technological revolution (BECSA, 2007) due to the fact that there is not really a new pedagogical methodology in the way of teaching. The real change is based on the new services, and the new possibilities that they offer to both students and teachers.

The concept of e-learning was used to define the online environments where students rarely came to faculties. Over time the offer distance learning courses has increased, relieving traditional courses. These courses also include doctoral programs.

E-learning is naturally suited to distance learning (Castro, 2003) and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used.

In higher education especially, the increasing tendency is to create a Virtual Learning Environment (VLE) (which is sometimes combined with a Management Information System (MIS) to create a Managed Learning Environment) in which all aspects of a course are handled through a consistent user interface standard throughout the institution (Castro, 2004).

E-Learning lessons are generally designed to guide students through information or to help students perform in specific tasks.

A common standard format for e-learning content is SCORM whilst other specifications allow for the transporting of "learning objects" (Schools Interoperability Framework) or categorizing meta-data (LOM).

The way to implement the new technological resources will depend on one's own programmer or teacher of the course, that it always taking into account existing technology. So the level of involvement between student and teacher, even the content of the course may change depending on the preferences given. A course of international politics can be beneficial if there are tools that give the synchronous communication appear natural and fluid. On the other hand a course which requires a more individual study is not necessary to introduce this kind of tools.

Therefore the communication and the technology associated with a course will be asynchronous or synchronous. As asynchronous communication are blogs, wikis and discussion boards, in addition to the email for all one known. Participation requires no interaction with other users or with the programmer of that course. On the other hand the highly participatory courses where there is a need for real-time communications are those who use synchronous tools such as chat sessions or virtual classes.

In addition to e-learning that we all know, is the e-learning 2.0-inspired Web 2.0. As such, it aims to give greater impetus to all the collaborative tools and a social aspect, such as virtual communities where you can get a large amount of documentation

as a live communication with the other participants. A clear example of these places of learning would be the Second Life.

So e-learning in itself does not change in this second generation, just taking the influence of current interest and try to use all the technology possible to apply it to education learning. But it is true that the way to raise learning takes another way. In e-learning 1.0, the students were taking the contents of a course and conducting some practical exercises in order to obtain knowledge. Such practices were evaluated by the teacher, the current e-learning gives greater emphasis to communication and exchange of ideas either synchronous or asynchronous.

The first e-learning was focused on using the internet to replicate the instructor-led experience. Content was designed to lead a learner through the content, providing a wide and ever-increasing set of interactions, experiences, assessments, and simulations. E-learning 2.0, by contrast is built around collaboration. E-learning 2.0 assumes that knowledge is socially constructed. Advocates of social learning claim that one of the best ways to learn something is to teach it to others.

E-learning can provide for major benefits for the organizations and individuals involved:

- Virtual environment allows some reduction of paper usage.
- Reduce the costs of higher education.
- The time to update content as well as their correction is very low.
- The perception of the learner is a livelier interaction and a rich of content.

A great part of the Web evolution towards Web 2.0 or "social web" has gone to the idea of sharing knowledge (e.g. Wikipedia), developing nets which share ideas, situations, images, knowledge, or any educational resources and knowledge on an open way. UNESCO has established some definitions about open knowledge and knowledge-based society (UNESCO, 2005) and has adopted in 2002 the concept "Open Educational Resources" (OER) to refer to materials and other learning subjects offered openly through the use of information technologies, for consulting, use and adjustment to a user's community with no commercial purposes.

The OpenCourseWare (OCW) project started at the Massachusetts Institute of Technology (MIT), in the year 2001, with the aim of offering pedagogical materials in an open and free of charge basis to society. At present, the MIT provide about 1800 courses freely and universally accessible on the net (Lerman, 2006). The main objective of this proposal is to promote and develop higher education sharing, in a free and consistent way, the teaching resources with other educators' students, graduates and anyone in general who wants to improve its knowledge. This philosophy is being spread to the world main universities creating the OCW Consortium (OCWC), in which more than 200 Universities and Institutions collaborate.

The initial conditions to include Higher Educational Institutions in this project regard three different types: educational, technical and legal matters. Regarding technical demands a globally and approachable site via Internet with the right quality must be maintained. Although it has not been a requirement, most of participants have used the technology of content management based on eduCommons (COSL, 2009), an Open Source project built on Pone, developed by "The Center for Open and Sustainable Learning" of Utah State University specifically for the creation of OCW projects.

3 BLENDED LEARNING

Blended learning (b-learning) has allowed a new way of convergence between distance, on-line and on-class education. The convergence is going through the mixed model education that has a different percentage of any kind of methodology depending on the student or learner approach.

In this case the new approach is learner-centered instead the previous model of teacher or content oriented. Learners depending on their availability on:

- Time,
- Technology and communication, and
- Human resources,

will adopt a mix-approach from pure traditional education that are including now elements of on-line and on-class tutoring and collaboration tools through classic distance education.

This evolution from the post mail and telephone education in the distance model (1975) to this b-learning model (1995) is the answer of the large Universities for Distance Education to the Internet and the beginning of the learning-centered change.

Then, blended learning is the process of incorporating many different learning styles that can be accomplished through the use of 'blended' virtual and physical resources.

A typical example of the delivery method of blended learning would be a combination of technology-based materials and face-to-face sessions used together to present content. An instructor can begin a course with a well-structured introductory lesson in the classroom, and then to proceed follow-up materials online. The term can also be applied to the integration of e-learning with a Learning Management System using computers in a physical classroom, along with face-to-face instruction.

At first b-learning as we have said is the combination of e-learning (electronic) or m-learning (mobile) with other educational resources. But besides this, the key of b-learning is human intervention in some form, such as a sense of monitoring or tutoring.

As e-learning, b-learning also has a number of obvious advantages over a traditional course. The costs are quite significant for both the institution and for the learner; ease of access for people who already have another degree in addition to their professional career; flexibility of schedules and of workload. Of course it does take a few disadvantages which may be: having limited access to a computer or Internet, a lack of knowledge of the use of technology. These disadvantages are also present in the institutions for traditional course, because in many cases a course is supplemented by a volunteer and own use of technology in order to gain a greater understanding. So then, one could say such disadvantages are in all kinds of learning today.

4 SOA: SERVICE ORIENTATION PARADIGM

Being IT-based, e-learning is naturally being affected by the current IT paradigm shift towards service orientation. The term Service-oriented architecture (SOA) has been coined to encapsulate this trend.

Information Systems (IS) are built to support business processes (in the case of e-learning systems, the learning process and all associated sub-processes). SOA proposes building these systems as an ad hoc collection of smaller modules called "services". These “services” can be shared by more than one IS, and the details of the implementation are hidden from the IS that use them (even though their “business behaviour”, and any change in it, must be explicitly declared). Furthermore, they can be provided by organizations different from the ones developing or utilizing the IS that uses the services.

Current SOA implementations are usually based on Web Services; they are generally built utilizing one of the existing Web service frameworks, based on implementation platforms such as .Net or J2E. According to the W3C Web Services Architecture Working Group (W3C, 2004), a Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-process able format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.

SOA is, however, a much broader concept than Web Services, and as such it provides a general framework capable of accommodating the peculiarities and specificities of e-learning. On the other hand, that broadness has led to the term SOA being used with differing - sometimes, conflicting - understandings of implicit terminology and components. Therefore, OASIS (Organization for the Advancement of Structured Information Standards - a not-for-profit consortium founded in 1993) created the Service Oriented Architecture Reference Model Technical Committee. After producing several drafts, that OASIS SOA-RM TC published in 2006 the Official OASIS Standard “OASIS Reference Model for Service Oriented Architecture 1.0” (OASIS, 2006), followed in 2008 by an initial draft of the more specific “Reference Architecture for Service Oriented Architecture” (OASIS, 2008).

The aim of the Reference Model is to avoid the proliferation of conflicting definitions of SOA by defining the essence of service oriented architecture through an abstract model that can remain relevant, irrespective of the various and inevitable technology evolutions that will influence SOA deployment (Figure 1).

Service Oriented Architecture (SOA) is defined as a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains.

People and organizations create capabilities to solve or support a solution for the problems they face in the course of their business. However, one person’s needs might be met by capabilities offered by someone else (i.e., one computer agent’s requirements might be met by a computer agent belonging to a different owner). SOA provides a powerful framework for matching needs and capabilities and for combining capabilities to address those needs.

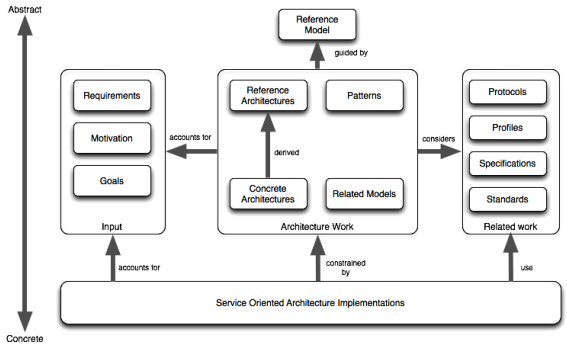

Figure 1: How a Reference Model relates to other work (OASIS, 2006).

Visibility, interaction, and effect are key concepts for describing the SOA paradigm. Visibility refers to the capacity for those with needs and those with capabilities to be able to see each other. This is typically done by providing widely accessible and understandable descriptions for such aspects as functions and technical requirements, related constraints and policies, and mechanisms for access or response. Interaction is the activity of using a capability and is typically mediated by the exchange of messages. The purpose of using a capability is to realize real world effects. An interaction is "an act" as opposed to "an object" and the result of an interaction is an effect.

Regarding the concept of "service", that term encompasses several related ideas:

- The performance of work (a function) by one for another
- The capability to perform work for another
- The specification of the work offered for another
- The offer to perform work for another

These concepts emphasize a distinction between a capability and the ability to bring that capability to bear. While both needs and capabilities exist independently of SOA, in SOA, services are the mechanism by which needs and capabilities are brought together.

SOA is a means of organizing solutions that promotes reuse, growth and interoperability. It is not itself a solution to domain problems but rather an organizing and delivery paradigm that enables one to get more value from use both of capabilities which are locally "owned" and those under the control of others. SOA does not provide any domain elements of a solution that do not exist without SOA.

Thus, under SOA, people and organizations offer capabilities and act as service providers. Those with needs who make use of services are referred to as service consumers. The service description allows prospective consumers to decide if the service is suitable for their current needs.

Although SOA is commonly implemented using Web services, services can be made visible, support interaction, and generate effects through other implementation strategies.

SOA shares many traits with Object Oriented Programming (OOP) paradigms (Anything can be a service in the same way anything can be an object). However, while as the focus of OOP is packaging data with operations, in SOA the central focus is the task or business function – getting something done. This leads to several distinctions:

- OO has intentional melding of methods to a given data object. The methods can be thought of as a property of the object. For SOA, one can think of the services as being the access to methods but the actual existence of methods and any connection to objects is incidental.
- To use an object, it must first be instantiated while one interacts with a service where it exists.
- An object exposes structure but there is no way to express semantics other than what can be captured as comments in the class definition. SOA emphasizes the need for clear semantics.

Rather than as a single, complex, monolithic system, SOA-based systems can be visualized as an ecosystem comprising people, machines and services. This leads to a number of ownership, management and governance issues, since there are strong limits on the control and authority of any one party when a system spans multiple ownership domains. Even when a SOA-based system is deployed internally within an organization, there are multiple internal stakeholders involved and there may not be a simple hierarchy of control and management.

5 SERVICES IN LEARNING

Learning Management Systems (LMSs), as eLearning platforms are generally known, provide a suite of tools which support the creation of, the maintenance of and the delivery of online courses, the enrolment and management of students, the administration of education and the reporting of student performance (Dagger et al, 2007).

They might be based on e-learning frameworks that provide specifications for LMS development,

which are increasingly SOA oriented (Alvarez et al, 2008). The IMS Abstract Framework (IMS, 2006) provides an abstract representation of the set of services that are used to construct an eLearning system in its broadest sense (Figures 2 and 3).

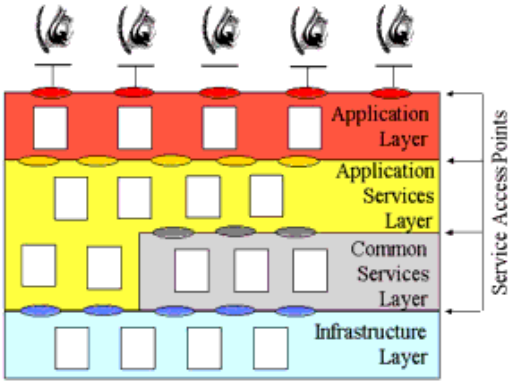

Figure 2: IMS Abstract Framework layered model (IMS, 2006).

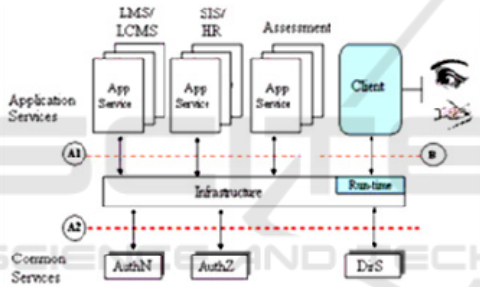

Figure 3: IMS Abstract Framework services (IMS, 2006).

The Open Knowledge Initiative (OKI, 2001) is an MIT project that sponsors a SOA-based set of Open Service Interface Definitions (OSIDs) (current version is V2, V3 is under development). OSIDs have been applied to integrate many educational applications with a variety of content publishers and have become a widely accepted strategy for repository integration.

The "e-Framework for Education and Research" (Olivier, 2007) is another international initiative (established by the UK's Joint Information Systems Committee (JISC), Australia's Department of Education, Employment and Workplace Relations, the New Zealand Ministry of Education and The Netherlands SURF Foundation), that advocates service-oriented approaches to facilitate technical interoperability of core infrastructure as well as effective use of available funding. Among their successful implementations they cite the City University, London (e-framework, 2008).

LMSs can be grouped into two main categories:

- Open source initiatives such as:
  - dotLRN (http://www.dotlearn.org/)
  - Moodle (http://www.moodle.org),
  - SAKAI (http://sakaiproject.org/),
  - ATutor (http://www.atutor.ca/) and
  - Whiteboard (http://whiteboard.sourceforge.net/)
- Proprietary solutions such as:
  - WebCT/Blackboard (http://www.blackboard.com/),
  - Gradepoint (http://www.gradepoint.net/),
  - Desire2Learn (http://www.desire2learn.com/)
  - Learn.com (http://learn.com/).

Open source LMSs are typically built upon extendable frameworks allowing implementers to adjust and modify the LMS to suit their specific needs. This approach, although traditionally not adopted by the proprietary sector, is emerging through such initiatives as WebCT's PowerLinks kit and Blackboard's Building Blocks. These provide software developers with "hooks" to tie third-party software into the LMS. Al-Ajlan and Zedan (Al-Ajlan, 2007) provide a detailed description of how using Web services in MOODLE would allow educators at different institutions to work together and share material by connecting individual courses together, which are hosted on different MOODLE's. Thus, they could teach the same course and share activities such as assignments or chats. Initiatives such as the The LearnServe Project (Learn Serve, 2005) at the Münster university make e-learning offerings available though Web services.

Dagger et al (Dagger, 2007) classify LMSs in successive generations (Figure 4) according to their degree of adoption of the SOA approach and the corresponding supporting standards and technologies.

Smart (Smart, 2008) summarizes the results or recent collective experience in the adoption of SOA approaches in Higher Education institutions presented at the recent IMS Global Learning Consortium Summit on Interoperability. She concludes that SOA has a great deal to offer to these institutions, but of all the challenges that remain, the cultural and governance issues seem to me to be the most difficult to tackle.

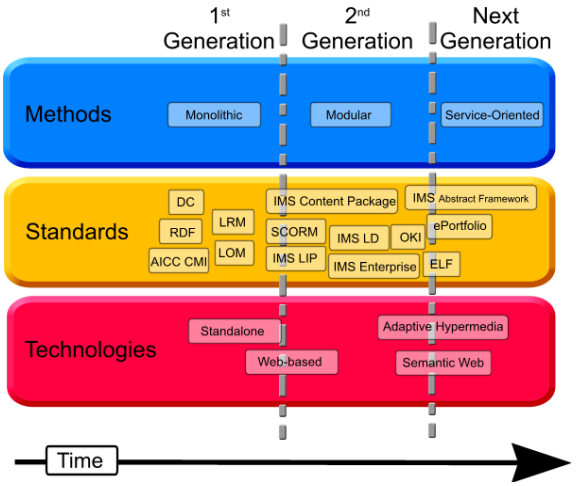

Figure 4: Generations of LMSs (Dagger et al, 2007).

This continuous evolution is providing us a complete word search mixing the learning with letters (Telefonica, 2007):

- B-learning, E-learning, M-learning.
- U-learning (ubiquitous)
- P-learning (pervasive)
- A-learning (ambience)
- C-learning (capacity)
- T-learning (digital TV)
- V-learning (video or visual)

According with this terminology, the concept of s-learning (services oriented to e-learning) is emerging at the same time that organizations create their own e-learning tools. As a consequence of that fact, s-learning promulgates a new methodology based on the creation of e-learning tools encapsulated in a service-shape. In this way, they will be easily integrated inside the different e-learning platforms.

One of the main reasons is to reuse the services that learning management system (LMS) already provide, such as identification and authentication modules; content managers, calendars and agendas; assessment modules; synchronous and asynchronous communication methods, etc. Thus, organizations only must focus on the creation of services to be integrated in a very rich environment of services, and not to reinvent the wheel in each development (Figure 5).

Following this methodology, UNED is developing several e-learning projects with the target of the creation of different services that will improve in some way the learning experience.

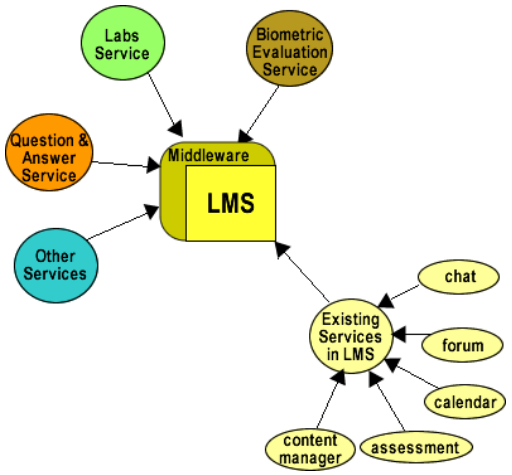

Figure 5: Example of integration of new services in a LMS.

A learning management system (LMS) is software for delivering, tracking and managing training. LMSs range from systems for managing training records to software for distributing courses over the Internet and offering features for online collaboration.

Most LMSs are web-based to facilitate access to learning content and administration. LMSs are used by regulated industries for compliance training.

LMSs are based on a variety of development platforms, from Java EE based architectures to Microsoft .NET, and usually employ the use of a database back-end. While most systems are commercially developed and frequently have non-free software licenses or restrict access to their source code, free and open-source models do exist as we have already explained.

The virtual learning environment used by universities and colleges allow instructors to manage their courses and exchange information with students for a course that in most cases will last several weeks and will meet several times during those weeks. In the corporate setting a course may be much shorter, completed in single instructor-led or online session.

The characteristics shared by both types of LMSs include:

- Manage users, roles, courses, instructors, and facilities and generate reports
- Course calendar
- Student messaging and notifications
- Assessment/testing capable of handling student pre/post testing
- Display scores and transcripts

- Grading of coursework and roster processing, including wait listing
- Web-based or blended course delivery

From the LMSs it can talk about learning content management system (LCMS) which are systems that focus on the development, management and finally published content in an LMS.

An LCMS is a multi-user system where different users can develop, create, manage, reuse, store and send learning content from a central object repository.

Today LMS is used as a term to encompass the functionality of the LCMS but this is not entirely correct, since the LMS can not create or manipulate courses, even they can not reuse an existing course to create another. Instead LCMS applications allow one to create, import, manage, find and reuse units of learning content, which is known as learning objects (Kecheng, 2005).

The learning objects can include media files, assessment, simulations, text, graphics or any other object that may be part of the contents of a course.

An LCMS provides tools for authoring and re-using or re-purposing content (mutated learning objects) MLO as well as virtual spaces for student interaction (such as discussion forums and live chat rooms). Despite this distinction, the terms LMS is often used to refer to both an LMS and an LCMS, although the LCMS is a further development of the LMS.

In essence, an LMS is software for planning, delivering, and managing learning events within an organization, including online, virtual classroom, and instructor-led courses. The focus of an LMS is to manage students, keeping track of their progress and performance across all types of training activities. It performs administrative tasks, such as reporting to instructors but isn't used to create course content.

In contrast, an LCMS is software for managing learning content across an organization's various training development areas. It provides developers, authors, instructional designers, and subject matter experts the means to create and re-use e-learning content and reduce duplicated development efforts.

Rather than developing entire courses and adapting them to multiple audiences, an LCMS provides the ability for single course instances to be modified and republished for various audiences maintaining versions and history. The objects stored in the centralized repository can be made available to course developers and content experts throughout an organization for potential reuse and repurpose. This eliminates duplicate development efforts and allows for the rapid assembly of customized content.

6 REUSE OF SERVICES

As we have seen around the LMS it created an action of reuse internally and externally. Internally through the learning objects that can be changed, reused content of courses, manage them, and so on. What received the name of LCMS. In the same way as it reflected in the above figure (Figure 6) in addition to reuse content to generate more or less different courses between them, another thing different is add additional services to the learning management system to provide greater robustness of this system in place where it was implemented.

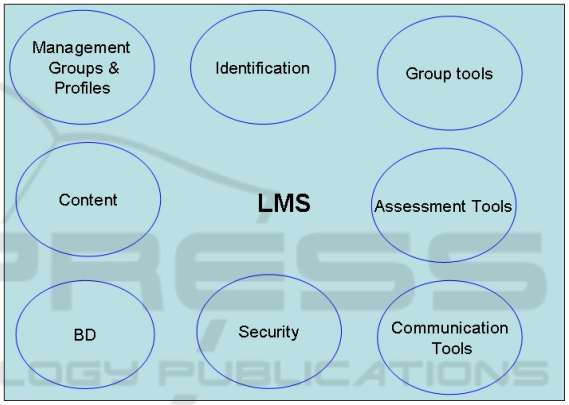

Figure 6: Diagram of Services in LMS.

The LMSs offer a range of services or packages that are almost common to all of them. These are broadly: identification, management groups and profiles; content (news, surveys, questionnaire, reviews, forum, calendar, tasks mailbox, etc.); database; group tools; assessment tools; communication tools; and security.

Within an LMS can generate different courses each with a different content, as it was said. Going up one level, this content could be used within a single institution or in the case of education in the same university. The possibility to extrapolate to other universities will depend on the LMS used. As seen, there are a lot of LMSs, a commercial and other free. All use standards but these are not common among them. So some courses made in a specific LMS would need to adjust to the new LMS where one tries to use them.

About services that a LMS offers there is the same level of reuse. At first a LMS is equipped with

basic packages, standards and databases that handle the content of the courses developed in the LMS. But it may be the case that for a specific situation would be necessary a new service that could be integrated in some way within the LMS. Also, let the new service to adapt to the growth of the institution and the changes of the environment. Thus the work done in the first instance would be valid for next situations.

Of course the level of reuse is also limited to the LMS in use for any new LMS should change the interface of communication or dialogue with the new service.

But if we conceive the idea of independent capsules of LMS and just depending on the environment. Simply create all possible generic services for a particular environment and reuse them in the same environments by changing the interfaces with the LMS.

Of course this idea suggests a poor design of the LMS in itself, which is not entirely true. For the vast majority of current situations an LMS can cover all points, personnel management, presentation of tasks of a subject, surveys, etc. An important point, whatever one wants to refine or strengthen an existing service which is the election of the administrator or developer of the LMS, is there are new virtual environments as a repercussion of the on-line learning that is using.

For example for virtual laboratories (Lang, 2006), it seems reasonable to introduce a system of reserve management to monitor the slot of time during which one can use a remote laboratory (Dominguez, 2005). These laboratories use real instrumentation which is limited, so then there must be a system of reserve them (Figure 7).

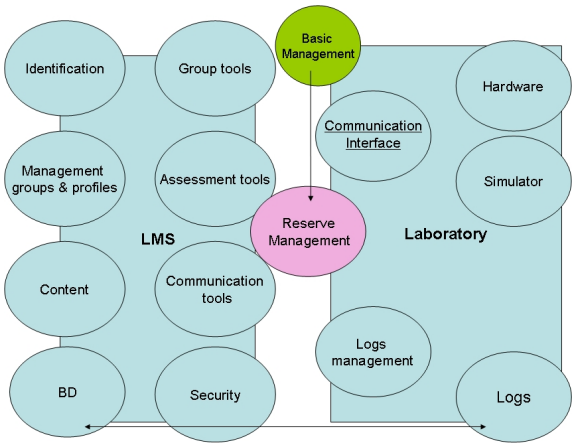

Figure 7: Example of services needed in vLabs.

7 REUSE OF LEARNING OBJECTS

E-learning is probably one of the means by which higher education can reach a greater number of people. It is the largest growth sector in training and development. Nowadays a process of standardization is taking place in learning resources. Learning object repositories are an effective way of sharing knowledge within and between academic institutions. However, simply making resources available on the network is not enough. An additional layer of services is necessary (Wilson, 2001).

A service is a software component supporting processing behaviour or access to information that is accessible to other services through a clearly defined interface (ERL, 2005). An infrastructure service might be user authentication, as well as a learning service might be an assessment capability used to measure student performance. Learning services – based on web services– enable integration of learning objects and other learning resources. Academic institutions offer an environment based on them. Course management systems, learning management systems, learning object repositories or the repositories of student information are some of its elements.

Users need to get access to educational portals based on their own personal profile. Students must identify themselves in this infrastructure to access their courses. Same way, instructors do it in order to publish their contents and communicate with their students or colleagues. Integration of all applications with a single sign-on for users obviates them to re-enter identifying information for each application. SSO systems and Identity federation and privacy data sharing are spreading slowly, such as Athens, Shibbolet or OpenID (Powell, 2007), (Tracking, 2009).

Until recent years, we did not have the means to share our works in different platforms. Learning objects are the best attempt to solve the interoperability, reuse, automated updating, and personalization issues (Hodgins, 2002). Search engines were not suitable to find digital resources. The fact is that many results use proprietary formats or the lack of information about them is usual pitfalls. Metadata can be used to obtain the additional information users need. They describe the nature and purpose of a learning object (i.e. authors, title, rights, etc.) so that it can be found, managed,

and reused. Instead of searching through lists of results, we explore collections of LOs about our topic of interest. This is possible with resources organized by pedagogical value. Dublin Core or IEEE LOM are learning standards on this subject. For interoperability across implementations, the latter is expressed on XML. Inside most communities, their characteristics are extended and adapted to the requirements of their own education system through application profiles (CanCORE, LOM-es, etc.), (Duval, 2003).

Courses must also be structured to allow them to be used in multiple environments, by multiple tools and systems. SCORM standardizes how Learning Management Systems (LMS) launch and track directed learning experiences promoting interoperability (Reload, 2008). A SCORM package (a zip file) contains a manifest file that declares its contents and is set up to describe the order in which the SCOs –a special kind of LOs– are to be delivered. SCORM can communicate learner information with any LMS using a standardized method based on Javascript. Metadata is stored in these packages following the LOM standard. In order to avoid unnecessary work load resulting from updating and publishing content, authoring tools for improving document creation and conversion have been developed.

Generally, we cannot find single LOs. They are stored in large collections with tools to view, edit and share their descriptions –and, of course, retrieve them. Learning object repositories can be accessed through Web services. Usually these repositories are programmed as web applications (web server, database and scripting language). This approach gives LOs a number of benefits, as expanded searching capabilities, accurate access or usage statistics (Sanchez, 2004).

Last but not least important is how to transfer content of metadata between multiple repositories. A federated search layer can be used as middle layer in the architecture without having to modify anything of the other previous tools. In a federated search system, queries from users are sent to different LOR's. The FS engine then merges the results received by these LOR's (Ternier, 2003). Protocols like OKI or OAI-PMH provide a method to reuse repository metadata from external applications. This allows individual institutions to build their own individual registries. The global network GLOBE allows sharing of index information of learning resources available from the five main individual services around the world (GLOBE, 2004). Users can search just one service to gain access to all of the content of all of the repositories.

8 CONCLUSIONS

The convergence towards the Common European Higher Education Area sets the framework within which the IT-based approaches analyzed in this paper must operate.

This massive, simultaneous redesign of all degrees presents daunting challenges but also offers unprecedented opportunities. On the one hand, since all degrees must be simultaneously redesigned, synergies among them can be effectively exploited, thus encouraging the re-utilization oriented approaches discussed in this paper (LCMS, standards like LOM, Dublin Corem QTI, IMS, SCORM, etc.). On the other hand, shifting the unit of academic measurement to student hours (through the ECTS) facilitates the seamless combination of face-to-face, distance and blended learning in academic degrees.

E-learning is naturally suited to distance learning and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used. E-learning in itself does not change in the second generation, just taking the influence of current interest and try to use all the technology possible to apply it to education learning.

The nature of next generation e-learning platforms will be based on service-oriented visions. We have profiled the most prominent initiatives and actors on the scene of distance education. It is clearly a step forward in providing a framework that encourages the reuse and sharing of learning contents. However, now we must focus more on pedagogical and didactical issues of eLearning as well as knowledge management.

A framework built on the aforementioned protocols and metadata is capable of enabling a first level of interoperability between institutional repositories and to improve the discoverability of resources. Nevertheless, it is not enough for developing more intelligent, reliable and precise services or connecting institutional repository resources with other resources involved in the research process. If the future versions of SCORM and LOM want to have success, their specifications shall become equally easy to understand for developers and instructors. There are legal questions in the field of digital content creation. Ensure interoperability by standardizing the tools and data

management across LMSs is also a matter of utmost importance. It is here that we get an insight into the advancements of education.

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