Starting up a LMS at the University of Bari to support e-learning activities

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Abstract: - This paper presents the result of the application of the Oracle iLearning Learning Management System (LMS) to supply education in University courses. The organization of courses structures in some didactic activities is presented. The ways to import didactic modules, to prepare evaluation tests and to offer contents are described. The experimental results obtained in applying the LMS in the University environment are shown and the usefulness of the learning system in practical application is also pointed out.

Key-Words: - e-learning, on-line learning, LMS, self-learning, integrated-learning.

1 Introduction

The learning activities based on digital contents are becoming more and more widespread in several learning areas like those for: industrial applications training, scholar teaching, university courses delivery, and also in many other fields [1, 2, 3]. The e-learning is a solution to acquire knowledge, based on digital contents, available on specialized knowledge bases.

Some years ago electronic documents were used beside paper documents to offer a more attractive product to classroom learners. Successively learning products were distributed on CD and DVD. In the last years, Internet is becoming the preferred place to publish information and to retrieve didactic material. HTML pages have been enriched with multimedia components and web pages have been organized in complex sites.

Learners, during studies, need to be monitored and sustained while using Internet in didactic activities. To handle and analyze the learning process, tracking and testing activities need to be considered beside contents. To support all requirements of e-learning, several Learning Management Systems have been proposed and implemented. They range from great, complex, commercial systems, to little, easy to use, freely available systems. Their purpose is essentially to provide a path to follow, to acquire knowledge, while supplying contents and tracking learning activities. The characteristics of modern LMSs are presented in the section 2. In section 3 some of the most important LMS components are presented. The way in which LMSs access learning contents is presented in section 4. How to prepare the LMS to support university learning courses is described in section 5. The organization of some courses to provide a learning path is presented in section 6. The analysis of statistical results is in section 7. Considerations about the usefulness of the system are in the successive and final section 8.

2 Modern Learning Management Systems

A Learning Management System [4, 5] provides administration of the learning process for an organization: it is useful for the management of courses, students and topics; it makes possible the planning of learning cycles and it traces learning activities.

A Learning Management System (LMS) is a collection of integrated software pieces to import, to organize and to distribute learning, to monitor behaviors and results, and to provide effective feed-backs. In some cases LMSs also include an authoring tool to produce learning objects.

Whether learning is distributed on-line or off-line, live or recorded, the LMS enables to organize and trace presentations, to manage content scheduling and lists of users qualified at the enjoyment, to set up and update involved resources.

The most important LMSs are the well known IBM Lotus Learning Space, the SumTotal Total LMS, the Microsoft LRN 3.0 Toolkit, the Macromedia Breeze and the Oracle iLearning.
- The IBM [6] solution can be used in two versions: core module and collaboration module. It supports self learning, collaborative learning and real-time learning.

- The SumTotal [7] solution consists in a highly scalable collection of dedicated and interoperable software products.
- The Microsoft [8] solution is an Xml implementation of the Content Packaging 1.1 LMS; it supports the Metadata 1.2 specifications and the SCORM model.
- The Macromedia [9] solution is essentially based on the flash technology; a plug-in allows an easy conversion of Power Point slides in e-learning products.
- The Oracle [10] solution allows an effective on-line learning; it supports user creation and aggregation, content publishing and delivery, test creation and management, course and test tracking; it also has a lot of collaboration tools to help students in cooperation activities.

In web-learning systems, advanced collaborative tools are provided to support the learning process [11, 12, 13]. The tools allow different forms of interaction among all people involved in the learning process (teachers, students, tutor, administrator, content-object producers, etc). In effect, the availability of Internet information tends to isolate learners. Distance among users becomes higher and higher with the growing use of Computer Based Training instruments. To support students in the formative process, and to remove them from isolation, collaborative tools and self evaluation tests are useful. Collaborative tools consist of:
- an electronic whiteboard;
- a chatting system;
- a forum support;
- a notice board;
- a messaging system;
- a self-testing support;
- a final test system;
- an evaluation system.

In content production and organization, the reference paradigm is based on learning objects [14, 15, 16]. Didactic products consist of modules and of learning objects. This organization allows an easy tracking activity and a good use of LMS resources. The learning object is the unit of information of an e-learning product. It consists of a set of pages that exhaustively present a concept. The metadata describe properties of the pages and the way in which they will be handled by LMS [17, 18].

A course needs to be developed according standards to be imported on a LMS. Standards ensure fulfillment of RAID requirements [19, 20]:
- Re-usability: the possibility of modifying and reusing the learning objects;

- Accessibility: the possibility of searching and making available didactic contents to selectable users;
- Interoperability: the possibility of using the product on different platforms;
- Durability: the capability of the product of being installed on new management software versions.
There are different organizations that propose standards and guidelines to develop e-learning products. The most important are:
- IMS Global Learning Consortium [21]: an organization that groups some of the most important research centers and farms interested in e-learning; its purpose is to develop open specifications to produce interoperable e-learning products;
- Aviation Industry CBI Committee [22]: born to produce guidelines for e-learning products of US Air, it has become an international reference point for problems concerning computer-based training;
- Association of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) [23]: a European foundation that aims to involve European citizens in the opportunities and possibilities offered from web-learning.

The LMSs, to ensure the management of courses developed according different standards [24, 25], support different ones, such as: IMS, SCORM [26] and AICC.

3 LMS components
A LMS consists of different software components which work together to allow an organization to create, manage and distribute didactical courses in different ways.

Usually a LMS can be hosted on different operating systems (such as Windows, Linux, Solaris, Unix) and it uses the http protocol to supply data. Since it is composed of various components, it results highly configurable and it can be extended or customized in different ways. Services are provided by means of a great number of applications included in it. The different components co-operate to produce an all in one solution.

The following list shows in summary the main LMS components specifying their primary functions.
- LDAP Directory: if used, it is useful to keep a centralized list of user accounts of an organization. It can be used from various applications during authentication phase;
- Relational DBMS: it includes and manages LMS databases; some databases, in effect, are reserved to the LMS, other ones contain information about

users and their activities, courses and their offerings;

- Delivery server: it introduces students to the structure of courses and it permits the navigation among the activities; it allows to access contents and it traces progress of studies;
- Content server: it contains all lessons files that compose courses;
- SMTP server: it manages the transfer of mail messages among students and teachers and between the system and its administrators. In other words, it manages the transfer of mail messages from and to all users authorized to use the system;
- POP3 server: it handles all mailboxes of users registered into the system;
- FTP server: it allows to collect and transfer courses produced by developers and to make them available to be imported into the system;
- Authoring tool: it allows developers to create courses, test and polls according to the learning courses production standards;
- Collaboration server: it provides support for collaboration;
- LMS server: it represents the interface of the learning system to the outside environment. All users have access to the various functionalities provided by the system exclusively through LMS interface;
- Web browser: it renders learning products to client stations;
- Stream server: it allows streaming of audio-video multimedia contents and transferring of real time shooting;
- On line sparse classroom server: it allows to distribute the lesson from a teacher physically present in a classroom to student groups in remote places;
- On line virtual lesson server: it enables to distribute pre-recorded lessons to specific groups of remote students according to defined supply scheduling.

4 Accessing e-learning contents

Users access the learning platform through the LMS server. When a user points the access URL (Uniform Resource Location) of a LMS into a web browser, it opens the home page of the learning platform. Now the user is an anonymous one and he has limited access to system resources. When he signs up (provides login and password so that system validates the information to verify if the user is known and if his credentials are valid or not) the system produces a customized page. This new page, and its content, depends on supplied credentials. Every user has access only to authorized functions and services.

Students use the interface to scroll courses list, to register themselves to courses of interest, to access their contents and observe their study improvement. Administrators access the system to modify working configurations, register new users, define roles and produce reports. Developers produce and update courses and store them into the system. Directors define resources to associate to courses, classes and teachers.

To produce didactic material, developers use authoring tools. Once completed the production phase, courses are published and transferred into the learning system; at this purpose an ftp-server is used. The structure of courses is stored into specific databases and managed from the Delivery Server, while content files are stored in the Content Server.

To access on-line courses, students select the relative voice from the list of courses available in the LMS and activate it. The LMS server drives the student to the Delivery Server that provides the structure of the course and allows the navigation inside the course index; if necessary, the Delivery server establishes a predefined sequence of actions within learning components. When students select a particular course activity, the Delivery Server makes available specific contents extracting them from Content Server and it shows them through the user interface. As long as students make use of courses, progresses are captured from the Delivery Server and sent to the LMS that provides to store them inside RDBs.

5 Specializing the LMS to support learning activities in university courses

The learning management system taken in consideration is Oracle iLearning [10].
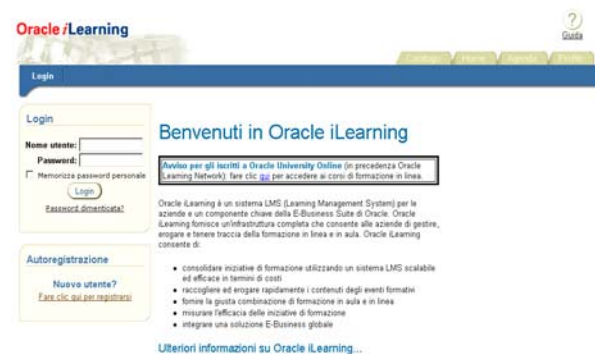

Figure 1: Oracle iLearning interface

The learning management system (Figure 1) is accessible through a web based graphical user interface. A portal (Figure 2) introduces users to e-learning activities [27, 28] and drives them into e-learning courses [29].

Figure 2: Uniba e-Learning Portal

After logging, a user can use Orale iLearning to follow courses or to administer the internal structure of the knowledge repository. New contents can be made available to pre-existing or newly entered users. The LMS essentially distinguishes users in administrative users and regular ones. The distinction is made by considering the username and the password used to enter the system. After logging, an administrative user can access the management section thought a dedicated button available in the graphical interface. He can enroll or organize users; upload, rearrange or publish contents; and access reports or collaborative tools. To operate he needs to select the section he wants to update (contents, users, report, etc.) and to perform associated operations.

The LMS implements the Object Oriented paradigm, folders, learning contents, tests, are considered as objects. In the LMS it is possible to create new objects or modify existing ones. The main window is essentially divided in two frames. Object creation is possible by means of buttons available in the left frame of the window. Object modification is possible by means of commands available in the object contest sensitive menus, available in the right side frame. Contents and users are organized in tree structures having as root the site name.

Content management allows the creation of folders, learning contents and tests (Figure 3). They can be simple or structured and can be moved or copied within the site. A learning content can be created directly in the site root or in a folder. Content publishing consists of two phases: file uploading and metadata importing. In the first phase the learning content is transferred from the local machine to the content server, successively it is made available in the Learning Management

System by means of metadata. At this point the product is ready to be offered to learners. Users can belong to organizations, groups and hierarchies. If a user belongs to an organization he cannot belong to another one. Instead, a user can belong to one or more groups according interests or common activities. The hierarchy reflects the organization according manager and subordinates.
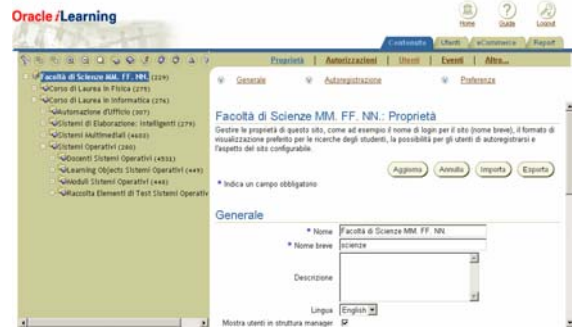

Figure 3: Content Management Interface

To operate on users, after having selected the user panel and the site name, it is possible to create new organizations and then populate them (Figure 4). New user insertion and group creation are considered as site modification. From the contest sensitive menu, selecting the user section, new users or new groups can be added to the site.
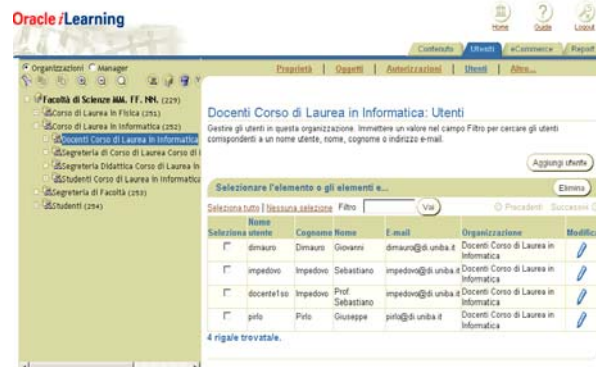

Figure 4: User Management Interface

6 Organizing e-learning activities

In a university consisting of several faculties, a site for each of them has been created.

By considering contents, there is a folder for each degree path and, for each degree, a folder for each teaching course. Successive course sub folders can contain: teacher names, learning objects, question collections, offerings and tests (Figure 5).

By considering the user panel, the set of all actors involved in the learning-teaching process can be organized according the following structure (Figure 6).

Figure 5: Preparing an offering

The Faculty site contains an organization for each degree path. For each degree there is an organization for teachers, for administrative secretary, for didactic secretary and for students. Beside degree organizations there are few organizations containing teachers having courses in different degree paths, faculty secretary and students not yet assigned to a degree path. By selecting an organization it is possible to operate and update it.

Figure 6: Registering a user

At the University of Bari in Italy, in the starting phases, only some courses are being provided in e-learning. In the Science Faculty, for example, the Computer Science degree path has been involved in the experience, and for it some modules of the following courses have been published:
- Operating Systems;
- Intelligent Systems;
- Office Automation;
- Multimedia Projects and Products.

In the first semester about 75 students of the third year of the first level Degree in Computer Science have been enrolled in the course of Intelligent Systems. In the second semester about 120 students of the first year of the first level Degree in Computer Science have been enrolled in the course of Operating Systems. The students of the third year that attended the course of Intelligent Systems had the possibility to use the LMS to study modules on:

- Introduction to Discrete Systems,
- The z-Transform and Discrete Systems,
- The Discrete Fourier Transform,
- The Fast Fourier Transform.

They could use didactic modules in e-learning and tried tests to evaluate by themselves the level of comprehension of the subject they were studying.

The students of the first year that followed the course on Operating Systems used the LMS as a completion of the frontal lessons on:
- Introductions to Computing Systems,
- Introduction to Operating Systems,
- The Processes,
- Process Management,
- Mutual Exclusion and Concurrence,
- Scheduling,
- Memory Management,
- File System.

They attended frontal lesson in class and used the learning objects to repeat lessons and complete their study and to evaluate their level of comprehension of the subject under examination.
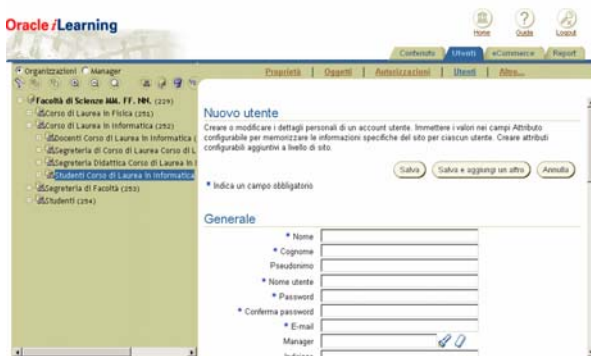
7 First statistics of the LMS use

A First analysis on the use of the LMS shows that the LMS is being profitably used from early students. By considering the module entitled "Introduction to Discrete Systems" a test, organized in 8 sections, and a total number of 40 questions, was prepared. Each test section treated a specific theme presented in the learning module: Series, Discrete Systems, Causal Systems, Stability of Discrete Systems, Difference Equations, Frequency Response of Discrete System and Fourier Transform of a Series, Inverse Discrete Fourier Transform, and Relation between Fourier Transform of a continuous function and Fourier Transform of its discrete sampled version.

The results have shown that all students used the system correctly to achieve knowledge. The students obtained an average score of 93.33% of correctness in their answers, with a standard deviation of 4.69%. Students, in order to complete the test, needed an average time of 25.29 minutes, spending about 38 seconds per question, with a standard deviation of 15 seconds. All students obtained a score above the 85.00% of correctness, the 25% of them a score below the 90.00%, the 50% a score below the 93.75%, the 75% a score below the 97.50%, while the remaining 25% obtained a score above 97.50%.

The analysis of the performance in each section shows (Table 1) that the average score per section ranges from 86.67%, in section 6, to 98.15%, in

section 4, with a mean value of 93.33% and a standard deviation of 3.73%. In detail in sections 1, 3, 4, 5, and 7 the performance was above the mean value, while in sections 2, 6 and 8 it resulted under the mean value.
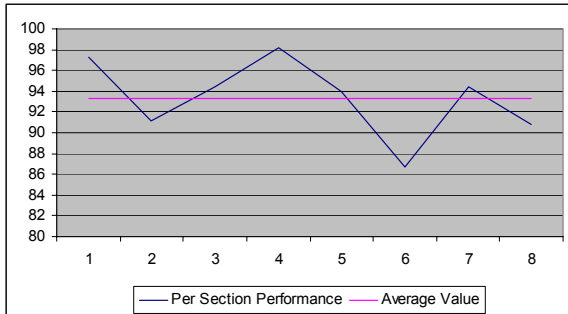

Table 1: Per Section Performance Analysis

The analysis of the time spent to complete each section of the test (Table 2) shows that students needed a minimum of 24 seconds per question in section 7, and a maximum of 1 minute and 10 seconds in section 2, with an average of about 37 seconds and an average absolute distance from the mean value of 10 seconds. Moreover it resulted that the first 3 sections, and particularly the second one, required a time above the average value, while the remaining 5 required a time under the average value, with values of time particularly low in the last and last but one sections.
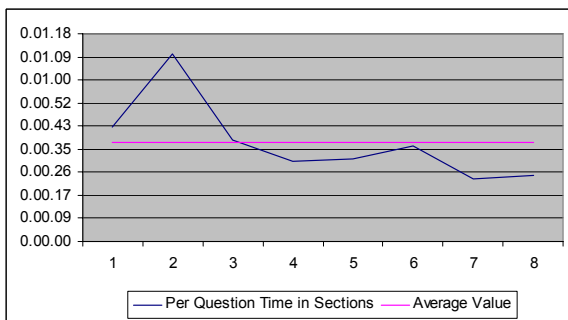

Table 2: Per Section Time Analysis

The first learning module of the course on Operating Systems presents an Introduction to Processing Systems. It consists of three learning objects: the first on principal components of computers and basic concepts of computation, the second on memory types and hierarchy organization, and the third on I/O modules and input output operations. Students spent, on the average, 1 hour 46 minutes and 57 seconds in the learning module.

In Table 3 can be observed that the 61.70% of students used the learning module for no more than 5 minutes. The 6.38% of students spent a time between 5 and 10 minutes to visit the module, the

8.51% of them spent between 10 and 15 minutes, the 2.13% between 15 and 20, the 4.26% between 20 and 25, none of them spent a time between 20 and 60 minutes, and the 17.02% spent more than 1 hour.
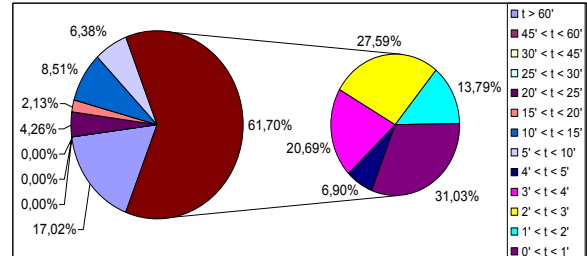

Table 3: Learning Module Time Analysis

Among the 61.70% of students that spent no more than 5 minutes, the 31.03% (19.15% of the sample test) spent less than 1 minute in the course; the 13.79% (8.51%) between 1 and 2 minutes; the 27.59% (17.02%) between 2 and 3 minutes, the 20.69% (12.77%) between 3 and 4 minutes, and 6.90% (4.26%) between 4 and 5 minutes.

8 Conclusion

The use of the LMS proved that it can be effectively applied both to provide self-learning and to complete in-class lessons. The carried out activities were traced from the system. Intermediate tests allowed students to self evaluate their progress. Final tests enabled teachers to estimate the student preparation in the main concepts of the courses.

References:
[1] European Commission, The role of Universities in the Europe of Knowledge, *CUM (2003) 58,* February 2003.
[2] European Commission, eEurope 2005: An information society for all, *Communication from the Commission of the Council, The European Parliament, The European economic social committee and the committee of the regions,* January 2002.
[3] S. Impedovo, G. Dimauro, G. Pirlo, Traditional Learning Toward On-Line Learning, *Proceedings of the International Conference on Technology-Enhanced Learning - TEL'03,* FAST, 2003, pp. 255-360.
[4] P. Avgeriou, A. Papasalouros, S. Retalis, M. Skordalakis, Towards a Pattern Language for Learning Management Systems, *Educational Technology & Society*, Vol. 6, No. 2, 2003, pp. 11-24.

[5] M. F. Paulsen, Experiences with Learning Management Systems in 113 European Institutions. *Educational Technology & Society*, Vol. 6, No. 4, 2003, 134-148.

[6] http://www.ibm.com/software/lotus/

[7] http://www.sumtotalsystems.com/products/

[8] http://www.microsoft.com/Presspass/press/2000/feb00/elearningpr.mspx

[9] http://www.macromedia.com/software/breeze/

[10] http://ilearning.oracle.com/

[11] K. Kreijns, P. A. Kirschner, W. Jochems, The Sociability of Computer-Supported Collaborative Learning Environments, *Educational Technology & Society* Vol. 5, No. 1, 2002.

[12] P. L. Isenhour, J. M. Carroll, D. C. Neale, M. B. Rosson, D. R. Dunlap, The Virtual School: An integrated collaborative environment for the classroom, *Educational Technology & Society* Vol. 3, No. 3, 2000.

[13] D. Smith, G. Hardaker, e-Learning Innovation through the Implementation of an Internet Supported Learning Environment, *Educational Technology & Society,* Vol. 3, No. 3, 2000.

[14] B. Harvey, Learning Objects and Instructional Design, *International Review of Research in Open and Distance Learning,* July 2005.

[15] M. Sosteric, S. Hesemeier, When is a Learning Object not an Object: A first step towards a theory of learning objects, *International Review of Research in Open and Distance Learning*, October 2002.

[16] R. Robson, All About Learning Objects, *Eduworks*.

[17] S. Downes, Learning objects: Resources for distance education worldwide, *International Review of Research in Open and Distance Learning*, Vol. 2, N. 1.

[18] R. Robson, Reusable Learning Objects, e-Learning Magazine, Oct 2002, Vol. 3 Issue 9, p 18-19.

[19] M.-A. Sicilia, E. García, On the Concepts of Usability and Reusability of Learning Objects, *International Review of Research in Open and Distance Learning*, October 2003.

[20] H. Singh, Achieving Interoperability in E-Learning, *Learning Circuits*, March 2000.

[21] http://www.imsglobal.org/

[22] http://www.aicc.org/

[23] http://www.ariadne-eu.org/

[24] http://ieeeltsc.org/

[25] http://www.cenorm.be/cenorm/businessdomains/ businessdomains/isss/activity/wslt.asp

[26] http://www.adlnet.gov/index.cfm

[27] S. Impedovo, G. Dimauro, A. Ferrante, N. Greco, M. G. Lucchese, R. Modugno, G. Pirlo, L. Sarcinella, The PROTEO Project: New Advances in e-Learning Activities at the University of Bari, *WSEAS Transaction on Communication,* Issue 1, Vol. 5, January 2006, pp. 23-30.

[28] S. Impedovo, G. Dimauro, R. Modugno, G. Pirlo, A New Step Toward e-Learning at the University of Bari, *Proceedings of the the 1st WSEAS/IASME International Conference on Educational Technologies (EDUTE'05),* 2005, WSEAS Publishing, pp. 134-137.

[29] http://www.web-learning.uniba.it/