Designing simplicity: usability perspectives on Learning Management Systems

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Abstract: - This paper presents an experimental Learning Management System (LMS). The usability aspect of its functions serves as the main focus of this system because the potential for usability problems seems to be especially severe in LMSs, due to their ability to implement complex features and intricate interactions. In order to establish a more efficient e-learning environment, an LMS should have intuitive interfaces and clear information design, allowing learners to concentrate on learning and instructors on learning strategies. The proposed LMS includes all the important functions of delivering learning material, tracking learning activities and managing community tasks, yet by following recent usability techniques it manages to hide all this complexity. Moreover, providing a comprehensive idea of content organization and management along with a simple navigation tool, it allows learners to focus on their learning activities without excessive hassle and instructors, especially those unfamiliar with Information Technologies, to profitably exploit their learning resources.

Key-Words: - E-Learning, Usability, Learning Management Systems, Learning Objects

1 Introduction

According to leading scientists in the field, specialized platforms which provide educational material in digital form, educational activities and support the administration of learning programs are divided into two main categories: Learning Management Systems (LMS) and Learning Content Management Systems (LCMS) [18]. An LCMS has the functionality of a LMS with the addition of some course editing tools, while an LMS does not provide tools to support the editing and publishing of on-line courses. However, all modern e-learning platforms are actually referred to as LMSs despite their support for course authoring tools. Taking this into account, we use the term LMS for any similar e-learning environments throughout the present paper.

The recent progress in e-learning specifications and standardizations has contributed to the development of many quality LMSs. Many instructors use these LMSs in their courses. Yet, their successful functionality is not always without problems. Modern LMSs provide many services but are usually subjected to increased complexity and require experience in their use [1, 2].

For the development of qualitative educational material, the knowledge and skills needed are not quite widespread. Most of the available applications require the participation of professionals with multiple qualifications: content experts, learning designers, multimedia developers etc. At the same time, the contribution of professionals such as web administrators and e-learning technicians is required in most LMSs [3, 19]. Instructors are often blamed for exhibiting insufficient skill and willingness to cooperate with these professionals. Therefore, in order to assure quality of instruction in E-Learning, LMSs should become friendlier, assisting and motivating even users with practically no prior computer experience to organize and deliver course material efficiently.

Aiming to simplify the services of an LMS, we began implementing an experimental system that uses learning objects inspired by the SCORM specification. In the following sections, we will present the current theoretical framework on which LMSs are generally based on, describe the problems regarding their complexity and outline the features of the proposed LMS. Future work and developments will be noted in the last section.

2 LMS specifications

The purpose of an LMS is to provide a virtual environment for students with the functions of

online learning, online discussion, performing learning activities (projects or exercises), taking assessments, recording learning history and finally delivering lessons in a series of learning units. An LMS also gives professors the ability to view and manage all previously described functions and services. In order to manage educational material, an LMS usually "breaks" content into "elements" which are called learning objects (LOs) [4].

The term “Learning Object” was coined in the mid-90s, based on the development and reuse of software elements in software engineering and object oriented programming [17]. Although there are many definitions, the most acceptable is the one given by “The Learning Technology Standards Committee” (LTSC), which defines learning object as "the entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning". However, the main point is to have learning material broken down into smaller pieces that could be later combined by instructors, learners and eventually computers into larger structures to support learning.

Modern e-learning technology recognizes the importance of LOs. The goal of all specifications [5] is to produce educational content that will be:

- interoperable
- accessible
- durable
- reusable

The most important benefit of a LO approach is reusability. This means a LO used on one LMS can be used to provide the same function for another LMS. A requirement for obtaining this reusability is the rapid spread and adaptation of specifications and standards.

There are many organizations working on specifications, developing standards for LMS functions and for LO metadata. The following four in particular are leading e-Learning standards development.

- Aviation Industry Computer-Based Training Committee (AICC). Its specification allows course interchange between LMS. It includes a description of functions of LMS, course structure and architecture for e-learning implementation.
- Instructional Management System Global Learning Consortium, Inc. (IMS). It develops specifications for LOs and learning services. It has evolved into the LOM Working Group (Learning Object Metadata) which focuses on a standard for the description (metadata) of LO.
- Institute of Electrical and Electronic Engineers (IEEE). It has a LTSC (Learning technology standards committee) dealing with data models and process communication.
- Advanced Distributed Learning (ADL) initiative. It was established in 1997 by the American Department of Defense in collaboration with a number of American universities and firms. One of the most widely used specifications is the SCORM (Sharable Content Object Reference Model) which proposed by ADL in early 1999.

The SCORM metadata information model is a reference to the IMS learning resource metadata information model, which itself is based on the IEEE LOM standard. The SCORM metadata also adheres to the IMS learning resource metadata XML binding specification and provides an XML representation for the SCORM metadata information data model. The main goal of SCORM is to provide a neutral pedagogical standard that allows course designers to link pedagogical resources together in order to build a curriculum [6]. SCORM aims at encouraging and supporting small, reusable, sharable course content, discoverable via metadata descriptors.

The SCORM specification defines a rather complex XML metadata data model, consisting of over 60 metadata entries. It even has the ability to use recursive data structures [7]. Hence, the building of even a simple course that meets the specifications of SCORM requires the contribution of an experienced instructional designer.

3 Background

During the last decade, more than 500 LMSs have been created by software companies and universities, most of the time outside the scope of standards [18]. A great number of these LMSs allow instructors to develop online courses, offering them many different choices according to the type of the available material and the learning experience aiming at the student. The LMS provides an interface for preparing the material while at the same time is responsible for its storage. Unfortunately, this kind of courses does not follow standards which allow users to migrate content between systems. Additionally, integrating materials is not so easy in the majority of these LMSs and the assessment engine is not so sophisticated, resulting in causing frustration among staff.

The procedures followed in order to create a

course compliant to the SCORM specifications are different in mainstream LMSs (WebCT [11], Dokeos [12], Moodle[13] e.g.). The instructor uses an authoring tool (e.g. Reload [8], Macromedia AuthorWare) offline and then uploads the result to the LMS server. The LMS itself does not permit the management of the LOs comprising the course or the modification of the course structure. Nevertheless, there have been some recent efforts regarding the integration of LMSs' authoring environments which aim at developing SCORM-compliant courses. Version 1.55 of Dokeos (early 2005) supports the SCORM conversion of an online course. However, these functions currently contain numerous bugs and present many limitations.

Recently, some academic institutions have begun implementing experimental LMSs that feature authoring environments for the online creation of SCORM courses [20, 21]. These LMSs try to address efficiency issues by applying adaptive learning models, learner-centred designs or innovative extensions to the existing implementations. The common goal to all these efforts is the creation of an ideal web-based learning environment that is easy, friendly, engaging for learners and practical for instructors. Our proposed LMS aims to contribute to this same direction, while focusing on simplicity and utilizing modern programming techniques such as these offered by the Microsoft .NET framework. We hope that our efforts, though still on their early stages, will serve as a guideline for the design of similar LMSs in the near future.

4 The problem of complexity

The increasing popularity of e-learning has speeded up the pace in the development of current e-learning standards leading to many LMSs that, although they claim to meet some specifications, at the same time they are incompatible with educational content that adheres to the same specifications. In addition, even if the compatibility issues are to be resolved, other issues pertaining to uniformity may emerge. More specifically:

- the uniform appearance of educational content in various LMSs
- the uniform tracking of the student activities and their use of learning material
- the uniform appearance of learning objects without sacrificing their independence and reusability

This lack of uniformity causes confusion to both the developers of educational material and the managers of the educational process, thus discouraging instructors who are not familiar with Information and Communication Technologies to use LMSs.

One challenge for LMS developers is to simplify the development process of educational material that is compliant with the SCORM specifications. To deal with this issue many e-learning tools have been proposed, with most of them being rather poor in terms of features and capabilities. On the other hand the most powerful authoring applications such as Reload [8], Macromedia AuthorWare and Trivantis Lectora are difficult to use or require the knowledge of programming languages, thus hindering e-learning efforts. Many of the current tools for creating training material make use of rigid interaction schemes and awkward interfaces, thus demanding considerable time to learn and even more time in order for an instructor to come up with some useful results [9]. The creation of a technology-based course not only does it require a multimedia expert but a learning technologist as well.

Both commercial LMSs (Blackboard [10], WebCT [11]) and open LMSs (Dokeos [12], Moodle [13], Atutor [14]) appear to be very complex. This complexity derives from the large number of students, lessons and professors they support, the adoption of numerous specifications, and the responsibility of management (administration of student registrations, certificates, events). In addition, the adaptation of such an application to the infrastructure of a small organization is difficult. The parameterization of characteristics such as language, appearance and services offered is not always possible.

Last but not least, we should not overlook the LMSs user interface. A poorly designed interface becomes a barrier to effective learning. Forcing students to spend longer time understanding poorly usable interfaces than understanding learning content disturbs accommodation of new concepts and overall retention of what is being learnt. The same applies to instructors, especially to those without prior experience regarding Information Technologies. Interfaces ought to concentrate on learners' needs and goals, providing a clear idea of content organization and system functionalities, simple navigation, advanced personalization of paths and processes. The user should be involved in the learning process without being overwhelmed [15]. Online support needs to be planned carefully in order to be effective and to avoid an overload of the instructor's time.

5 Proposed LMS features

Ensuring usability, simplifying the use of system services and making the preparation of educational material easier were the main factors taken into consideration while implementing the proposed LMS. Our primary goal was to serve the needs of the Department of Applied Informatics (DoAI) Multimedia Laboratory, University of Macedonia. In addition to the above, that new LMS would form a basis through which to explore and experiment on the possibilities of learning objects. The initial design was intended to support a small number of professors and lessons. The project is currently being developed step by step with upgradeability in mind.

5.1 Technical aspects

The proposed LMS was developed in ASP.NET and runs on a Microsoft Windows Server 2003, Enterprise Edition server. Microsoft IIS 6.0 serves as the web server and Microsoft SQL Server 2000, Enterprise Edition as the RDBMS. The main reason why we decided to use Microsoft's technology as the basic developing platform was our previous experience with it, in order to accelerate the development of the project. Among several features of the .NET application development, such as increased security, easy implementation and rapid development, our interest was mainly focused on the inherent features of XML file management and powerful Web Services development [16].

Although our LMS was designed with a focus on simplicity and aimed to serve a limited amount of lessons, it still provides all the services of a typical LMS:

- Network services
  - user authorization
  - roles and privileges management
  - site administration
- Community Tools
  - Fora
  - site searching
  - links
- Course development and delivering services
  - curriculum progress
  - course authoring
  - quizzes
  - course delivering
- Learning tracking services
  - learning path
  - time consumed by learner in each LO
  - assessments results
  - user profile

The access of these services is controlled by role based security rules. There are three main user roles:

- Student: Any person who is registered to take courses
- Instructor: A person responsible to create courses and their structure of learning objects, i.e. the learning path the student will follow, and
- Administrator: A person who maintains the whole system and users' profiles.

5.2 Authoring of courses

The focal points of our efforts towards a simple yet attractive and engaging environment are the LOs. We have created an authoring environment where the instructor is capable of uploading on the LMS server whatever file that can be published on a web server (e.g. HTML, PDF, FLASH or POWERPOINT files). Each LO appears to be nothing more than a small web site to the instructor (Fig. 1). The user friendly interface and simple mechanisms for uploading learning materials allows building a variety of courses in various knowledge domains.

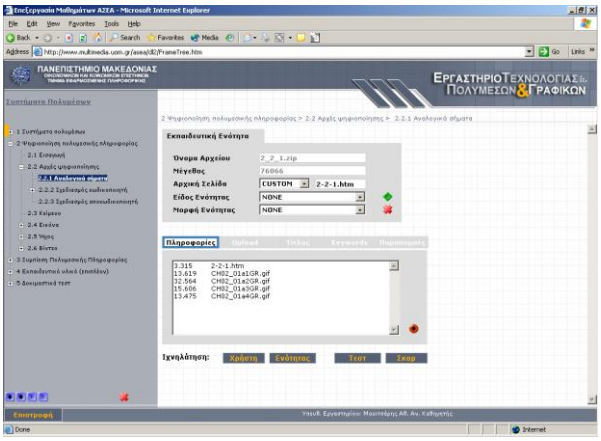

Fig. 1: Authoring environment

Inspired by the SCORM specification we enable the instructor to create an aggregation model from the LOs simultaneously with their uploading. The procedure is similar to moving files between the folders of a hard disk, a task well known even to novice computer users. That enables instructors to publish their own Web-based courses without having any skills or prior knowledge of HTML, JavaScript and other Web-programming languages or tools. Moreover, the instructor can define

metadata for each such LO, as keywords, links to other units, etc. An instructor with educational material in electronic form, such as word processor documents or presentation files, can build a course very quickly. The tree structure of the LOs is the learning path the student has to follow during the lecture (Fig. 2).

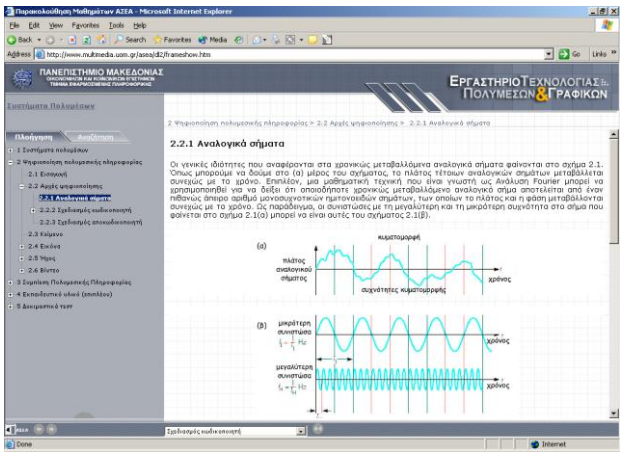

Fig. 2: Learner's environment

5.3 Independent LOs

The LMS's authoring environment is designed to make processing of the LOs' hierarchical structure as easy as possible, while at the same time provides auto-numbering of the LOs. In this way the LOs maintain an increased level of independency and can be easily reused for the development of other learning paths. The instructor performs the management procedures of the LOs as if they were files to be moved or copied into folders. Furthermore, the metadata of the LOs can be defined similarly to adjusting properties through a multitab form.

5.4 Authoring of assessment LOs

In order to maintain uniformity regarding all LOs, we have decided to exclude design details of assessment LOs from the online environment. Self evaluation tests are implemented as simple Microsoft Access database files. Microsoft Access was our database of choice due to the fact that it is very popular, available at minimum cost and provides all the necessary functionality that we need. For each test the professor should create a simple database containing only one table (Fig. 3). Instructors have a template of this database file in their computers. That template contains a simple form which should be filled in. Every record in this form corresponds to a question. After the form records (questions) are filled in, the database file can be saved using any suitable name. That database file, after compression, is uploaded to the LMS as any other LO. When the LMS needs to present this test to the student, it creates the web pages with the relevant questions dynamically (Fig. 4).

5.5 Dynamic publishing of LOs

A similar policy on dynamic publishing is followed by all LOs, with a personal learning path being created for each student. Although this method has been mainly used so as to address implementation problems, we believe that it could also accommodate further development of the LMS in the future.

5.6 Better response times

Another problem we tried to address was many LMSs' tendency towards forcing users to visit several different pages in order to complete a single task. In our case, the instructor's activities, both authoring and tracking a course, take place in a single web page. The same applies to the learner; navigation and searching of LOs occur within the same page. Using "web panel controls" of the .NET developing platform allows us to create user-friendly web pages with very fast response times, while at the same time our LMS maintains the look of a robust window application. The user interface retains options for the most common services only, thus providing an easy interaction grasping the students' interest.

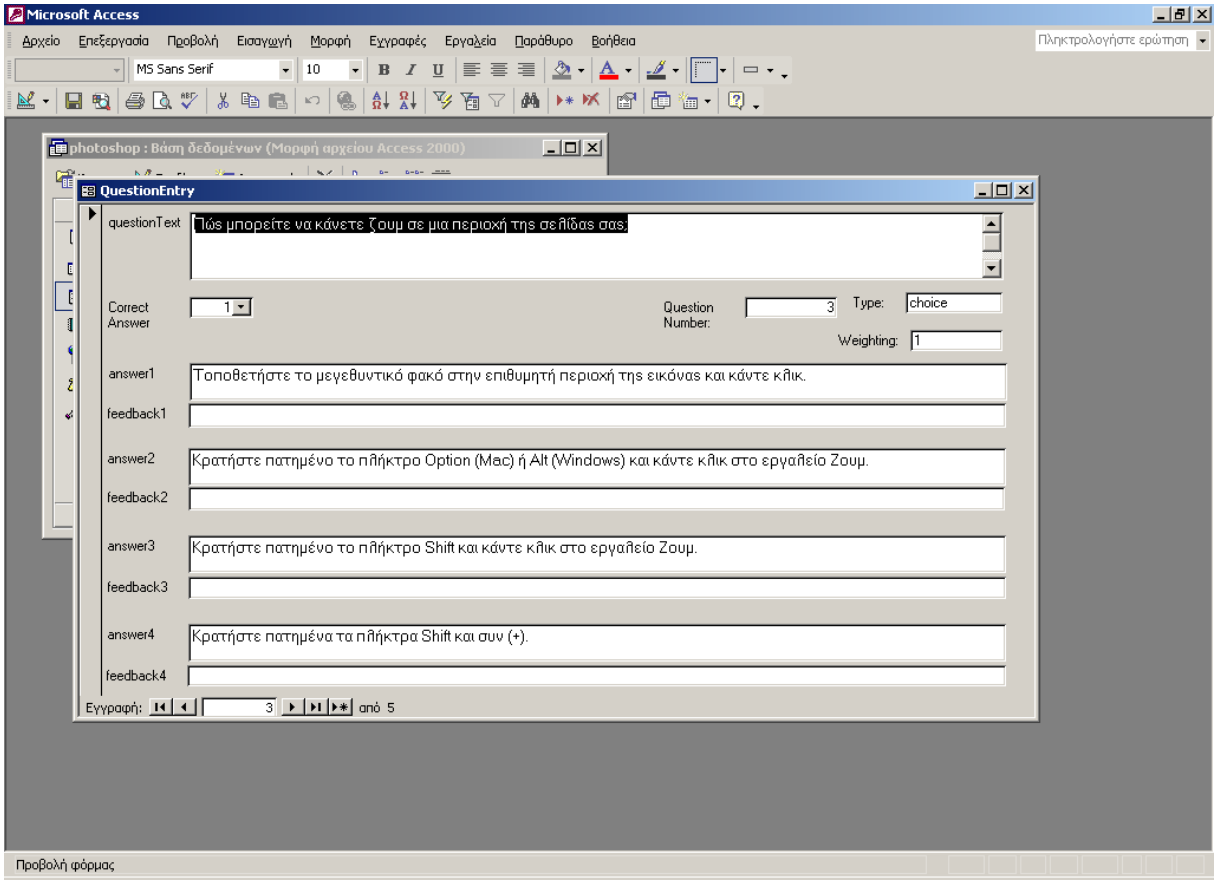

Fig. 3: Building a test in Microsoft Access

6 Future work

A major upgrade regarding the integration of SCORM specification in our LMS is currently under way. Our main goal is to make the proposed LMS able to include any SCORM course in its course structure and additionally export its courses in a SCORM form. To this aim, our main tool is the Web Services technology.

The planned integration of more aspects of the Web Services technology will also provide faster web page response times. The student's browser would communicate asynchronously with the LMS, calling the proper Web Services in order to download only the necessary parts of the Learning Path Structure and corresponding course content. As a result, the whole learning experience could be richer and smoother.

The next stage of our LMS development - extending it with learning repository features in particular - is also based on Web Services. Learning repositories are web applications providing facilities to store Learning objects along with their metadata, and possibilities for viewing, inserting and modifying these learning objects. They also support connection and interchange of LOs with other distant repositories. We intend to develop one or more Web Services-based API interfaces which will serve as a bridge to heterogeneous learning repositories.

Finally, an evaluation of the usability of the proposed LMS has been scheduled in order to isolate learning problems with particular e-learning packages and propose methods to correct them. Furthermore, this usability testing will obtain an overall figure of merit of the usability of the system to allow comparisons between different LMSs.

7 Conclusion

We have discussed several issues related to the complexity problem of LMSs and presented an experimental LMS that aims at simplicity, featuring:

- simple and user-friendly authoring of courses and assessments
- use of independent learning objects

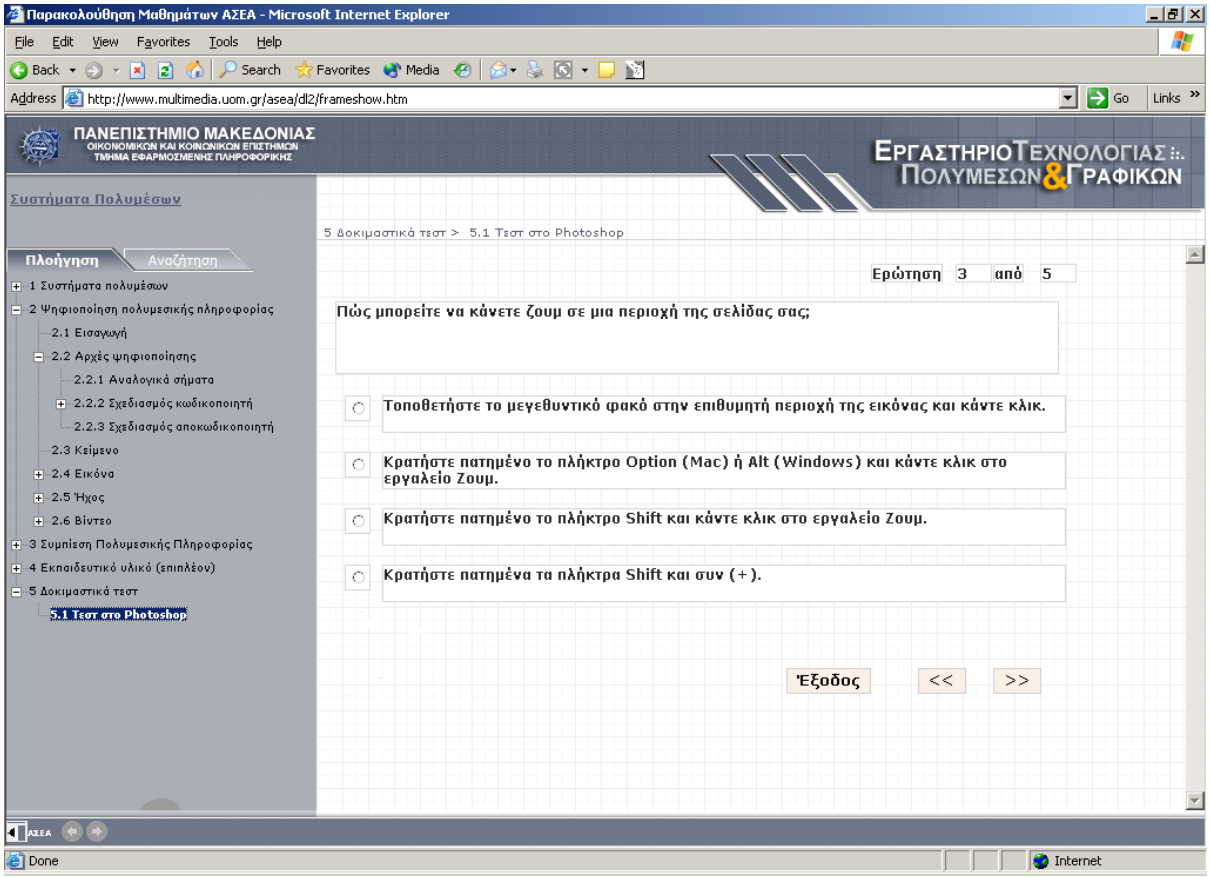

Fig. 4: Learner's view of a test

- dynamic publishing of LOs and user-friendly navigation

The proposed LMS provides users with a LOs management and navigation environment using the metaphor of a computer's operating system files management, thus immediately making them understand their basic functionality.

We are currently using our LMS as a LOs potential experimentation platform as well as a Web Services utilization platform. In future development we are going to deal with:

- upgrading it to a SCORM compliant LMS
- improving its user interface
- finalizing its database schema
- performing a usability evaluation

A usability testing of the proposed LMS has already been planned for the next academic semester. However, the results and feedback received from its current use in courses such as "Introduction to Multimedia Systems" and "Introduction to Computer Graphics" are more than encouraging. Professors with no or little experience in e-learning technologies have already created adequate LOs, while students have participated with increased interest.

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