Ing. Laura Violeta GRINDEI

DEVELOPMENT OF A MULTIMEDIA SYSTEM FOR CONTINUING AND DISTANCE EDUCATION IN ELECTROTECHNICS

PhD thesis abstract

Scientific Coordinator

Prof. dr. ing. Emil SIMION

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1. Introduction

Education, as we know it, is changing before our very eyes. In the new millennium, the power of technology and the Internet will drive an enormous implementation of eLearning content, infrastructure, and services. Increasing demand for eLearning poses new challenges for educational institutions and training organizations that must prepare to serve potential audience. The explosive growth of the Internet and the World Wide Web (WWW) is transforming teaching and learning at all levels of education. Training and education organizations that understand the issues surrounding eLearning and implement effective solutions will achieve the greatest success in the 21st century.

The Romanian education system is making efforts in order to join the standards of the European education, a series of Romanian institutions providing regulations and directives in the particular domain of continuous and distance education in our country. Few universities from Romania are offering online courses distributed by eLearning platforms for continuous and distance learning education but their number is increasing year by year.

This paper approaches the design, development and implementation of two online courses in the field of Electrical Engineering, distributed within the eLearning platform IeL of the Technical University of Cluj-Napoca. The IeL platform was developed and implemented at the Technical University of Cluj-Napoca and it is used for successful delivery of eLearning on line courses, since 2002.

2. Distance education using Internet: eLearning

Since 1990 distance education was associated with education provided via Internet, known also as eLearning, and is considered to address mostly to those people who, for various reasons, cannot attend regular classes offered by the traditional education system. The defining feature of most types of distance education is that learners and teachers are not within eyesight of each other and they may also be separated in time (asynchronous learning). In eLearning the instructors, at times, may be a machine, such as in computer-based training or computer-based tutorials (CBT). eLearning (or Web-based learning), a relatively new form of distance education, is rapidly becoming the dominant form of distance education delivery in developed countries.

eLearning is one of the fastest growing and most promising markets in the education industry, as emerging platforms offer effective solutions for eLearning. The main characteristics required for an effective eLearning system are to provide on line learning facilities using the Internet, in real-time (24 hours/day, 7 days/week), anywhere, anytime, to offer learner-centred education (personalized to the individual and customized to the organization), to include a mix of learning methods (virtual classroom, simulation, collaboration, community, etc.), to offer several ranges of learning experience (from assessment through testing and, optionally, certification), to provide on line administration (LMS, handle administrative tasks like security, registration, payment, and monitoring learner progress) and network-assistance.

3. eLearning platforms

An eLearning platform represents an application software package that contains instructional materials and manages, tracks and deploys all learning across the eLearning program. Within a higher education environment, the LMS usually focuses on the support and integration of teaching and learning.

Specific functions of a LMS include: course development, content/course/curriculum management, course delivery, assessment/skills analysis, communication (individual and group, private/public), tracking/reporting, tutor support, skills and records management, student interfaces to all components of the LMS, administration processes/ requirements/ registration, etc. Conceivably, an institution can easily deploy hundreds of distinct eLearning offerings, hybrid courses, instructor-led classes and manage them all from one place.
There are several commercial eLearning platforms used all over the world, as Blackboard Academic Suite, IBM Lotus Learning Management System Solution, Claroline, dotLRN, Uni Open Platform, Moodle, etc. and also developed and used in Romania, such as AEL and the IeL platform developed at the Technical University of Cluj-Napoca (TUCN).

The IeL (Integrated eLearning) represents an eLearning LMS software application that is presently used at the TUCN for teaching online courses and also at two other universities from Transylvania. The IeL platform facilitates online distributed learning activities and provides key functions, such as locating and accessing courses, tracking learner progress, and reporting learner performance. This platform was designed and implemented using Java Server Pages programming and Microsoft SQL database server, based on the Apache Tomcat web server. IeL can be used by any organization in order to manage their electronic teaching deliverables in a Web-based environment. Fig. 1 illustrates two web pages from the IeL platform: structure and disciplines. The IeL platform consists in two main components: Educational Activities Management Module and Communication Module. IeL can be accessed at the following web address: http://teleoraltum.ctmed.utcluj.ro:8080/iel/.

4. On-line course design for eLearning platforms

Two new online courses - “The Theory of Electromagnetic Field” (TEF), presently taught to the students in the second year of study at the Faculty of Automatics and Computer Science, and Faculty of Electronics and Telecommunications (English language specializations) and the “Electromagnetic Compatibility” online course - that is presently taught to the students in the fifth year of study from the Faculty of Electrical Engineering were designed, developed and integrated in the IeL platform of the TUCN.

The online courses design and development consisted of several stages:

- analysis of the characteristics, technologies and design methods of the teaching materials for online courses distributed within eLearning platforms.
- comparative analysis of the commercial tools designed for creating eLearning content: course authoring tools, web authoring tools, multimedia editors and technologies, virtual worlds, etc.
- study of multimedia technologies, content conversion tools, database and web programming tools for dynamic web pages creation, mathematical web content tools and dynamic web charts tools.
- design and development of TEF and CEM online courses teaching materials: the courses are divided in modules, each module containing one or more chapters/lessons. For each chapter, multimedia teaching materials, dynamic web formats were designed and developed, using PHP, MySQL and JavaScript.

The graphical interfaces (fig.2-4) for the new TEF and CEM online course were created using menus implemented in PHP and JavaScript, several pages being realized for assistance, study guide, user guide, objectives, content, etc. including information regarding chat, forum and agenda.
Implementation of the teaching materials for the online courses, based on the actual eLearning models include, for each lesson and for each module, the development of tutorials with integrated movies and sounds (fig. 5 - example of a tutorial web page), assigned reading in PDF format, theoretical (solved or assigned problems, as well as assigned projects) and practical (virtual laboratory) applications and interactive autoevaluation tests. In fig. 2-5 several web pages from the new online courses are presented.

Also, dynamic web pages for glossary and virtual library using databases, MySQL and PHP, programming language with administration interfaces that facilitate adding, modifying and deleting operations for the glossary terms and also for the books, papers, software, multimedia files, and links from the library, respectively have been created. In fig. 6-7, two web pages created for the glossary of terms and virtual library are presented.

For the theoretical applications (solved, assigned and recapitulative problems, and project, respectively) for TEF and CEM online courses, multimedia interactive applications were realized (see fig. 8-13).
The assigned problems and the projects are realised as web pages, containing forms that allow students to provide the correct answer or the whole solving page in a text box or in a file in any chosen format that can be uploaded and sent automatically to the instructor of the course for the evaluation. The instructor has the possibility to mark these assigned problems and projects and take them into account for the final evaluation of the students.

The practical applications were included in the virtual laboratory of the TEF and CEM on-line course. They were developed using 3D animations for the exemplification of the solving stages in problems related to electrostatic field problems, using professional software tools (Electrostatic 3D, FEMLAB 3D, Ansoft 3D – Fig. 14-17) and Java applets for the Transmission Lines module (Fig. 18).
The on line students evaluation tests were divided in progressive autoevaluation tests that concluded each chapter and final evaluation tests that are automatically/manually generated by the IeL platform. In fig. 19 and fig.20 are illustrated the possible interactive answers given to the students within the autoevaluation tests integrated in the CEM and TEF on line courses.

![Interactive autoevaluation test for CEM course](image)

![Interactive autoevaluation test for TEF course](image)

The figure 21 presents an example for the final students on line evaluation within the CEM on line course realized with the IeL menus, using databases for questions and answers for each chapter and automatic generation of tests with manual/ random selection.

![Final evaluation test and marks for CEM course](image)

The quality of the new on line courses can be evaluated using the two questionnaires developed for the TEF and CEM on-line courses, based on the quality assurance study criteria used presently in the eLearning domain. Online evaluation or survey, determine learners subjective reaction to navigation, structure, multimedia technologies and content. In fig. 22-23 are presented the evaluation questionnaires realized for on line evaluation of the CEM and TEF courses.
5. Conclusions

The main benefits of the new on line courses are described below from the following perspectives:

- **University perspective** - allow the institution to serve a greater number of students and, using the facilities offered by IeL, to ensure student performance tracking, increase additional tuition, increase administrative efficiency and decrease expenses for educational activities.

- **Professors perspective** - an increase in professors productivity, efficiency and effectiveness of course/content management efforts, the improvement of content availability, content sharing within the course, among instructors and across disciplines, of assessment and evaluation capabilities, the decrease of course preparation time.

- **Student perspective** - new on-line courses enhance the personalized nature of the learning experience, provide additional, timely, convenient academic support, provide increased course completion opportunity/capability and improve overall learning, making it more flexible, more efficient and more attractive.

In this context, the new on line courses were developed using the experience of already existing systems and the facts found in eLearning literature and will hopefully be extremely user friendly (for teachers and students), in order to ensure efficient learning activities, good communication, team work and a competent on-line evaluation.

6. References


