On line web course for Engineering

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Abstract: - This paper describes a new on line web course on Electromagnetics for Engineering, designed by the authors and delivered at the Technical University of Cluj-Napoca (TUCN), Romania. The main results presented are related to the design of the on line course components: graphical interfaces, dynamic web pages created for glossary of terms and virtual library, multimedia applications for the virtual laboratory and interactive pages for the autoevaluation and final tests.

Key-Words: - on line course, web based training, eLearning, multimedia interactive application

1 Introduction

Today most universities and an increasing number of companies all over the world feel the necessity to offer on line web based courses to educate their students or employees.

In the last 10 years, more and more high education institutions worldwide provided access to on-line web courses, virtual laboratories or teleconferences, organized within eLearning programs. Many international collaboration projects were developed by high education institutions and standardization companies with the main goal of creating and improving eLearning programs.

The term of eLearning represents the formal learning material delivered electronically. Users need a desktop computer and Internet appliance. The term of Web-based training - WBT means training delivered over the Internet using the World Wide Web (WWW).

The demand for on line learning is growing as market pressures drive the need for more effective learning solutions. The increasing popularity of Web-based training presents significant new revenue opportunities for education and training companies, who must address this demand to stay competitive.

The Romanian education system is making efforts in order to join the actual standards of education, and the number of universities that are offering on line teaching materials to support all types of education (traditional, as well as continuous and distance learning) is increasing every year.

The main advantage of an effective on line web based training is that provide learning facilities on Internet in real-time: 24 hours/day, 7 days/week, accessible from anywhere,anytime.Other advantages are: offer learner-centered education, include mixed learning methods and learning experiences and provide on line administration [1].

The new on line course designed and used at the TUCN facilitate students and tutors to meet physically on a very regular schedule for learning activities such as courses, seminars, practical laboratories and final evaluation tests, but have on line access to all the teaching materials.

The whole course is available also for students enrolled in the eLearning, distance education program for which most interactions take place within the IeL (Integrated eLearning) platform that provides facilities for synchronous and asynchronous communication, course content management, and management of the learning activities [2].

Numerous methods of delivery are used in on line web courses including (but not limited to) audio/video tutorials, audio/video-teleconferencing, multimedia interactive applications, virtual applications, etc. The attraction of this type of education lies primarily in the ability for educators to create better access for their students by building flexibility into the time and place of the teaching and assessment of students.

2 Web course general description

The title of the new on line course is “The Theory of Electromagnetic Field” (TEF), and it is presently taught to the students in the second year of study from the Faculty of Electronics Telecommunications and Information Technology and also to the students in the second year of study from the Faculty of

Automation and Computer Science (English language specializations) from TUCN. All the teaching materials, and the web site for this on line web course were designed and developed by the authors of this paper.

The on line web course was divided in 5 modules: Electrostatics, Electrokinetics, Magneto-statics, Electrodynamics, Electromagnetic Waves, each module consisting in one or more lessons. For each chapter, multimedia teaching materials, dynamic web pages were designed and developed using PhP, MySQL and JavaScript.

The graphical interface (Figure 1) for the new TEF on line web course was 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.

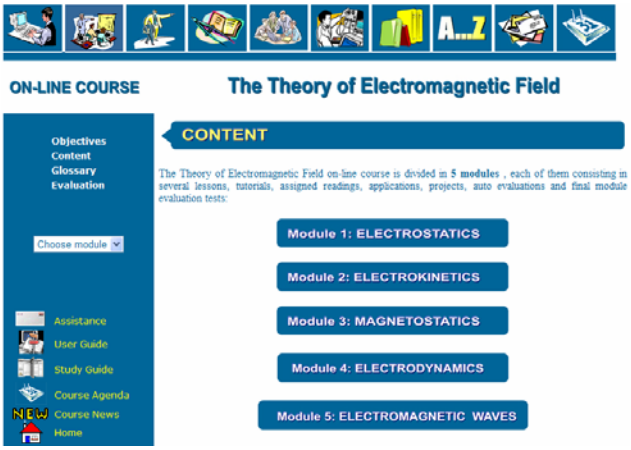


Fig 1. Content of the TEF course

Implementation of the teaching materials for the on line course, included for each lesson and module, the development of tutorials (with integrated movies and sounds), assigned reading (PDF format), theoretical solved or assigned problems, virtual laboratory applications and interactive auto-evaluation tests. In Figure 2 the content of the first module is presented.

Dynamic web pages using databases were designed for the glossary of scientific terms and a virtual library consisting in ebooks, papers or other publications in electronic format, as well as multimedia files, and useful links.

These web applications were realised using MySQL and PHP programming language, and include administration interfaces that facilitate adding, modifying and deleting operations for the glossary terms and for the virtual library.

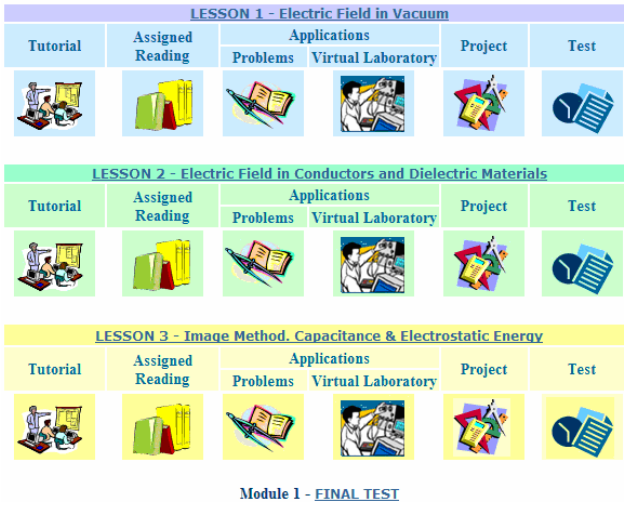


Fig 2. Module 1 study map

The practical applications that were realized for the on line web course consist in two different type of activities: practical laboratory that is represented by scheduled classes, where students and instructors are face to face and virtual laboratory , respectively.

For the theoretical applications were developed several pages corresponding to solved and assigned problems, as well as projects.

2.1 Tutorials and assigned reading

The tutorials were realised based on the conversion from PowerPoint to HTML format and they include also animations (animated GIF files), movies (MPEG, AVI). In Figure 3 is presented one of the tutorials web pages.

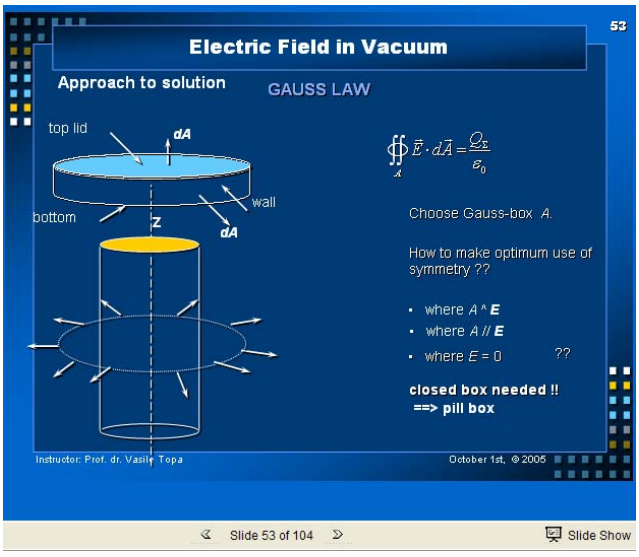


Fig 3. Web tutorial

For each module several tutorials with animated text and graphics, sound and movies were developed

in web format so that students have the opporunity to visualize all the slides in any order they want, and spend as much time as they need to understand the theory.

Each lesson includes also as support for learning the theory, some assigned reading representing detailed documentations in electronic format (pdf files).

2.2 Seminars and Projects

The seminars consist, for each lesson, in a set of solved problems (for wich the students can visualize the whole solving procedure for typical problems in electromagnetic), a set of assigned problems and a set of recapitulative problem and a set of assigned projects.

An example of a solved problem from the TEF course on the web is presented in Figure 4.

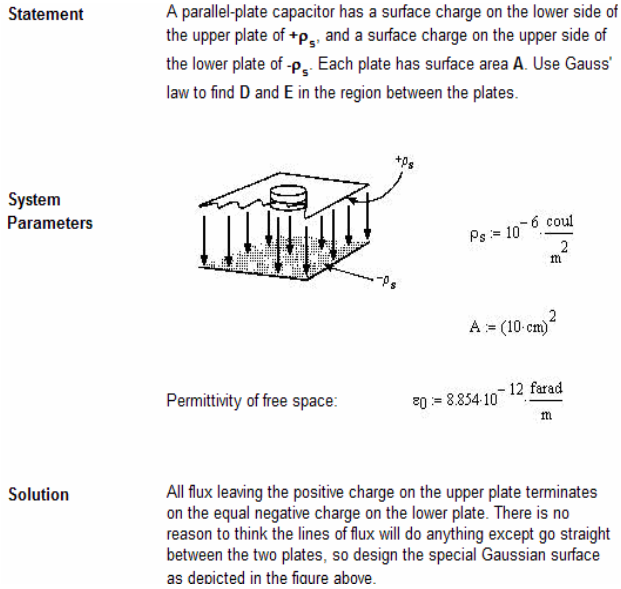


Fig. 4 Solved problems for seminar

The assigned problems (Figure 5) 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 recapitulative problems were realized using rollover images (Figure 6) and they conclude the seminars for each module, consisting in solved and assigned sets of problems.

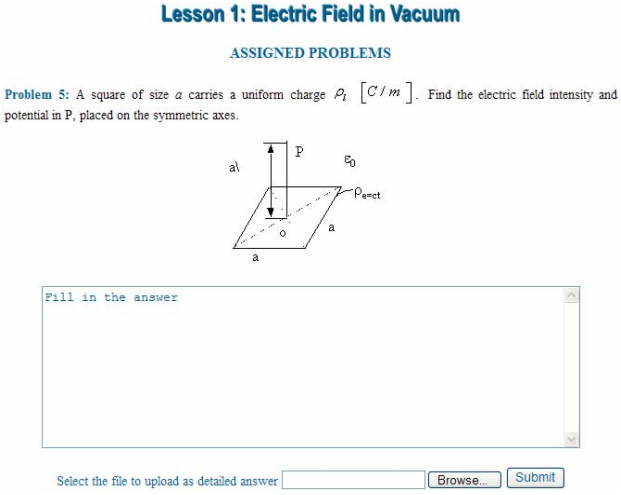


Fig. 5. Assigned problems

a)1st glance b) reading problem definition

c) reading a suggestion d) checking the solution

Fig. 6. Recapitulative solved problem for Module 1

2.3 Virtual laboratory

The virtual laboratory applications consist in demonstrations and assigned laboratory applications. For example, the first module includes demonstrations that were developed using 3D animations created with SnagIt 7 software tool. These demonstrations are presentations of the solving stages for problems related to electrostatic field, using professional 3D numerical modeling software tools (such as Electrostatic 3D, FEMLAB 3D, Ansoft 3D) [3].

In figures 7, 8 and 9 several sequences from the

multimedia applications realized for the virtual laboratory are presented.

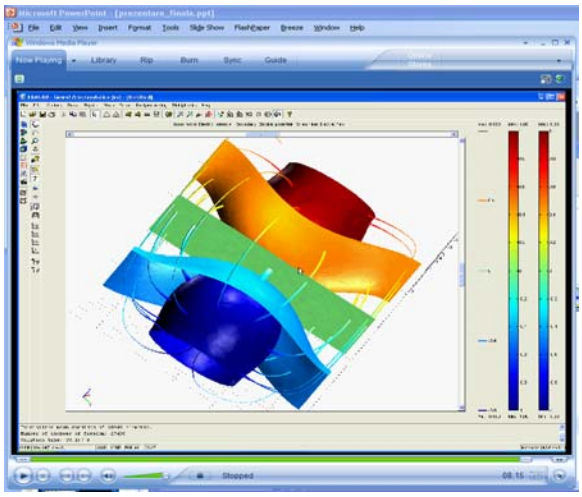


Fig.7 Virtual Laboratory : multimedia application solved using FEMLAB 3D (equipotential surfaces)

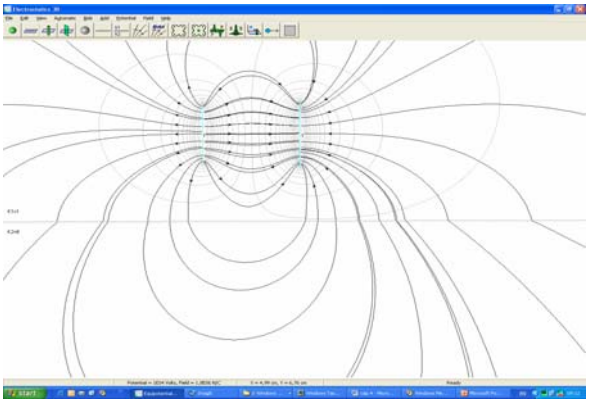


Fig.8 Virtual Laboratory : multimedia application solved with ELECTROSTATIC 3D

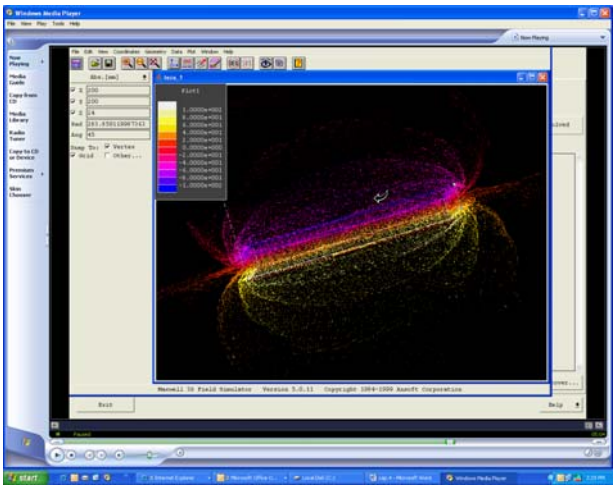


Fig.9 Virtual Laboratory : multimedia application solved using MAXWELL–ANSOFT 3D (electrostatic field spectrum)

Based on these practical demonstrations the students must elaborate individually or in group the rest of the assigned applications using the software tools available within the Virtual Laboratory and send the results to the instructor for evaluation.

2.4 Virtual library and glossary of terms

The virtual library was designed using a web multimedia database consisting in a collection of ebooks, papers, links, multimedia files and useful links.It was implemented using PHP and MySQL and it has an interface for adding new items, modify or delete the existing articles.

The glosary of terms was also developed using the same technologies and it has an interface for adding, modifying and deleting scientific terms and their definitions .In Figures 10-12 are presented the web pages created for the virtual library and glossary of terms respectively.

Fig. 10 Virtual library

Fig. 11 Virtual library administration interface

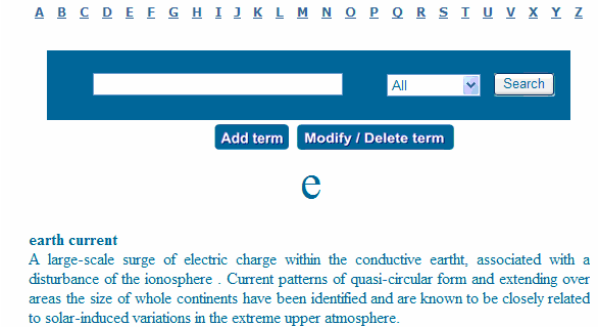


Fig. 12 Glossary of terms

3 Students and course evaluation

Two different approaches were taken in consideration for the evaluation: students and course evaluation.

3.1. Students on line evaluation

The on line tests, exams and quizzes are used to let learners gauge their progress and instructors measure the effectiveness of the course.The on line students evaluation tests were divided in progressive autoevaluation tests that concluded each lesson and final evaluation tests. In Figure 13, examples of questions from an autoevaluation test are illustrated.

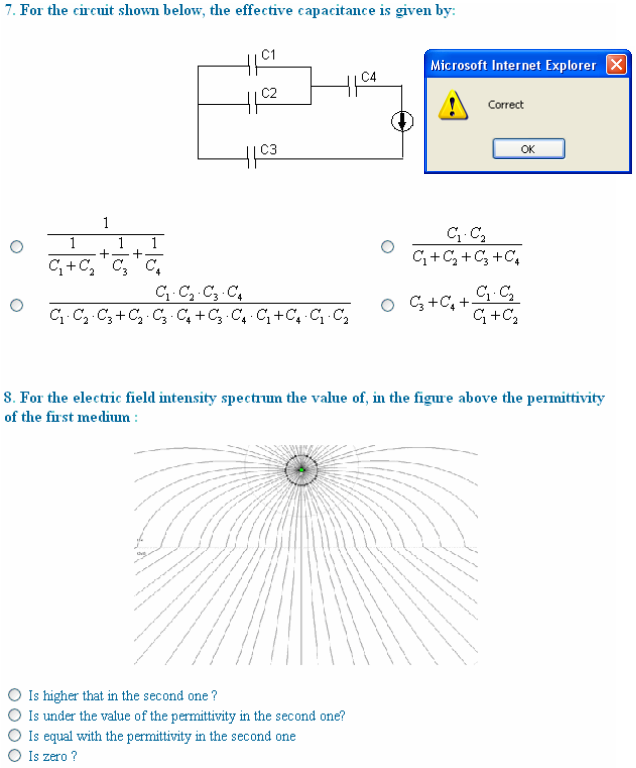


Fig. 13 Interactive autoevaluation

For this type of tests the students have to choose the corect answer (or multiple answers) and they receive instantly the response correct/incorrect. The autoevaluation tests are not temporised so that students can take as much time as needed to answer to all questions and they are also able to repeat the tests as many times as needed.

The final student evaluation tests are generated manually/ automaticaly by the profesor using the IeL platform that provide access to a database of questions [4]. The tests are always temporised, the questions can be selected manually or generated randomly by chossing also levels of difficulty and the results of tests are generated automaticaly.

3.2. Course on line evaluation

The quality of the new on line course is evaluated using a questionnaire based on the quality assurance study criteria presently used in the eLearning domain.

Online evaluation or survey, determine learners subjective reaction to navigation, structure, multimedia technologies and content. In Figure 14 is presented the evaluation questionnaire realized for the on line evaluation of the TEF course.

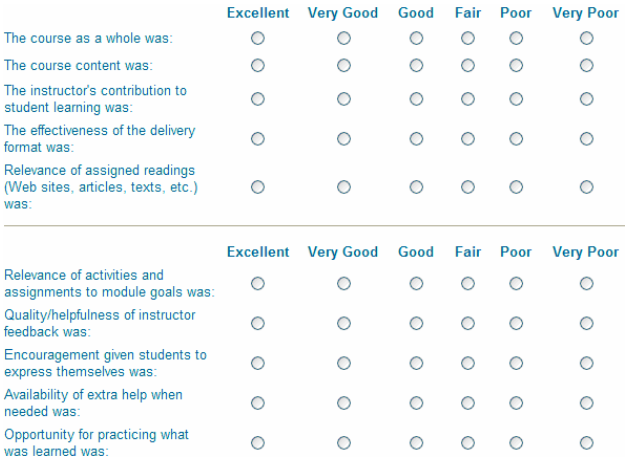
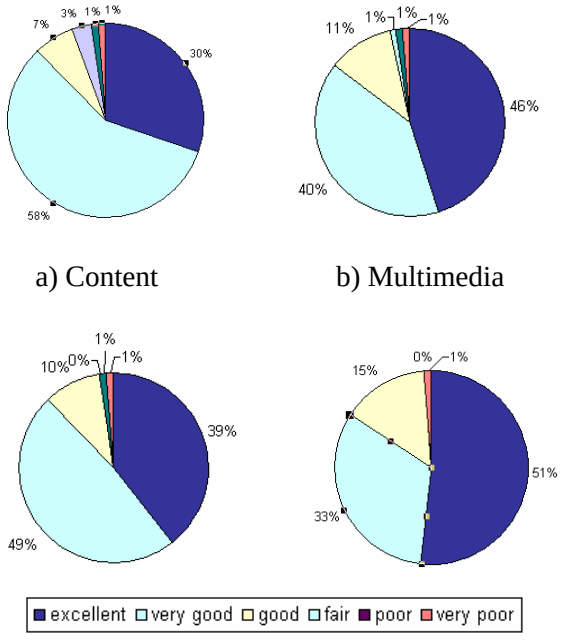


Fig. 14 Quality evaluation test

In Fig.15, statistics regarding the students satisfaction related to the TEF course are presented. From the total number of 89 questionnaries filled in by the students, the following statistics resulted.



a) Content b) Multimedia

c) Dynamic content d) Interactivity

Fig. 15 Evaluation statistics for the TEF course from students answers

The statistics regarding the academic staff and experts opinions related to the TEF course are presented in Fig.16. The total number of academic staff and experts that answered to the questions was 24, and the statistics of their answers are presented below:

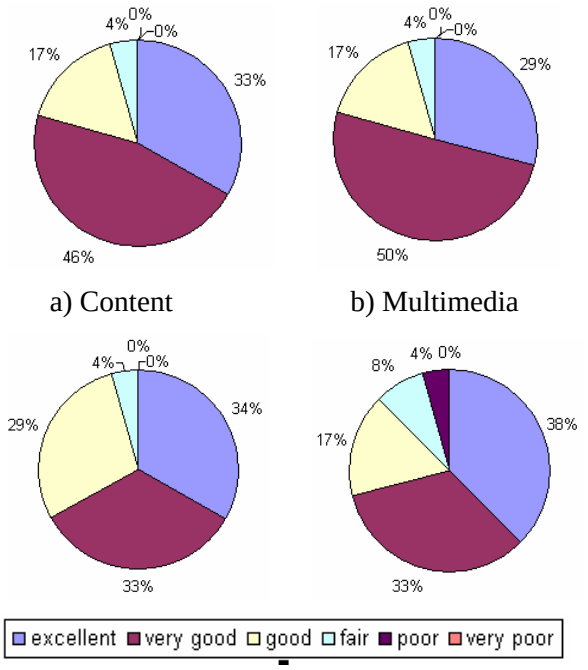


Fig. 16 Evaluation statistics for the TEF course from academic staff and experts answers

The results of the on line courses evaluation were considered overall satisfactory by the academic staff, the professionals and the students involved in the e-learning program but, at the same time, they show that there is considerable room for improvement, both in technologies used to support e-learning and quality of e-learning content. The participants to the survey revealed a number of factors they consider it would improve the effectiveness of the on line courses, including greater use of custom-developed content, greater personalization capabilities, and increase of multimedia and interactivity.

4 Conclusion

Just as the assessment and certification of learning is fundamental for eLearners, global programme evaluation is considered to have a relevant dimension given the need to judge the quality of the whole programme. While few people debate the obvious advantages of on line courses, systematic research is needed to confirm that learners are actually acquiring and using the skills that are being taught online, and that eLearning is the best way to achieve the outcomes.

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
- **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 course 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.

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