

Technology enhanced electrical engineering education in context of CRUNT TEMPUS Project

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Abstract — In the CRUNT TEMPUS project, pedagogy of using ITC learning environments was used. Elearning inter-university network of Moldova uses a virtual learning environment for training and learning process improvement dedicated to engineering students. The article presents some methodological elements that contributed to the success of TEMPUS CRUNT Project. Several web courses, based on Blended Learning methodology are highlighted. This paper presents elearning instruction materials for engineering undergraduates developed on the Virtual Learning Environment <http://elearning.utm.md/moodle/login/index.php/>. Processes of: design, development and implementation of interactive educational modules are presented, for the topic of electrical engineering and technology. Elearning modules provide student with information examples containing rich multimedia elements: text, glossary, webography, bibliography, knowledge and skills assimilation assessment. The modules are divided into a number of teaching and learning units which can be studied autonomously (or independent). Electrical Engineering and Technology (EET) Discipline model is a new approach to learning electrical technology—one that presents concepts in the customary logically developed order but illustrates them with exemplars that reflect the applications students are interested in. Electrical Engineering Discipline resources are especially for secondary school teachers and students, with topics ranging from introductory to advanced Electrical Engineering and Technology. Teachers will find reliable and quality resources including videos, articles, demonstrations, worksheets, assessments and activities all in one location. Resources are searchable by topic and standards. eLearning Modules are using visualization of electrical engineering concepts. These principles focus on a few specific pedagogical pointers: 1. providing multiple representations and descriptions, 2. making linked referential connections visible, 3. presenting the dynamic and interactive nature of electrical engineering, 4. promoting the transformation between 2D and 3D, and 5. reducing cognitive load by making information explicit and integrating information for students.

Keywords—Technology enhanced education, CRUNT TEMPUS Project, pedagogy, moodle, blended learning

I. INTRODUCTION

Teaching Engineering as one of the components in the foundation technological program has been a challenging task to electrical engineering lecturers. A course webpage

was constructed with the Moodle software system that utilizes various applications such as forum discussions, on-line assessments, accessing course information and learning resources including videos and useful links. The web application is not a duplicate of classroom content but serves as a complementary to further provide guidance and assistance to students' learning outside the classroom. Therefore, the research will investigate students' perception on the usefulness of the course webpage in terms of content, accessibility, satisfaction and whether the experience stimulated their interest towards learning Engineering. The hybrid approaches offer flexibility and provide adequate support to students in learning EET.

The principles of ICT integration in engineering education are expressed as seven specific learning objectives for Teaching Engineering by using Blended Learning:

1. Critically apply the pedagogical principles of ICT integration in education.
2. Develop and facilitate ICT-based learning activities in the context of teaching EET.
3. Analyse and evaluate appropriate content and context for the use of ICT in EET teaching.
4. Use appropriate and varied communication and multimedia tools (emails, websites etc) in teaching and learning EET.
5. Use ICT efficiently in research, problem solving and project-based learning in EET.
6. Use ICT efficiently for professional development in the context of teaching and learning EET.
7. Integrate ICT appropriately into EET curriculum activities that will foster students ownership of their ICT-rich learning environment.

Methodology. Electrical Technology courses in higher education have traditionally been composed of lectures, problem-solving sessions, and laboratories. This study was aimed at developing a freshmen Web-based EET course and investigating the performance of the students who use it. The course Web site included the following elements:

- Weekly problem sets, for which solutions were provided a week later

- Hyperlinks to Web sites that provide information about topics in EET that are relevant to the course, including historical and philosophical background
- Hyperlinks to sites that provide access to free computerized electrical circuits and drives modeling software
- An electronic forum that enables students to pose questions and instructors to answer them
- An optional, individual CMM project. The Capability Maturity Model project was originally developed as a tool for objectively assessing the ability of government contractors' processes to implement a contracted software project.

II. USING THE MOODLE PLATFORM IN CLASS

Moodle is a tool which enables teachers to create a website environment for your class with online activities such as forums and quizzes.

"Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It is a free web application that educators can use to create effective online learning sites." (<http://moodle.org/>)

Course Webpage Design and Description by using Moodle platform (VLE, Virtual Learning Environment)

The blended learning environment was designed for a course entitled "Electrical Engineering and Technology, EET", which was a core module offered to engineering students. The front webpage provides the overall course content of the EET module with the names of the chapters, followed by the activities in a drop-down list for each chapter. The activities involved in each chapter include: course materials, additional materials, quizzes, open forum/chat and latest news message/calendar.

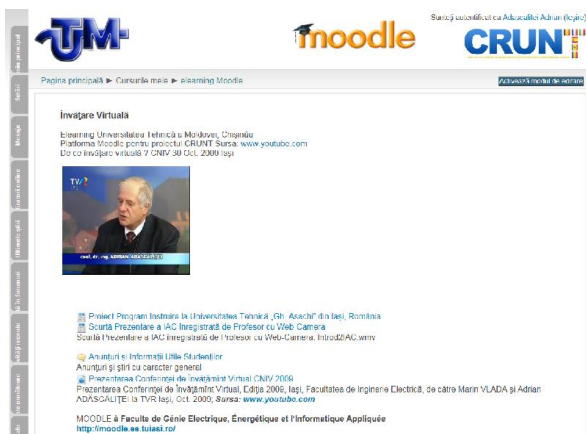


Fig. 1. Blended Learning course developed at the Technical University of Moldova, Chişinău, Republic of Moldova

Course materials. There are a total of nine chapters in EET with topics of namely, Each of these chapters has plenty of information and activities related to the topic. This includes the course materials in the form of PowerPoint slides and Acrobat PDF documents, which are the duplicates of hand-outs that the students received in class. It is important to provide a softcopy to the students, as it

is colored compared to their hardcopy and helps better in comprehending complex diagrams or figures.

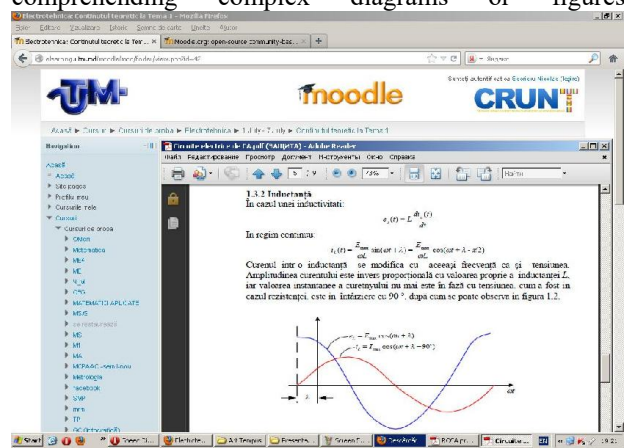


Fig. 2. The Content Presentation of "Electric Drive and Automation of Industrial Mechanisms"

Additional Materials. Nowadays students are very much visual learners. The majority of the students expressed the strongest preference to visual learning style compared to other learning style dimensions. This implies that engineering students are strongly depending on visual learning environment. Video is clearly a valuable additional learning activity that provides a sensory experience that allows concepts and ideas to actually become alive and connected. It has the option to rewind and review a particular section of the video to ensure students understand the key concept. Thus, free educational video sharing websites that explained the EET theories were uploaded in the webpage. In addition to this were video links from YouTube. Apart from this, problems and solutions as well as simplified diagrams explaining complex concepts, taken from textbooks or take-home questions which were not discussed in class, were made available online for students. In each of these adapted materials, references were stated clearly in order to allow students to seek the original sources if the need arises, apart from avoiding copyright infringement.

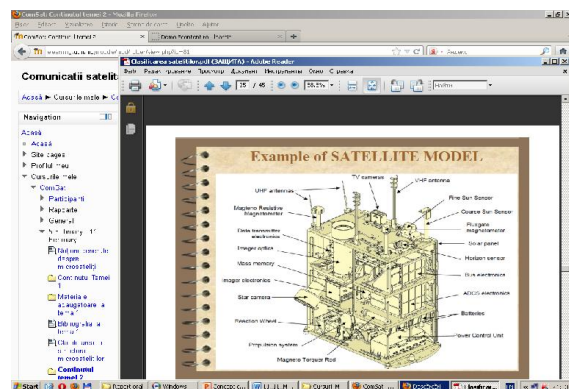


Fig. 3. The Content Presentation in "Satellite Communications"

Quizzes. Quizzes were incorporated in each chapter for students who were keen to self-test their knowledge and learning after the revision of a chapter. Short quizzes in the form of true/false, multiple choice, short answers or numerical questions were assigned, depending on the chapter content. The majority of the questions were of

problem solving type that involved calculation with pre-determined specific units and significant figures of the numerical answers. Two attempts were allowed for each question and the students received immediate feedback if they failed in their first attempt. Positive responses were provided if the students were successful in answering the questions. However, there was no time limit to answer each question as the students were given sufficient time to read and understand the questions, and to answer calmly at their own pace.

Since the quizzes were not part of the students' assessment, it was considered as an independent study at the students' own will. Hence, the quizzes were designed with a due date of two weeks, in order to encourage the students to have a constant revision and to avoid last-minute cramming before examination.

Open Forum. Open forum serves the purpose of allowing a student to post his/her questions or doubts and can be viewed by their fellow peers. This allows the lecturer to disseminate the answered questions to the whole class without repeating in the classroom. Hence, each of the chapters was constructed with their very own Open Forum. Students were also encouraged to use the chat function that facilitated live discussion and interaction with their instructors and peers.

Latest news Message/Calendar. Another interesting feature of Moodle is the function on the right of the webpage which allows the lecturers to post any new messages. It also comes with the list of recent activities so that students can keep-track with any updates. General announcements such as due date of assignments, examination dates and venues, replacement classes etc. were posted at this section and these were linked to the students' email accounts, so that they were notified of every update.

II. GENERAL PRESENTATION OF OPEN EDUCATIONAL RESOURCES AND MOOCS

Open Educational Resources (OER) have the potential to broaden access to education and to improve the quality and cost-effectiveness of teaching and learning in Europe. The best way to put OERs into practice is through Massive Open Online Courses (MOOCs). MOOCs are large-scale courses that represent one of the latest developments in open education, an initiative that is always trying to improve quality, access and equality in education and training.

MOOCs can be implemented in formal, informal and non-formal learning, and make learning ubiquitous.

Project will use leading-edge technology to create a combined Moodle MOOC platform– based on individual platforms and resources provided by project partners – making it possible to combine and transfer pilot activities in all the hubs involved.

Project will contribute to increasing awareness of the advantages of open education in Europe. The project will prove the potential of MOOCs (courses and communities) for breaking down technological barriers in learning across people with special needs or at risk of exclusion.

MOOCs adopted definition: MOOC is an online course designed for large number of participants that can be accessed by almost anyone anywhere as long as they have an internet connection, is open to everyone without entry

qualifications and offers a full/complete course experience online for free.

A MOOC includes educational content, facilitation interaction among peers (including some but limited interaction with academic staff), activities/tests, including feedback, some kind of (nonformal) recognition options and a study guide / syllabus.

III. UTILISING THE VIRTUAL LESSONS AND LABORATORY RESOURCES FOR ELECTRICAL ENGINEERING

Teaching electrical engineering laboratory's procedures by means of a virtual laboratory on a personal computer will be much welcome by educational institutions for whom maintaining a hands-on electric engineering lab is not viable due to various reasons. Instructional laboratory simulations can be incorporated in the virtual laboratory resources where students are free to make the decisions they would confront in an actual laboratory setting.

Electrical Engineering and Technology eLearning Resources

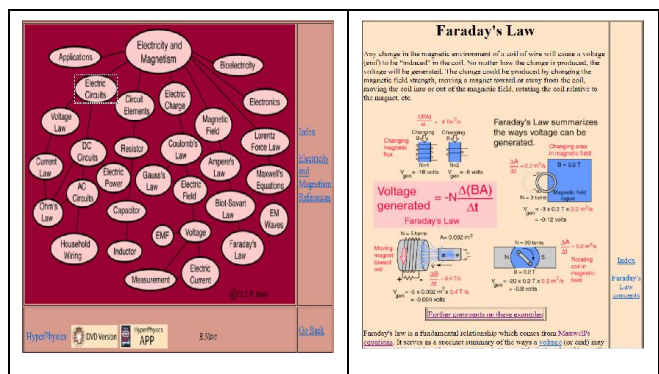


Fig. 4. Hyperphysics, Electricity and Magnetism, <http://hyperphysics.phy-astr.gsu.edu/hbase/emcon.html#emcon>

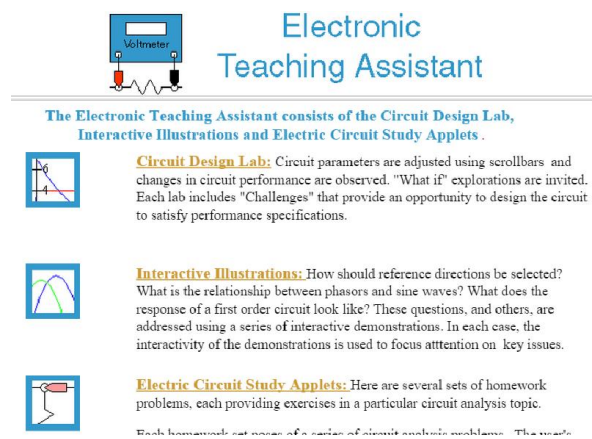


Fig. 5. The Electronic Teaching Assistant: the Circuit Design Lab, Interactive Illustrations and Electric Circuit Study Applets

Real-life situations and problems are faced by them, where they have to make/take decisions and face the consequences thereof.

The available links to following websites are given below as examples for the teachers to have an idea of such virtual laboratories.

IV. CONCLUSIONS

This paper is a synthesis that presents the conception of a project devoted to use moodle Virtual Learning Environment for the development of MOOC courses which mainly contains OER materials in order to educate the Engineering Students.

Engineering School teaching and students' learning are moving through transition processes that use education technology in support of academic work. There exists a greater acceptance of the online mode of instruction as an adjunct to learning. Nevertheless, the results of our work showed that most students preferred a moderate use of e-learning in their courses. Their positive attitude was observed towards the model of blended learning approach, and Moodle platform did create a positive impact on students' learning experiences in terms of the accessibility of learning materials and the support of online assessment activities. Students reported that the most valuable benefits of using Moodle platform in learning EET were the convenience of accessing the course materials and completing the online assessment tasks. Overall, the majority of the students perceived the use of course website as an opportunity to enhance their academic experience.

Although the students agreed that the hybrid learning provided them with the needed assistance, one of the drawbacks observed was that this method of delivery was prone to become a one-way communication. Responses to this study showed that the number of the students' email correspondences to the lecturers were minimum. The students were expecting to be "spoon-fed" with information, announcements and notes. Thus, a more interactive learning is needed to promote a two-way communication. Communication tools such as forum discussion and online chat room have the features that create interaction with instructors and among the peers. However, as mentioned earlier in the study, most students are likely to participate in the learning practices only if the activities are considered as part of the evaluation of their academic performance. It is therefore necessary to assign grading procedure in e-learning activities to increase students' participation. With the improvements at these loose ends, Moodle application in Electrical Engineering will be an invaluable and imperative tool for the instructors as well as for the students.

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