

NEW CHALLENGE FOR DEVELOPERS OF E-INFRASTRUCTURE

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ABSTRACT: Students should always be at the heart of each change in teaching and the question is how they want us to change. In the survey carried out after the winter semester 2005/06, when the first classes were taught in accordance with the new Bologna program, 224 students of the 1st semester at the Faculty of Geodesy, University of Zagreb, said that the most important factors within the course were: content, teachers' commitment and availability of the content on the Web. That same year, we launched the system of e-learning with Moodle LMS. Due to the enthusiasm of both teachers and students it reached nearly 95% involvement of all undergraduate courses.

There is a five-year period of shared experience through two courses behind us: Analytic Geometry and Linear Algebra in the first semester and Differential Geometry in the third semester. We apply the blended (mixed mode or hybrid) learning model with the purpose to introduce students to various mathematical/geometrical digital technologies. Moreover, our priority is to make them perceive these technologies as "modern pencils." Our task is not easy, because the benefits of digital technologies in teaching will be fully exploited only when it becomes unthinkable for a student to solve a complex mathematical/geometrical problem without direct access to digital tools. We strive to be attentive to our students needs and adapt to each new challenge that the next generation brings.

The importance of content and involvement of teachers, the values that students ranked among the most important factors of successful teaching, is unquestionable. Availability and form of content on web is a platform that is subject to constant change and improvement. This, however, goes beyond the personal abilities and preferences.

In this sense, in autumn 2010 we applied with the project "The Introduction of 3D Modeling in the Teaching of Geometry at Technical Colleges (3D GEOM TECH)" to the competition for development projects, Fund for the Development of the University, University of Zagreb with the purpose to enhance collaboration among teachers and improve teaching of math/geometry courses at the Technical Faculties in Zagreb.

The Project will cover, among other activities, creating the basic repository of educational materials related to shared teaching topics and those customized to profiles of individual faculties. Such a repository does not exist within university and polytechnic centers in Croatia. We hope that its formation will result in improving teaching, harmonization of approaches and methods of using e-learning on colleges within our University, as well as ensure the adoption of common standards and recommendations for the creation and use of educational materials for e-learning.

In December 2011 the Project was approved by the relevant Committee.

At ICGG2012 we would like to present parts of the teaching material we use within the course Differential Geometry, which would become the integral part of the repository. The course is taught at the Faculty of Geodesy and the Faculty of Civil Engineering, in Zagreb, Croatia.

Keywords: E-learning, educational material, repository.

1. ABOUT E-LEARNING BEGINNINGS

In 2007, when the Internet penetration in Croatia was 35% i.e. the half of the today's value, the Senate of the University of Zagreb accepted the E-learning Strategy 2007-2010 [3, 4]. E-learning was defined as a process of education (learning and teaching) by means of information and communication technology which improves the quality of the process itself and the quality of its results.

Consequently, the coordinated decentralized e-learning organization model was developed. On the one hand, the University E-learning Support Centre was established with the role to provide the main support, which also included e-learning platform "Merlin". On the other hand, the Faculty of Geodesy launched its own E-learning System ("E-učenje"). E-učenje is now a place where the students, teachers and administrators communicate and collaborate in an innovative and more productive way than ever before.

Both systems are based on the learning management system Moodle (*Modular Object-Oriented Dynamic Learning Environment*) which has been taking the educational world by storm from 2006. It is still very highly ranked by 531 learning professionals worldwide – it is in the eighth place among the Top 100 Tools for Learning 2011 list of the C4LPT Annual Survey [1].

Friendliness, functionality and flexibility of Moodle sparked the enthusiasm of teachers and students from the start of the course Analytic Geometry and Linear Algebra in the first semester [6]. Visualization with Java applets, mathlets and many online available powerful tools together with the empowered communication on discussion forums and with instant messenger successfully extended the old face to face method of teaching in the classroom.

Our experience of a new tool for learning was playful and fun. It resulted in higher percentage of students who passed the exam and in much higher average score. They also

proved to be well skilled in choosing and applying appropriate programs for drawing and animation in a classical assignment. For example, when dealing with equations of conics via diagonalization of the quadratic form. They identified the conics sections in standard position from general quadratic equation in two variables and draw them (see Figures 1 and 2). The most of students recognized GeoGebra, free and open source software package for dynamic mathematics visualization, as a valuable tool.

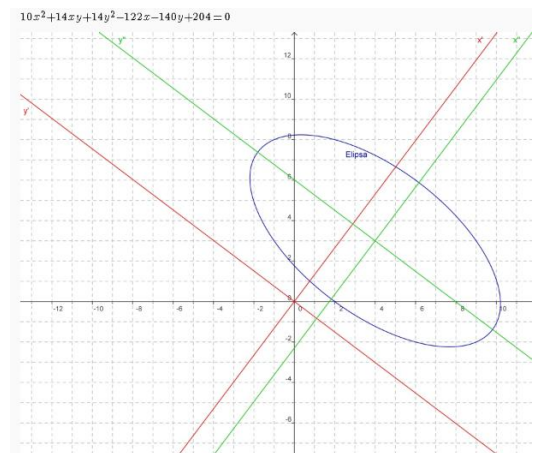


Figure 1: Solution in GeoGebra

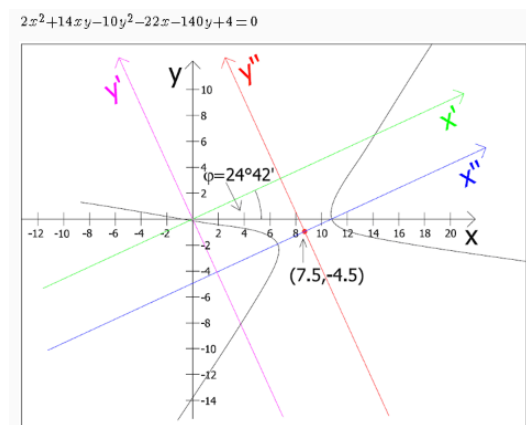


Figure 2: Solution in AutoCAD

It was 2007 and that was our e-learning beginning. How to improve the process of learning and teaching is a constant challenge for teachers. Quality teachers always seek to bring their students to higher-order thinking skills.

2. FORMS OF UNIVERSITY EDUCATION ACCORDING TO APPLICATION LEVEL OF E-LEARNING TECHNOLOGY

The year 2007 is behind us, we have the E-learning Strategy, the faculties within our University are systematically implementing e-learning, and the *blended* (mixed mode or hybrid) learning model is recognized as the most appropriate and accepted by the majority of institutions.

As mentioned before, each faculty has been given the choice to determine and define the form of e-learning that is appropriate in its area of education, study and course and to choose the pace of implementation in accordance with the institution's capacity and willingness of teachers. However, it is well known that introducing e-learning, even at the best-organized faculties, is a lengthy and complex process usually conducted in phases. With the desire to assist in this process and to harmonize it, the University Senate passed a resolution [5] in 2009, in order to facilitate the recognition of e-learning levels in university teaching.

This document proposes three levels to be distinguished, defined by purpose, scope and method of application of ICT in teaching and relating to the courses in which the blended model of e-learning is used.

The main points of those individual levels we convey from [5] and [2]:

Level 1

- the announcement of basic information about the course, learning outcomes, curriculum, literature, selection of teaching materials in their original form,
- communication with students via email,
- open forum for general discussion.

Level 2

- the organization of selected educational material to the teaching units (lectures, seminars, exercises),
- an open forum (a forum with news, forums related to the teaching unit,

discussion of students),

- access to calendar events in the course (lectures, exams, homework),
- publication of information related to the course (general information, results of tests, tasks, ...),
- existence of on-line self-assessment,
- possibility to submit homework and conduct assessment using the system for e-learning,
- creation of glossaries,
- possibility of holding lectures via the Internet at real-time,
- production of supplement teaching material using audio and video,
- maintaining administration related to students (grades/scores, attendance, ...).

Level 3

- all the teaching material is organized according to teaching units and is available through the system for e-learning,
- organization of a course in a way that allows the individualization of the teaching process,
- creation of an environment in which students take an active role and responsibility for achieving the educational outcomes,
- organization of a course in a way that allows installation of mechanisms that encourage the development of core competencies,
- creation of an environment that encourages the development of attitudes and values as an integral part of competence,
- shaping the environment that encourages creativity,
- scoring all relevant student online activities,
- submission and assessment of assignments, seminars, homework using the system for e-learning,
- maintaining administration related to students (grades/scores, attendance, ...).

3. ADJUSTMENT OF DIFFERENTIAL GEOMETRY COURSE TO E-LEARNING

In the case of Differential Geometry course, which has been taught at the faculty of Geodesy for more than 40 years, the first level of e-learning has been quickly achieved. The higher percentage of students who passed the exam as well as their positive and encouraging comments received through student surveys have prompted us to go further.

Each teaching unit now consists of methodically prepared presentations, defined learning outcomes and glossary [II]. Illustrations (see Figure 4), animations and interactive tools for self-exercise have been implemented. The open forum is active as well as the access to calendar events in the course. The complete administration (grades/scores, attendance ...) is available to students who enrolled this item.

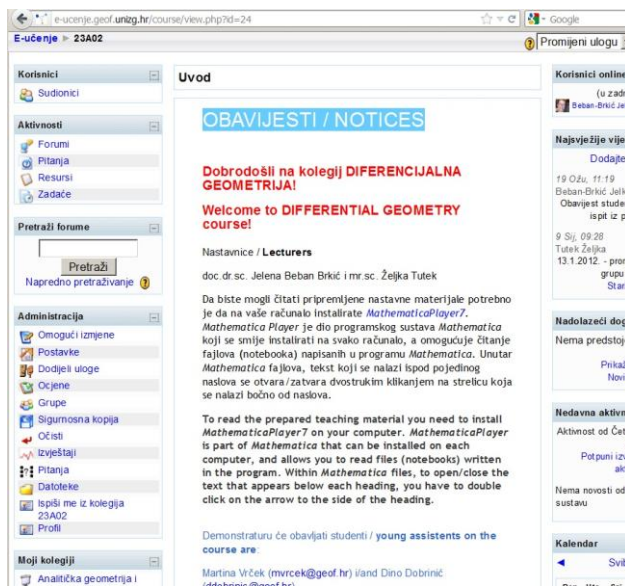


Figure 3: Welcome to the course...

As for exercises, the full process solutions are given for the typical problems within the teaching unit while also codes are written to enable students to solve problems with mathematical software. For solving assignments students have freedom in choosing and applying appropriate programs of their own

choice (see Figures 5 and 6). Interest and involvement of students sometimes surpasses our expectations. An example is a seminar paper named *Stereographic Projection*, made by two of our students. The work received its video versions and ultimately resulted in the professional work [1] and Dean's Award (see Figure 7).

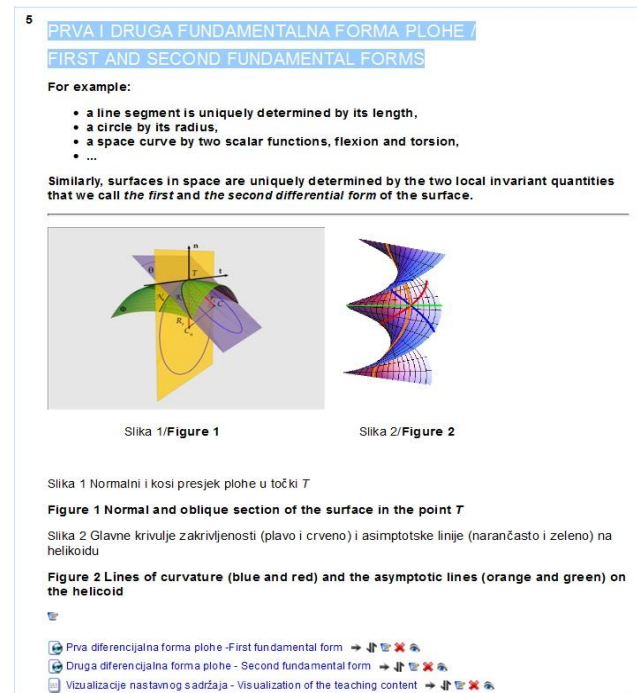


Figure 4: Part of the teaching unit *First and Second Fundamental Form*

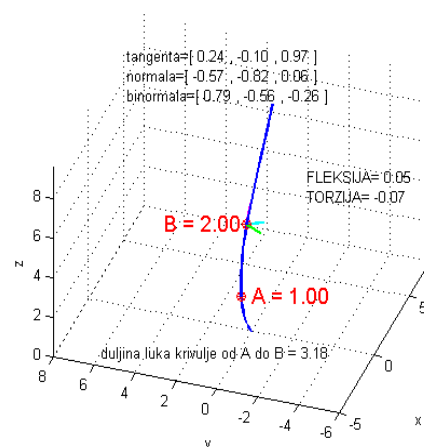


Figure 5: Assignment solved and illustrated with MATLAB

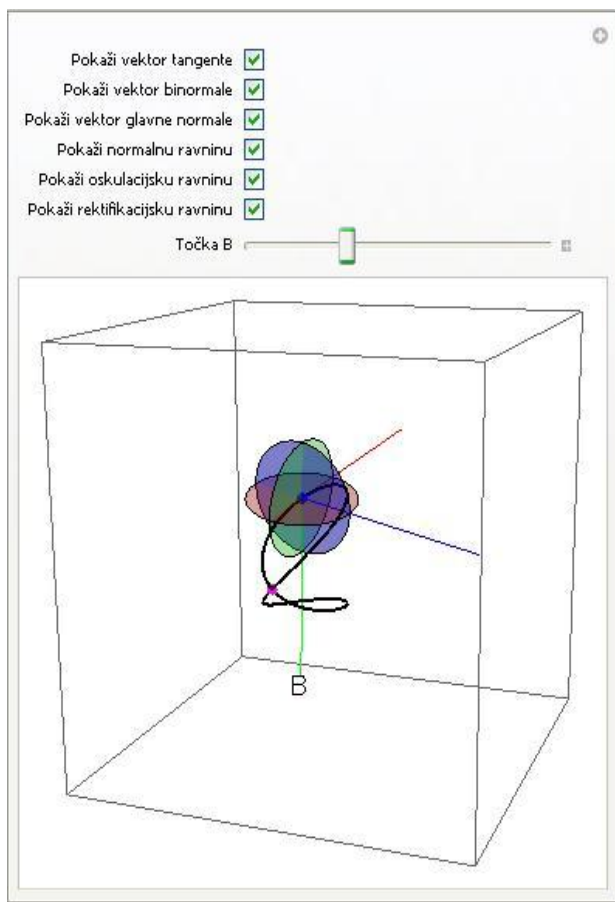


Figure 6: Assignment solved and illustrated with *Mathematica*

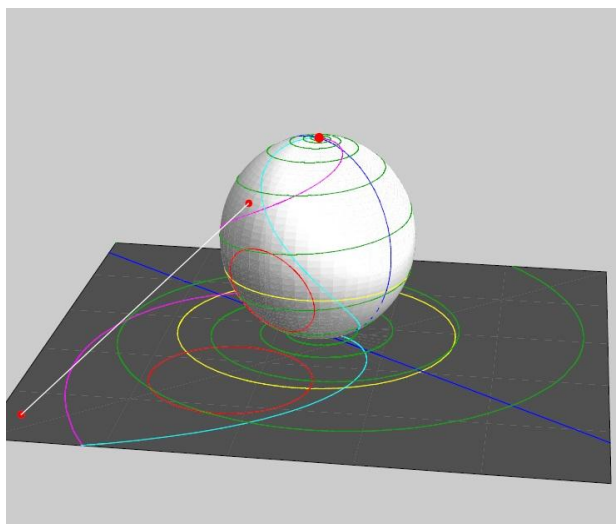


Figure 7: Visualization of the stereographic projection

The course is now organized in a way to fit into the second level of e-learning.

4. 3D GEOM TECH - NEW PROJECT OF UNIVERSITY OF ZAGREB

We would like to emphasize that we had worked on introducing the elements of e-learning much earlier than the E-learning Strategy was accepted by the Senate of the University of Zagreb. In the year 2002, within the framework of the project "Selected Chapters of Geometry and Mathematics with *Mathematica*" [III] we made an effort to compile our teaching materials so as to make them available to students as well as all other users interested in a particular content. Our basic idea was to connect the related contents of mathematical and geometrical educational material, being treated by different methods in various courses at our faculties.

We have been attentive to our students needs. They ranked content, teachers' commitment and availability of the content on the Web as the most important factors within a course.

In this sense, with the purpose to enhance collaboration among teachers and improve teaching of math/geometry courses at the technical faculties in Zagreb, this year we have started the project "Introducing 3D Modelling in the Teaching of Geometry at Technical Colleges (3D GEOM TECH)" supported by the Fund for the Development of the University of Zagreb.

The Project will cover, among other activities, creating the basic repository of educational materials related to shared teaching topics and those customized to profiles of individual faculties. Such a repository does not exist within university and polytechnic centers in Croatia. We hope that its formation will result in improving teaching, harmonization of approaches and methods of using e-learning on colleges within Universities, as well as ensure the adoption of common standards and recommendations for the creation and use of educational materials for e-learning.

5. CONCLUSIONS

In this paper we provide information about the process of e-learning implementation at the University of Zagreb. We describe in detail the three levels of e-learning technology

implementation. We also illustrate how it has been applied in Differential Geometry course at the Faculty of Geodesy. We believe this experience will contribute significantly to the project "Introducing 3D Modelling in the Teaching of Geometry at Technical Colleges (3D GEOM TECH)" supported by the Fund for the Development of our University, started this year. The Project will cover creating the basic repository of educational materials related to shared teaching topics and those customized to profiles of individual faculties. Such a repository does not exist within university and polytechnic centers in Croatia. We hope its formation will result in improving teaching, harmonization of approaches and methods of using e-learning on colleges within Universities, as well as ensure the adoption of common standards and recommendations for the creation and use of educational materials for e-learning.

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- [I] <http://c4lpt.co.uk/>
- [II] <http://e-ucenje.geof.unizg.hr/>
- [III] http://www.grad.hr/itproject_math/

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