

e-Physics - the First Multimedia Textbook

Miroslava OŽVOLDOVÁ

University, Faculty Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, ozvold@mtf.stuba.sk, Pavlinska 16, 917 24 Trnava, Slovak Republic

Soňa HALUSKOVÁ

Slovak University of Technology in Bratislava, Faculty of Mechanical Engineering, haluskova@sjf.stuba.sk, Nám. Slobody 17, 812 31 Bratislava, Slovak Republic

Peter BALLO

Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology, ballo@elf.stuba.sk, Ilkovičova 3, 812 19 Bratislava, Slovak Republic

KEYWORDS: *multimedia e –course, basic Physics, World Wide Web, e-learning*

ABSTRACT: *Offering a set of important theoretical knowledge and practical skills, a basic course in Physics has always been a basement of technical creativity and critical thinking development in engineering universities. The aim of the course is to build up a complex physical platform outcome for comprehension of real system and process, so that students are able to get an insight into things and actions. The basic course in Physics for bachelors should offer students a tool to achieve the above-mentioned goal.*

Students entering engineering universities show absence of such insight and comprehension, and minimum interest in viewing the world via "physical eyes". This is surely due to incomplete physical picture and absence of principles of top contemporary inventions offered by secondary school Physics. Physicists bear responsibility for sharing their knowledge in their field with wider public as a part of general culture which may also improve the unfavourable situation in Physics education in universities.

A team of university teachers from four Physics Departments of the Slovak University of Technology in Bratislava took up this challenge and developed two outcomes within the framework of the following projects: „Teaching basic course of Physics for bachelor study in the form of distance education via Internet“ (Internet Distance Education Program of Open Society Foundation), STUonline and An Interactive Multimedia Project for teaching Physics in Engineering Universities in SR (Ministry of Education of Slovak Republics projects). Their aim has been to :

- 1. implement latest elements of Information and Communication Technology (ICT) into university education;*
- 2. develop qualitatively new form of education;*
- 3. prepare attractive study material using advanced technologies.*

In this paper we introduce the first Web-enhanced textbook (in Slovak language) which is intended for undergraduate students in engineering. The interactive study materials gives complete coverage of the physics course (Physics I, Physics II) at the Slovak University of Technology (STU). The course offers many of solved problems, task and control questions concerning various topics of classical and contemporary physics. Coordinated collection of interactive Web pages enables fast access to any part of the book. Student can use either CD ROM version or free Web page on http://kf-lin.elf.stuba.sk/~ballo/fyzika_online or www.kf.sjf.stuba.sk.

This paper presents the results of a questionnaire made by a method of inquiry concerning distance education via Internet and deals with the first practical experience of e-learning, a new method of university teaching. At present we are verifying the quality and efficiency of the course for online study and distance learning.

1. INTRODUCTION

It was a team of physicists, under the leadership of Tim Berners-Lee who in December of 1990, after a decade of preliminary work at the European Particle Physics Laboratory in Geneva, Switzerland, ran the first version of the World Wide Web. It was put up on the Internet in the summer of 1991. Developed first to provide a way in which physicists could communicate more easily and more rapidly with each other, virtually every institution of any kind is scrambling to develop “a home page” and a presence on the Web. Led first by the military and major universities and research centers, the focus of Web activity has shifted to the commercial sector. Later on, many of university teachers all over the world have been trying to utilize and spread these activities to the web-based instruction - new form of education via Internet.

The World Wide Web opens new ways of learning for many people. Now, educational programmes and learning materials installed and supported in one place can be used by thousands of students from all over the world.

The basic course of Physics belongs to the standards in curriculum at the universities of technical orientation. At most of the Slovak engineering universities basic course of Physics is lectured for two semesters (in the first two semesters or in the second and third semester.) The aim of the course is to acquire basic natural laws on the basis of physical aspect using calculus. The application of physical knowledge acquired in the course encourages the development of students' creative thinking. The course content is aimed at creating conditions for successfully mastering specific subjects. In recent years, weekly hours assigned to Physics have been constantly decreasing due to various reasons. The result is a difficult situation for both, students and teachers: The teacher tries to cover as much as possible in the limited time; the student is not able to master all the new presented information as his high school knowledge in physics is insufficient. Students do not remember much from secondary school physics course usually concentrated in the first and second year of study. As a result only 40% of students pass the exams in Physics I, most of them after several retakes. This concerns all the STU faculties. That is why teachers from the Departments of Physics decided to contribute to solving this situation by innovating classical forms of education for full-time students and offering a new form of education for part-time students using all the available information and communication technologies.

The team of university teachers from four Physics Departments of the Slovak University of Technology in Bratislava:

- Faculty of Materials Science and Technology (MtF)
- Faculty of Mechanical Engineering,
- Faculty of Electrical Engineering and Information Technology (FEI);
- Faculty of Food and Chemical Technology

took up this challenge and developed outcomes within the framework of the following projects: „Teaching basic course of Physics for bachelor study in the form of distance education via Internet “ (IDEP-Internet Distance Education Program of Open Society Foundation), STUonline and “An Interactive Multimedia Project for teaching Physics in Engineering Universities in SR” (Ministry of Education of Slovak Republics projects). The result of the IDEP programme was:

- e-textbook: Physics I
- ten consultations
- multiple-choice tests

that can be found on the Internet web site: <http://www.mtf.stuba.sk/> resp. [www.kf.sjf.stuba.sk.](http://www.kf.sjf.stuba.sk/) , part e-learning or <http://kf-lin.elf.stuba.sk/~ballo/e4> .

The way in which it was designed was outlined in our previous papers [1-4]. After the first experience a new version of electronic textbook “e-Physics, consisting of two parts: e-Physics I and e-Physics II, was prepared and is now available on: http://kf-lin.elf.stuba.sk/~ballo/fyzika_online or www.kf.sjf.stuba.sk .

2 ELECTRONIC TEXTBOOK

New information and communication technologies (ICT) influence our everyday life. Computers make education more and more effective and attractive. Internet in connection with powerful computers spreads the possibilities for education beyond the school walls.

It is known that prepared Educational World Wide Web material cannot use the simplest solutions and cannot be a static electronic copy, of regular textbook: chapter by chapter, page by page, picture by picture. Electronic materials and education electronic application have to be:

- interactive enough, e.g. student should not read the educational materials passively.
- adaptive, it means there should not be the same form for students with different abilities, knowledge, and background.

The latter is very important for educational applications on World Wide Web, which are expected to be used by very different classes of users without human teacher, that means in distance learning.

We are trying to meet the above mentioned requirements in the submitted e-textbook of physics. Electronic textbooks and tests can be used as a supplement and enhancement of classical lecture. Animations and numerical experiments make self-access more effective and attractive. Including appropriate testing programme enables students to test themselves before taking an exam. In connection with Internet such a testing program enables teachers to see how students mastered the given knowledge. Yet certain degree of conservatism and slow implementation of Internet is hindering wide use of e-textbooks in Slovakia. A paper textbook, on one hand, has some advantages: it enables reading long texts comfortably and simple handling. Anyway, electronic textbook represents a new kind of information media with such advantages as quick access to information, easy updating and attractive animations. The way of explanations should motivate student to use computer in an extensive way, e.g. writing a simple programme describing some of presented problems.

3 E-PHYSICS

The main objectives of the basic course of Physics are twofold: to provide the student with a clear and logical presentation of the basic concepts and principles of physics, and so strengthen an understanding of the concepts and principles through a broad range of interesting application of the real world. In order to meet these objectives, emphasis is placed on sound arguments and discussion of everyday experience. At the same time we have attempted to motivate the students through practical examples that demonstrate the role of physics in other disciplines.

The presented textbook of e-Physics fully covers the basics course of Physics demanded at all Slovak engineering universities, including all the STU faculties. The textbook is divided into two basic parts: Physics I and Physics II, as the STU course of Physics lasts two semesters. The front page can be viewed in Fig. 1.

The first volume, e-Physics I, consists of seven chapters as so does the second volume, e-Physics II. Each chapter contains a short introduction, information about the knowledge necessary for the study of the chapter, educational goals, key words, questions, tasks and solutions, as shown in Fig. 2.

The purpose of the first stage was to prepare well-organized multi-level and interactive electronic text with many animations and new interactive applets, which could be easily updated and enhanced with new interactive applications. Not all chapters contain interactive applets at present, their development is time and energy consuming, especially for university teachers with full teaching loads. So far, animations and interactive applets have been prepared for the following chapters: Basic Information on Vectors, Mechanics of a Mass Point, Mechanics of a Solid, and Optics (Fig. 3). The interactive form of the textbook was developed by the STU MtF students within the Student Research Conference project [6].

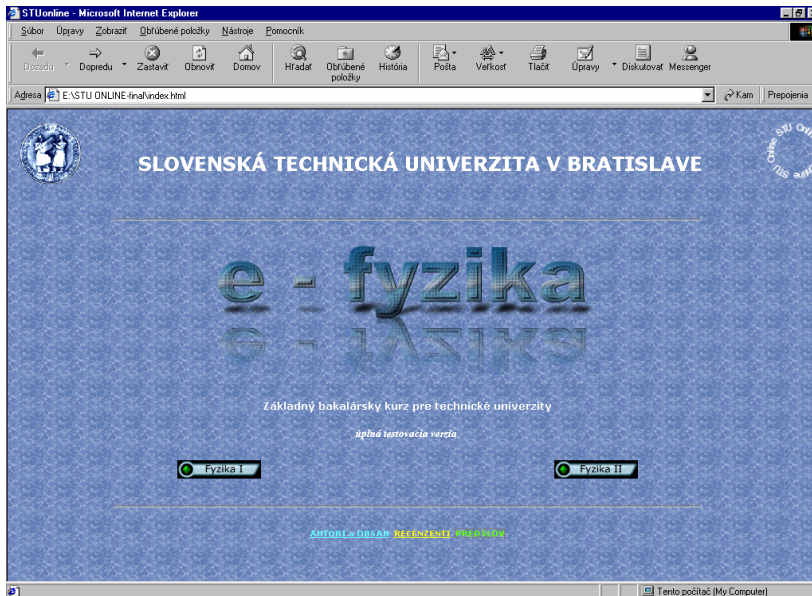


Fig. 1 Front page of “e-Physics”

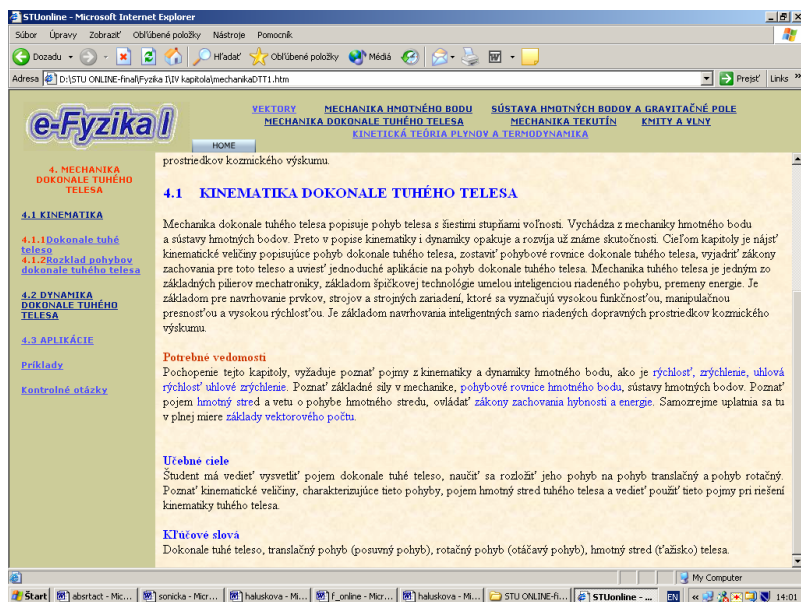


Fig.2 Sample of the chapter lay -out

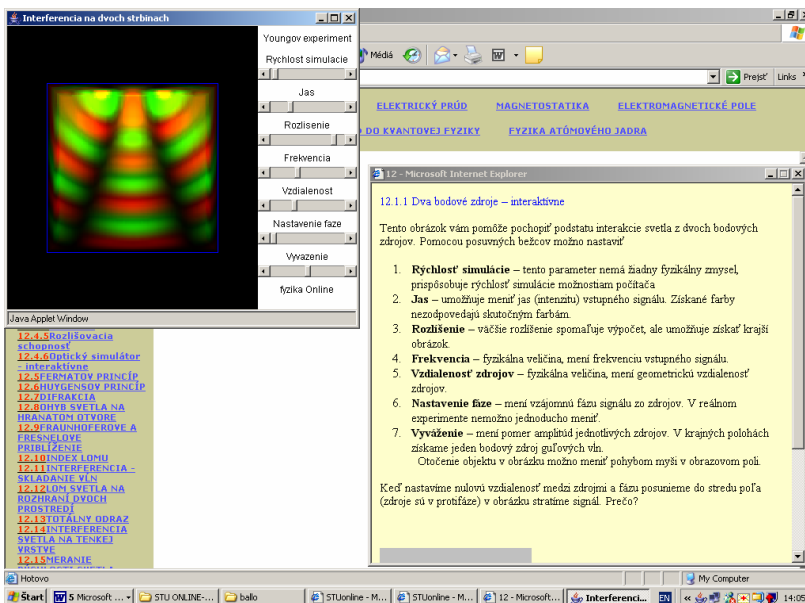


Fig. 3 Sample of Java applet
1246

4 EXPERIENCE

A) Presence study

In 2003/2004 academic year two groups of full-time students of STU Faculty of Mechanical Engineering participated in the experiment aimed at verifying suitability of the e-textbook. Numerical exercises were carried out in the computational centre. Each student was solving tasks on his /her computer. The teachers' role was that of a consultant. Electronic textbook e-Physics was available on:

- the Department websites www.kf.sjf.stuba.sk , part e-learning,
- http://kf-lin.elf.stuba.sk/~ballo/fyzika_online .

In the end of the semester the students were asked to fill in an anonymous questionnaire. Some responses can be found below. The number in parenthesis represents a relative amount of responses in percentage. Full questionnaire is given in reference [3].

1/ You have just completed exercises in Technical Physics I using e-textbook "e-Physics". How did you like it?

- it was excellent (43 %)
- it was very good (57 %)
- sometimes yes, sometimes not (0 %)
- mostly I did not like it (0 %)
- I did not like it at all (0 %)

2/ After finishing each topic (e.g. Kinematics of a mass point) you solved tasks. Did you find it helpful when the first task was solved as a sample for solving following tasks?

- very helpful (50 %)
- quite helpful (37 %)
- sometimes yes, sometimes not (10 %)
- it was not helpful (3 %)
- it was not helpful at all (0 %)

3/ When compared to preparation for tests at home, learning with e-textbook was:

- shorter than traditional learning (74 %)
- as long as traditional learning (23 %)
- longer than traditional learning (3 %)

4/ Would you recommend e-form for other subjects?

- I highly recommend it (50 %)
- I recommend it for some subjects (47 %)
- I do not recommend it (3 %)

5/ Would you like to take up numerical exercises in Technical Physics II in the spring semester again in computer room with textbook "e-Physics"?

- yes (100 %)
- no (0 %)

The questionnaire contained several open questions as well. The students stated the following positive experience:

- I appreciate also pleasant working atmosphere in the classroom.
- I liked that I could work in my own pace which is impossible within classical exercises when tasks are solved on the blackboard.
- The tasks were clearly set up.
- The vectors were accompanied with attractive animations.
- I managed to solve more tasks.

The following negative experience was stated:

- Missing filters on monitors – eyes hurt.
- Not enough numerical exercises.
- Missing practice examples.
- Misleading misprints.

It is possible to compare the responses with the result of questionnaire carried out in 2002/2003 academic year [5] which was verifying the pilot version of Physics I e-textbook.

B/ Distance study

Electronic textbook e-Physics is prepared for distance study via Internet. So far now the new study method, e-learning has not been yet introduced at STU in Bratislava completely. It has been used in e-education for selected study majors at STU FEI and external form of study at STU MtF in Trnava only for Physics. The study form was combining presence-distance course. The pilot course began in Trnava in April 2002. Thirty part-time students from STU MtF were involved. The course continued in 2003/2004 academic year at the detached workplace of STU MtF in Dubnica.

5 CONCLUSION

The experience in developing and using multimedia study materials showed, and the results of survey on using it in part-time study at the Faculty of Materials Science and Technology in Trnava and in full-time study form at the Faculty of Mechanical Engineering in Bratislava confirmed that:

- ICT can be successfully used for Physics education in engineering universities;
- Implementation of latest ICT elements is a supposition for new quality in distance education;
- Study materials available on Internet solve the problems of study materials lack;
- Study materials can be easily innovated and enhanced with animations, interactive graphs and pictures which increases quality of education, work effectiveness and attractiveness;
- Interactive self-tests with randomly generated questions with immediate evaluation (in the form of Millionaire competition) are very popular with students;
- Self-tests enable students to check their knowledge before exams which satisfies both, students and teachers.

The development of the above-mentioned e-textbook has completed the first stage of the information and communication technologies implementation. The textbook will be further enhanced of other interactive elements developing self-access, self-tests in the form of Millionaire, animations and interactive graphs, video shots, etc.

The first electronic version of Physics e-textbook in Slovakia does not intend to replace classical textbook or take over the irreplaceable role of teacher. Its main contribution is in an easy and complex access to information. The textbook is just looking for its place in the process of education.

We are just starting to develop flexible Physics education. It is up to us, teachers, to master new ICT and implement them into process of education. Unfortunately, present unfavourable economic situation does not enable us to employ all our creative ideas. Anyway, we realise that ICT offer invaluable replacement of real experiment and developing technical thinkin, leads to successful performance of engineering university graduates in real conditions.

ACKNOWLEDGEMENTS

This paper was written with the support of the Open Society Foundation in Bratislava (G 582/2000) and “STU online”, the Development Project of the Ministry of Education in 2002 and KEGA project 3/108003.

REFERENCES

- [1] OŽVOLDOVÁ, M., DILLINGER, J. & HALUSKOVÁ, S.: *The use of the Internet for teaching basic bachelor course of physics* .In PTEE 2002. Leuven, Belgium, 2002, 5 pp., CD-ROM
- [2] OŽVOLDOVÁ, M., BALLO, P. & ČERVENĚ, I.: *Basic course in Physics within Internet Education Programme* .In PTEE 2002. Leuven, Belgium, 2002, 5 pp.,CD-ROM
- [3] HALUSKOVÁ, S.: *Poznatky získané pri vyučovaní pomocou e-skript Fyzika I na Strojnickej fakulte v Bratislave*, Sborník prác zo seminára E-learn 2003, Žilina 2003, Slovensko, 2003, 31-36 pp.
- [4] OŽVOLDOVÁ, M.: *Uplatnenie e-learningu pri výučbe fyziky na STU v Bratislave*. In Schola 2003. Bratislava : STU, 2003, s. 165 - 168. ISBN 80-227-1943-9
- [5] OŽVOLDOVÁ, M.: *New Method of University Education in Physics via Internet*. In ICEE – International Conference on Engineering Education. Valencia: Universidad Politecnica, 2003, s. 263.
- [6] FATURÍK, M. & DOBOŠ, M.: *ICT a nové formy vzdelávania*, Študentská vedecká konferencia 2003, apríl 2003, Mf STU Trnava