

Interactive eLearning courses

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Abstract—This article shows the authors' motivation and experience in designing, realization and implementation of interactive www course “Electronic devices and circuits” in both Slovak and English language. These eLearning projects are accessible on the educational portal „eLearn central“ for the students. The essential part of the course is a library of interactive flash animations. The course “Electronic devices and circuits” in Slovak language is free and has been successfully exploited as support of face to face education in Dpt. of Microelectronics since 2005.

Keywords-interactive web course; eLearning; electronic devices and circuits; flash animations; SCORM

I. INTRODUCTION

The Internet, as an information source, has now a dominant position in our lives. Especially young people like this way of obtaining information much more than other ones. An ordinary student prefers automatic search of information through the Internet to personal visit of a library, information centre or another institution. These students expect to have an access to the same technology for education as they have now for other purposes - computers, cell phones, pagers, and PDAs. Simply they like to be connected. In this point when Internet is set on top, we can say that interaction beats the passivity. Modern Information Technology has opened up many new possibilities in learning [1, 2].

By combining the Internet, interactivity and learning we get one of the most popular and progressive forms of education at the present time, well-known as eLearning. Multimedia elements, time and place independence, wide information sources belong to other advantages which cannot be found in classical education.

Universities are the repository and the transmitters of the nation's scientific knowledge, so they must keep pace with the rapid expansion of knowledge. Otherwise, their students would receive an outdated education. This trend concerns of course students attending Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava, as well.

Our students engage the subject “Electronic devices and circuits” in the second year of their bachelor study [3]. The subject “Electronic devices and circuits” deals with basic knowledge of physical principles, electrical properties, technology and constructional principles of passive and active

electronic devices, the basic knowledge about electronic systems, circuit properties of passive and active devices, application of diodes, transistors, operational amplifiers, digital circuits and another semiconductor devices in different applications.

It is well known that it is very difficult to understand basic principles of electronic devices and systems without understanding inner processes in semiconductors. One of the ways how we can help students to reduce knowledge differences, to motivate them and to raise education efficiency of subject Electronic devices and circuits was to create an eLearning source of information - interactive www course “Electronic devices and circuits” to enhance the quality of traditional teaching methods.

II. THE COURSE “ELECTRONIC DEVICES AND CIRCUITS”

The course “Electronic devices and circuits” in Slovak language is the standard self contained eLearning course and includes 10 lessons converted into SCORM packages (Shareable Content Object Reference Model) [4], more than 30 interactive animations, glossary with more than 300 terms and number of hypertext references. The lessons have been supplemented by one/two types of interactive self testing modules. Creating of such type of course is very difficult and time consuming.

The course is accessible for students on the educational portal „eLearn central“ (<http://ec.elf.stuba.sk>). The „eLearn central“ portal is located on the server of the Department of Microelectronics FEI STU. The current version of this portal uses a course management system Moodle 1.9. (Modular Object-Oriented Dynamic Learning Environment), which is an open source software package designed to help educators create effective internet-based courses and web learning sites [5]. These courses are successfully implemented in education process on Dept. of Microelectronics since 2005 [6].

A. The course lessons

A single course lesson gives the basic principle definitions and terms connected with electronic devices and circuits to FEI students in the second year of their Bachelor study.

Lesson titles are the following:

- Electronic systems, devices and passive circuits
- Semiconductors and pn junction of semiconductors

- Semiconductor diodes and diode circuits
- Bipolar junction transistor
- Bipolar junction transistor dynamical parameters
- Unipolar transistor
- The bipolar junction transistor as an amplifier - the common-emitter
- Further basic scheme with bipolar junction transistors
- Operational amplifier
- Digital circuits (Fig. 1)

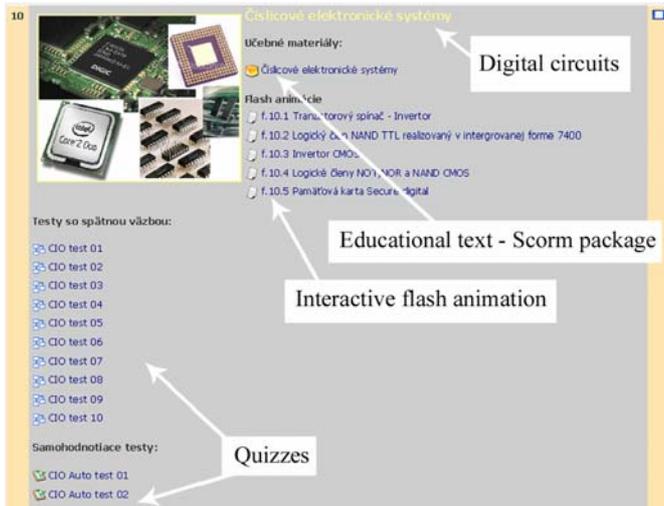


Figure 1. Visitor's view of the Student menu "Electronic devices and circuits" - lesson "Digital circuits".

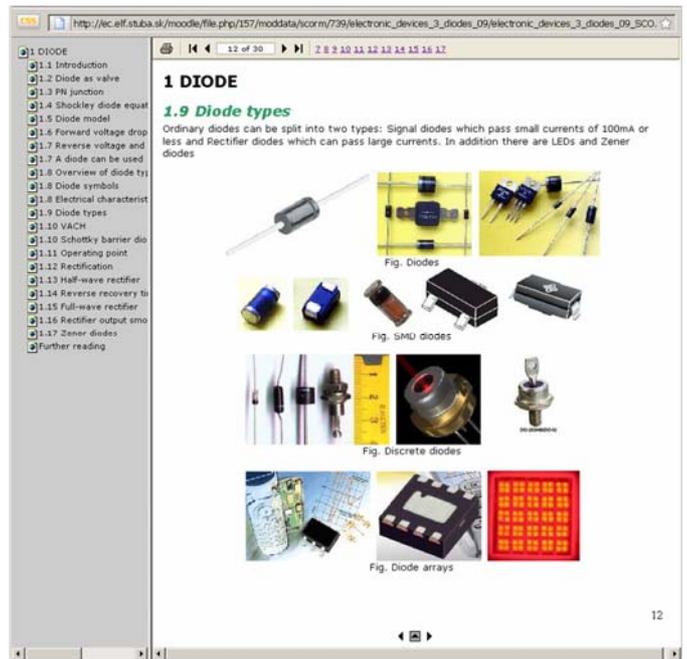


Figure 3. The lesson "Diode", Diode types – SCORM package.

All the course lessons are converted into a SCORM package (Fig. 2 and Fig. 3), as SCORM is a widely approved eLearning standard, which describes a specific way to deliver some eLearning content. It is a part of a strategy called the Advanced Distributed Learning (ADL) initiative [4]. SCORM is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of eLearning capabilities that enable interoperability, accessibility and reusability of web-based learning content.

SCORM packages are created by software THESIS Professional [7]. The THESIS product family comprises a set of SCORM compliant eLearning tools that make it possible for educators to use popular Microsoft Office programs, such as Word, PowerPoint, Excel, Visio, and MS Producer to create learning objects for eLearning.

B. The interactive animations

The students' imagination of inner processes in semiconductors and electronic circuits is not supported enough only by static pictures and characteristics. Our goal was to help the students to understand these processes through various interactive animations. The animations have been designed in such a way that they would show animated details of a given object and so help obtaining the knowledge much easier and faster.

The animations have been created by using Adobe flash tool [8] or by using both Adobe Flash software and SPICE (Simulation Program with Integrated Circuits Emphasis) (Fig. 4). Some animations work as a format converter of SPICE output files into graphic Internet browser show format [9]. We have created the output files for a variety of input parameters using simulation in the SPICE application. Thanks to this we are able to provide a high level of interactivity in our animations.

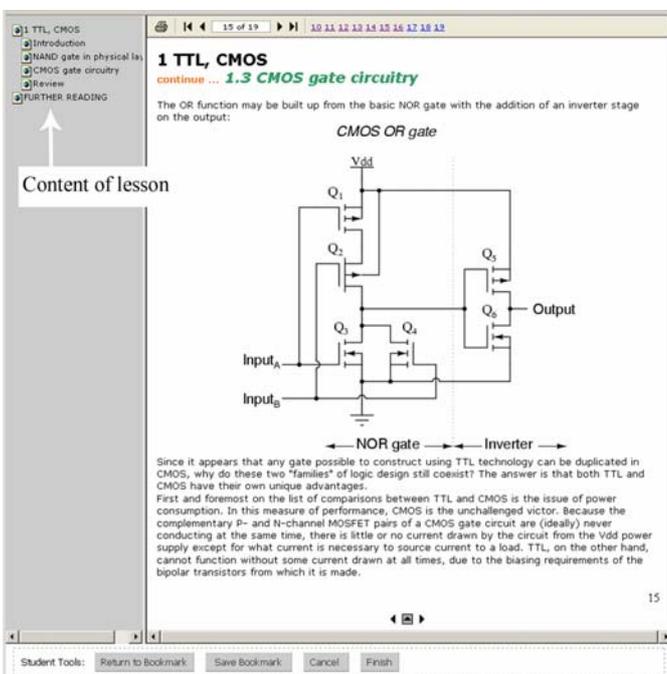


Figure 2. The lesson "Digital circuits", CMOS gate circuitry – SCORM.

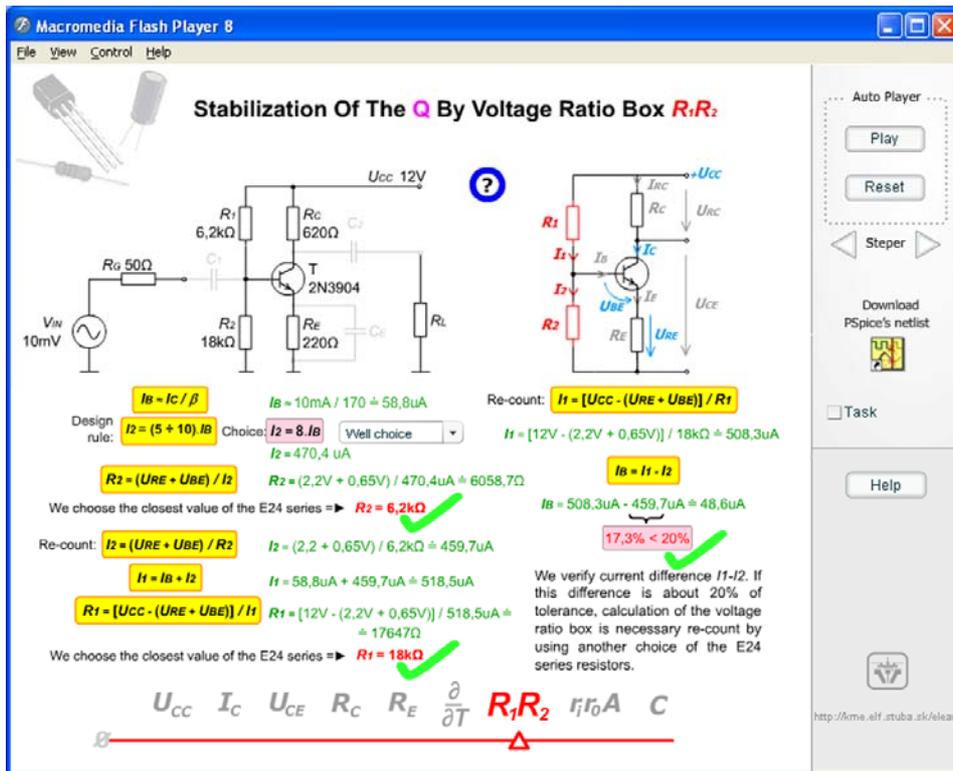


Figure 4. Interactive Flash animation “Low frequency Amplifier design” - Step by Step

We decided to use these authors’ tools for interactive animation creation because of its potentiality to authentically capture the important interaction in electronic devices and the possibility to work with scalable vector graphics. Flash also fulfilled the requirement for the smallest size of animations, vector graphic with the view of non-decreasing quality at higher resolution. An output format of finished animation could be then published on web pages very easily.

More than 30 interactive animations were initially developed for a course „Electronics devices and circuits”: among them animations of passive devices, passive filters, diodes and their usage in electronic circuits, LCD, LED, LD (Fig. 5), OLED, photodiode, laser diode, e-paper, as well as BT, HBT, FET transistors, amplifiers, real and ideal MOS structures, examples of planar technology produced diodes, bipolar junction transistor and CMOS gate, optical storage media, digital circuits and gates (Fig. 6).

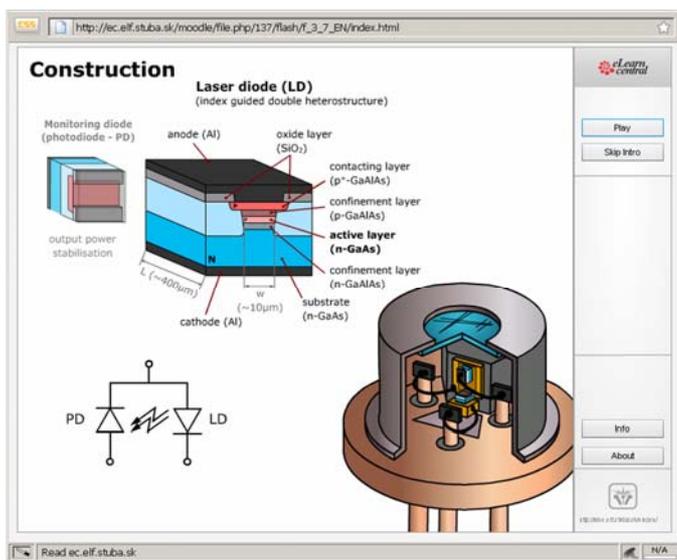


Figure 5. Interactive Flash animation Laser diode: “Intro” part construction with laser diode and monitoring diode [10]

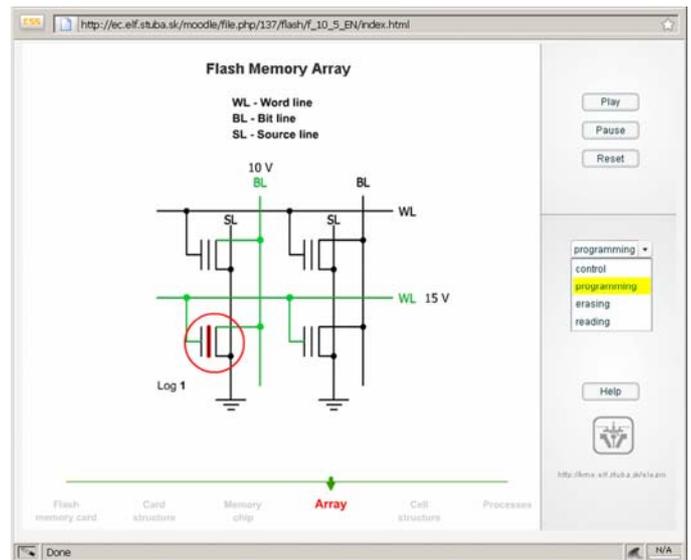


Figure 6. Interactive Flash animation Secure Digital Memory Card: “Flash Memory Array” – Programming

The screenshot shows the eLearn Central interface. At the top, the logo and user information are visible. The main content area is titled 'Electronic devices' and includes a collage of various electronic components like capacitors, resistors, and integrated circuits. Below this is an 'interactive site map' diagram. The diagram consists of a grid of colored boxes connected by lines, representing the course structure. The boxes include: Introduction, Passive Devices, Resistors, Capacitors, Inductors, Active Devices, PN Junction, Diode, Zener Diode, Bipolar Transistors, Unipolar Transistors, Transistor Circuits, Power Devices, Thyristors, and TTL CMOS. A red box highlights the 'Active Devices' topic. The left sidebar contains navigation options like 'People', 'Activities', 'Search Forums', and 'Administration'. The right sidebar shows 'Latest News', 'Upcoming Events', and 'Recent Activity'.

Figure 7. Visitor's view of the Student menu "Electronic devices and circuits" interactive site map of the course content.

These original animations are uniqueness of our portal. All interactive animations are free available for everyone interested [11].

C. The quizzes

All quizzes were created in Moodle XML format with our "questions and answers editor" This editor allows various question types to be mixed in a single text file and this format supports even popular Multiple-Choice option, line comments,

question names, feedback and percentage-weighted grades etc. Results are listed in %. The best results are stored in users' accounts. The user is informed about these results in the case he repeats the test. The lessons have been supplemented by one/two of two types of interactive self testing modules „Quizzes for Fast revision of knowledge” and „Quizzes with a feedback possibility”. By the quiz for fast revision, students can see not only their results in %, but after finishing the test also expected correct answers.

By the quiz with a feedback possibility, if the student does not answer correctly, the quiz automatically redirects him straight to the text related to actual question. The student has an opportunity to read through the educational text again and repeat the answer after that. He/she may proceed in carrying out the quiz only if his/her answer is correct.

There are available at least 5 various quizzes with 10 multiple-choice questions supporting single or multiple answers in both types of modules.

D. *The glossary*

One important and very useful option in Moodle is the possibility to create a glossary of terms, which can be maintained by the instructor or collaboratively by students. All terms edited in a course are auto-linked with the glossary so they can be stored and reused in other courses on the whole portal.

We decided to use this ability of Moodle to create our own glossary to help students to better understand the specific technical terms. Now the glossary has more than 300 explanations and our goal is to prepare all terms used in our education texts to this form.

E. *Two versions of the course*

The course “Electronic devices and circuits” was prepared in two language versions Slovak and English. The ambition to create the English version of this course (Fig. 7) originated from the fact, that our faculty annually provides the study process also for foreign students. The second but not less important objective was to present our study programs and activities in wider scope. There are several differences between Slovak and English version of the course. The content and education form of English version is slightly adjusted for needs of foreign mainly self studying students [12].

This English version is also extended with interactive navigation map of the course content (Fig. 7). The map is dividing all course chapters into the tree structure. After mouse click on each block, the desired theme is displayed, which means that you don't have to browse between single course weeks in Moodle environment.

The final modifications and customizations of English course version are still performed.

F. *The offline e-coursebook*

According to the fact, that the interactive www course “Electronic devices and circuits” is successfully used as an active support in educating the same named subject for five years now, we decided also to create the offline e-coursebook. So in 2009 we have published the offline version of the course “Electronic devices and circuits” in a form of electronic publication on cd with its own ISBN. We hope that this kind of study material will be helpful for those, who have no instant access to internet and appreciate all the interactivity of our courses.

III. SUMMARY

We have created an extensive eLearning source of information - interactive www course “Electronic devices and circuits” to enhance the quality of traditional teaching methods. The initiative to start such a project dates back to 2004 when also the “eLearn central” team was found, as a group composed of teachers and students. The members of our team have worked together and consulted all arose technical and software difficulties. The first version of eLearning course “Electronic devices and circuits” was created in 2006 and tested among students. Since this time the course has undergo various changes according to needs of our students and other visitors of the educational portal.

The complete course “Electronic devices and circuits” in Slovak language today includes 10 compact lessons, more than 30 interactive animations, glossary with more than 300 terms, several interactive self testing modules and number of hypertext references. The content of this course is regularly updated in order to follow the newest trends and research in the field of electronics.

Our experience with implementing the course to the educational process is very positive and we can observe the interest of students to use the interactive study material every school year not only to prepare for their exams, but also to find some additional information.

All the interactive Flash animations were created as a result of permanent two-way effort of “eLearn central” team. New members of the team were able to integrate and make complicated animations quite quickly thanks to our prepared templates, multimedia schoolbook [13, 14] and a library of our symbols. Most of the interactive animations in our courses are processed in very popular form and this is one of the ways how we are able to draw also the attention of younger people and motivate them to study electronics.

If we want to come close to wider range of so called customers of our work, speaking of potential students, students, partners or enthusiast, we need to meet actual demands. According to them we have prepared the offline e-coursebook of our educational material and also English version of the course “Electronic devices and circuits”.

ACKNOWLEDGMENT

This work was performed under the Center of Excellence CENAMOST (VVCE-0049-07) project and supported by the Slovak Scientific Grant Agency VEGA 1/0507/09, and by the project KEGA 3/7248/09.

REFERENCES

- [1] Kobal, D. and Zmazek, B.: “(E-)Mind Thinking with E-um”, Journal of Systemics, Cybernetics and Informatics, Vol. 7, N. 5, 2009, ISSN: 1690-4524, [cit. 2009-10-10],
<<http://ec.elf.stuba.sk/moodle/course/view.php?id=143>>
- [2] Oblinger, D. Boomers, “Gen-Xers, & Millennials: Understanding the New Students.” [online], 2003, Educause, July/August, pp. 37-47, [cit. 2009-09-10],
<<http://www.educause.edu/ir/library/pdf/erm0342.pdf>>

- [3] Stuchlíková, L., Redhammer, R., Hulényi, L.: Elektronické prvky a obvody, e-coursebook, Slovak University of Technology in Bratislava, Editorship STU, Bratislava, 2009, ISBN 978-80-227-3181-2, [on line] <<http://ec.elf.stuba.sk/moodle/course/view.php?id=7>>
- [4] SCORM 2004. Advanced distributed learning, 2006, [cit. 2010-08-04], <<http://www.adlnet.gov/Pages/Default.aspx>>
- [5] Moodle, 2006, [cit. 2010-08-04], <<http://moodle.org/>>
- [6] Stuchlíková, E. at. all.: Interactive www Course "Electronic Devices and Circuits", In: Virtual University VU '06: 7th International Conference, Bratislava, Slovak Republic, December 14-15, 2006, Bratislava : STU v Bratislave, pp. 119-124, ISBN 80-227-2542-0.
- [7] THESIS Professional: E-learning Tools, 2005, [cit. 2010-08-04], <<http://www.hunterstone.com/thesis.asp>>
- [8] Adobe Flash CS4 Professional, 2008, [cit. 2010-08-04], <<http://www.adobe.com/products/flash/flashpro/>>
- [9] Gron, M., Stuchlíková, E.: Interactive www guide for practice laboratory exercises of subjects Electronic systems and Electronic devices, In: 5th International Conference Virtual University. Proceedings Bratislava, Slovak Republic, December 16-17, 2004, pp.149-154, ISBN 80-227-2171-9
- [10] Pavlovič, M., Stuchlíková, L., Benkovská, J.: Laser Diode as a Basic Optoelectronic Device in e-Learning. In: ŠVOČ 2009. Proceedings. Bratislava, Slovak Republic, 29.4.2009. STU in Bratislava FEI, 2009. - ISBN 978-80-227-3094-5. - CD-Rom
- [11] Interactive flash animation, [online], 2006, The educational portal "eLeran central", Last revision June 29, 2009 [cit.2009-09-10], < <http://ec.elf.stuba.sk/moodle/course/view.php?id=39>>
- [12] Bohmer, S.: Web technology and Electronics, Diploma thessis, Dept. Of Microelectronics, Slovak University of Technology in Bratislava, 2009
- [13] Hrbáček, J.: Flash 1 - production inteligent graphic - multimedial schoolbook. Brno : MSD, spol. s.r.o Brno, 2007. p. 89. První. ISBN 978-80-7392-000-5.
- [14] Hrbáček, J.: Flash2, Basic programming in AS2 - multimedial textbook. MSD, spol s r.o., Skorkovského 70a, 63600 Brno, 2007, 83 s. ISBN 978-80-7392-001-2.