

Electronic Textbook and E-Learning System in Teaching Process

Larissa Zaitseva

Riga Technical University, Software Engineering dpt.
501, Mezha 1/3, LV-1048, Latvia
+3717089522, +37129412273

Larisa.Zaiceva@cs.rtu.lv

Jekaterina Bule

Riga Technical University, Software Engineering dpt.
528, Mezha 1/3, LV-1048, Latvia
+3717089549, +37129427514

Jekaterina.Bule@cs.rtu.lv

ABSTRACT

The paper describes the electronic textbook and e-learning system developed and used in educational process at Riga Technical University. The architecture of the universal on-line electronic textbook is reviewed. The possibilities of the textbook and e-learning system are shown. The courses included in them are outlined.

Key words

Electronic textbooks, e-learning systems

1. INTRODUCTION

Nowadays educational problems are very important because the quantity of necessary information permanently enlarges and many new specialists of modern specialties are required, but it's not possible consequently to increase the time of education. Taking into consideration a scientific and technical progress a re-qualification of existing specialists also is continually required. That's why the problem of increasing a quality and efficiency of a learning process is very actual. At present modern computer technologies are widely used in all forms of educational software [16]: different educational and methodical materials, tasks and examples of laboratory works are available in global network, various dictionaries, encyclopedias [4, 5, 8], specialized and universal learning systems [11, 12, 13, 14, 15] are developed. That allows to increase a quality and efficiency of education. The most useful forms to enlarge an efficiency of a learning process are electronic textbooks (ET) and e-learning systems. They can be used on all levels of education: at schools, at universities, for qualification increasing, in distance education, for life long learning, etc. Electronic textbooks are being created in many countries [1, 3, 6, 7, 9, 10]. They exist in two main formats: on compact disks (CD) and in Internet/Intranet. Electronic textbooks and e-learning systems allow solving such basic pedagogical tasks as [2]:

- initial acquaintance with the elements of the subject and making familiar with basic terms and concepts of it;
- basic preparation on different detailing levels;
- knowledge control and assessment;
- increasing of abilities to definite activity's types;
- renovation of knowledge and skills.

That's why on-line electronic textbook and e-learning system are developed in Riga Technical University (RTU) – Department of Software engineering and successfully used in a teaching process.

2. ON-LINE ELECTRONIC TEXTBOOK AND IT'S USING IN TEACHING PROCESS

Electronic textbook (ET) is the complex of informational, methodical and software tools that is predestined for learning of a

separate subject and usually includes questions and tasks for self-control and testing as well as provides a feedback.

Electronic textbook "Study HTML" [19] implemented using technology Flash and programming languages HTML and JavaScript and available on CD's and in local network was successfully used in practice to teach the subject "Web-application development" in 2003-2005. The analysis of its using and students' answers on questionnaire showed that: ET is popular between students (80% of students used it more than three times); ET is easy to use (it's the opinion of 77% of students and 62% of them did not use help working with the book); ET is useful for students (75% of students plan to use the book in a future) [20]. Some disadvantages of the book have been established, too: ET is software for one user and not available through Internet; results of student's activities (testing, etc.) are kept only while he/she works with the textbook.

As a result the main requirements for on-line electronic textbook have been formulated. They are [20]:

- Teaching material should be structured decomposing the content of the subject into chapters on the basis of subject model [18, 21]. Each chapter consists of some sections and each learning object should be represented in one (max two) screen using figures and examples.
- The following modes should be ensured: learning, self-control, testing, reference book and help. Special questions and tasks need to be prepared for self-control and testing that allows determining student knowledge and skills level. The comments for different student's answers should be developed as well. It will provide an adaptation to a student depending on his/her answers [17].
- Reference book should include short descriptions of the terms of a course and can be used at any time during learning and may be self-control.
- Help mode should assist user how to work with the textbook as well as help a student timing his learning process. It means that this mode also should include recommendations on how to organize work with ET and what time is needed to study a separate chapter and/or section [2].
- Electronic textbook should provide user registration for several user categories: student, tutor, author and administrator.
- Electronic textbook should allow presenting educational material of different types (text, images, animation, etc.) and formats (.doc, .pdf and so on).

On the basis of these requirements the universal on-line electronic textbook was implemented using technologies HTML, Flash, JavaScript, PHP and MySQL in the beginning of 2005. The architecture of this textbook is shown on Figure 1.

Separate interface for each user category (student, tutor, author and administrator) provides needed services. Thus, author can create ET, add, modify and test educational material, questions and tasks, descriptions of the terms and other data stored in

knowledge base. A student can use ET on selected subject in different modes: learning, self-control, testing, reference book and help. A tutor has a possibility to get information about student's work with a textbook, self-control and testing results as well as to select testing model for a student. Questions and tasks of different types (multiple choice, input word, etc.) and three difficulty levels can be used for testing and self-control. Administrator provides user registration and maintains ET. Information about users and their work with the book, portions of educational material and a complex of models to provide adaptation to a student are stored in knowledge and database.

In the learning mode students can get information with different examples. In self-control mode five questions defined in randomize order are offered to student. Answering questions he/she can use help and reference book, but in knowledge control mode (testing) it is not allowed. The knowledge control is being organized after tutor determined testing model. It includes the number of questions, the number of definite difficulty questions in

a set, comments detailing, questions sequence, etc. After testing results of it (number of correct and incorrect answers, time, and mark) are displayed. The student can see his/her own answers, correct answers and got marks for each question. The tutor can set the number of definite difficulty questions from each chapter.

Such approach to ET development allows creating easily electronic textbook on any subject. For this purpose it's necessary to prepare educational materials, questions and tasks, etc. and to save them in knowledge base. Now this software contains ET on the course "Study HTML" that includes eight chapters: HTML document structure; Text formats; Graphics; References; Tables; Frames; Styles; Dynamic HTML. There are 19 educational topics, eight tests on each topic and one final test to control student's knowledge on the subject in the textbook. Students of Bachelor's programme regularly use it studying the subject "Web-application development".

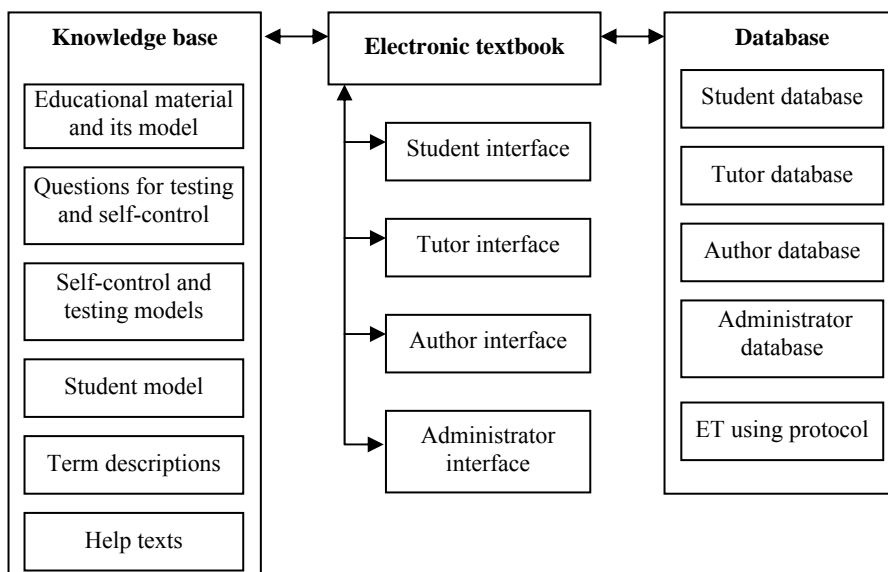


Figure 1. Architecture of the universal on-line ET

3. E-LEARNING SYSTEM

E-learning system allows to organize teaching process in such a way that students can get knowledge and skills via global network and tutor can conduct all their activities. It may include various courses and provides work for several user categories (tutor, student, learning material author, administrator, operator, etc.) [16].

Considering advanced computer technologies and other requirements for this kind of systems there was developed e-learning system at Riga Technical University by using PHP technology and MySQL database. It has 3-level architecture [22]:

- I. a kernel of a system ensures performance of standard functions for each network system;
- II. subsystems or agents (administrator, operator, tutor, learning material author (LMA), and student) are responsible for each user category's operability;
- III. modules of subsystems realize definite functions.

The developed system provides work for 5 categories of users: administrator, operator, tutor, LMA and student. The functions of each category are shown further.

Administrator ensures a correct work of a whole system, users registering, user's information modification and so on.

Operator can disconnect those users, who don't work with a system for a long time interval after connection.

Tutor is able to:

- ✓ determine different courses and tasks for a certain group;
- ✓ see information about each student or whole group work and success;
- ✓ communicate via e-mail with students;
- ✓ include new courses;
- ✓ modify existing courses;
- ✓ prepare tasks and questions for knowledge control, self-control and learning process;
- ✓ define the time for knowledge control (either for each task separately or for the whole work).

Learning material author has a possibility to include new courses, modify or delete existing courses or separate themes from them; prepare tasks and questions for knowledge control, self-control and learning process. Learning material consists of a set of various learning objects.

Learning objects (LO) can be of two types – learning objects information (LOI) and learning objects tasks (LOT). They are kept separately, what ensures the reusability characteristic of LO's. Moreover tutor or learning material author may define either definite LOT could be used in knowledge control and self-control modes as well as in learning mode or just in one of them. To provide different levels of adaptation various parameters of LO's are being considered:

- ✓ LOI's parameters: time, significance for definite specialty, type (either it is main LOI [concept/definition, rule, structure or example], detailed example, short or full explanation).
- ✓ LOT's parameters: time (for separate task or question); difficulty; possible number of tries (mostly in self-control mode); the mode, where it can be used; commenting possibility; type (multiple choice, word, sentence).

Student can work in four different modes: learning (get learning material); knowledge control (perform various tasks determined by a tutor); self-control (control his/her knowledge adjusting time for each task or group of questions, the tasks difficulty level, etc.); references (to get short information about course main concepts). Except of the mentioned modes students can also see own progress, success and messages left by tutor.

The information about a student is kept in the database as a student model and it includes such data as educational programme, specialty, and his /her progress in a work with a course. This information helps to provide adaptation by considering LO's parameters and its relation to the knowledge and skills level as well as current success.

The developed e-learning system ensures also adaptability feature by allowing students to define the difficulty of tasks and questions, the number of them, the number of tries, time for each question or for the whole work, to choose the next step (in the learning mode).

For now the system provides various educational programs of the subject "Software Engineering":

- the theme "Software process models" that includes about 16 LOI's and 54 LOT's of different types ensured in both learning and knowledge control modes;
- the theme "Software life cycle" realized in knowledge control mode;
- the theme "Software planning and metrology" realized in knowledge control mode.

These courses are being used in teaching process for Bachelor's and Master's programme students.

4. CONCLUSIONS

The developed at Riga Technical University (RTU) electronic textbook "Study HTML" was successfully used at RTU for 3 educational years. It was the reason to work on the universal on-line ET. It was included in educational process beginning with this year. The implemented at RTU e-learning system can be used for organizing as learning process. It allows including new learning programs without any difficulty and helps students to obtain knowledge and skills in appropriate field. The system is implemented in such a way that programs included in it satisfy adaptivity requirements by providing different technologies using (Curriculum sequencing, Adaptive presentation, etc.) as well as adaptability demands by allowing students to change some parameters of LO's and to choose an order of them. Due to tasks are kept apart from learning information objects, they are reusable, i.e., can be used exclusively for knowledge control.

The future work is to fill in as on-line ET as e-learning system with more courses ("Programming language C. Cycle operators", "Testing methods", "Data structures") and to research the usefulness and efficiency of including these systems in educational process (how it influence the results).

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