Yuriy BOBALO, Petro STAKHIV, Bogdan MANDZIY, Natalya SHAKHOVSKA, Roman HOLOSCHUK

Lviv Polytechnic National University

The concept of electronic textbook "Fundamentals of theory of electronic circuits"

Abstract. This paper presents the development of electronic textbook "Fundamentals of theory of electronic circuits". The main focus is laid on the concept, structure and the basic principles of the electronic textbook. The detailed procedure of evaluation of knowledge acquired by student in the field of electronic circuits is discussed.

*Streszczenie. Artykuł prezentuje doświadczenie autorów w tworzeniu elektronicznego podręcznika do nauczania podstaw teorii obwodów elektronicznych. Główny nacisk położony jest na rozwój koncepcji tego typu nauczania, strukturę podręcznika oraz podstawowych wymagań, które musi spełniać. Ważnym elementem artykułu jest dyskusja dotycząca procedury oceny wiedzy studenta nabytej przy studiowaniu elektronicznej wersji podręcznika. (**Koncepcja podręcznika elektronicznego „Podstawy teoretyczne obwodów elektronicznych"**)*

Keywords: electronic textbook, distance learning, virtual learning environment
Słowa kluczowe: elektroniczny podręcznik, uczenie na odległość, środowisko uczenia wirtualnego

Introduction

The self-study is the form of knowledge that is now widespread in Ukraine and abroad. It is a self - directed individual activity leading to increasing the someone knowledge and experience. In some western countries, this form of study has been existed quite a long time and reached great popularity among students and teachers because of its economy and training effectiveness.

There are many technologies used for learning: Moodle, Atutor, Claroline, eCollege. However, the disadvantage of the above technologies is that they work only with "standard test" and automatic generation of input data for exercises is not allowed. This leads to situation when after multiple learning on the limited set of tasks students can guess the correct answer and does not really solve the exercise. There is today no software that could effectively solve the problem of learning, and allow the students to study the limited set of tests and solve new tasks for which input data are not repeated.

Very important is the creation of methodological and instrumental bases of simulation training systems management and control knowledge, adequate current trends in information technology and didactic principles of organizing and conducting training.

The concept of the textbook "Fundamentals of the theory of electronic circuits, which was jointly developed in the electrical faculties of Lviv and Kyiv Polytechnic and was edited by Professor Y. Bobalo. It is based on considering such factors as the complexity of the learning process, the integration of various forms of activities - lectures, practical laboratory, independent, under the volume of tasks allocated credits; importance of self-knowledge and effectiveness of training for laboratory work.

The main material

The software tool used for learning in the course "Fundamentals of the theory of electronic circuits, should enable to display the Greek characters in the standard window Windows and produce answers in the form of formulas, tables. It should provide the creation of exercises providing some answers and more.

The process of learning involves the presence of two components:

1) Training material M - has short or full theoretical background. It is organized as a tree, which corresponds to the depth of nesting of topics M_i and sub-topics M_{ij}. It is characterized by the number of sub-topic $|M_{ij}|$, and time t_i allotted for teacher learning, questions of certain levels of difficulty Q_{ik} and points cushion R_{ik}.

2) Tests T - consist of the questions Qt_i, answers Vij, difficulty level Sk_i and type of task Tq_i.

$$(1) \quad E = \langle M, T \rangle, M = \langle M_i, \{M_{ij}\} t_i, \{Q_{ik}, R_{ik}\} \rangle,$$
$$T = \langle Qt_i, \{V_{ij}\} Sk_i, Tq_i \rangle$$

The teacher indicates the number of certain levels of complexity for each theme and gives time to perform tasks. If the allotted time is finished and student does not answer all questions, the test automatically stops, and program puts scores obtained by those questions that the student had answered:

$$(2) \quad \sum_{i=n}^{n} t_i \geq Ts ,$$

where n - number of sub-topics, which student tested, Ts – time in which the student completed the test.

Student can see randomly generated set of test questions:
- if a student gets 71-100 points - then it is recommended him to continue study the next section;
- if a student gets 40-70 points - then it is offered to take Option 2 and clarify his level of knowledge;
- if a student gets 0-39 - it is recommended to repeat the whole section.

The program develops the following modules:
1) Analysis of arithmetic expression and its automatic calculation - for the implementation of issues-based problems generated by parameters;
2) The formation of special alphabet characters, their processing, redrawing the window to display the characters and the introduction of expressions from the keyboard;
3) Determine the type of questions and answers and display them in the form: text, formulas, figures, table, mixed;
4) Validation of tests - Analysis of errors by the teacher - specification of the number of incorrect answers, non-existent type of question, etc.;
5) Formation of random questions bank, which considers the given number of questions by level of difficulty for a student;
6) Checking the answers of a student;
7) Determination of the total assessment of student;
8) Setting the time of testing;
9) Definition of related topics that is necessary to examine the student to achieve better results.

Questions - exercises include circuits, their parameters and values. Parameter values are generated automatically. Then the student submits his answer.

Let us describe the software system. The contextual learning process diagram is graphically shown in Fig. 1.
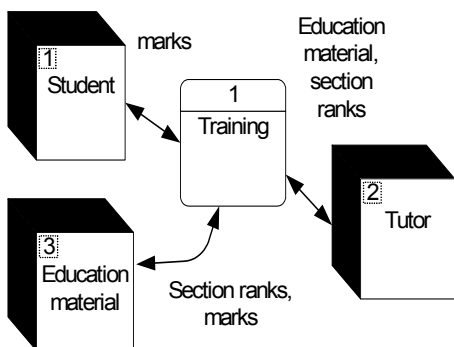

Fig. 1. Contextual learning process diagram

Let us select the main entity of the design domain. The entity of the student provides information about persons that study. The entity of the teacher performs setting of the educational material. The entity of educational material presents a graph of educational material. Detail of contextual diagrams shown in Fig. 2.
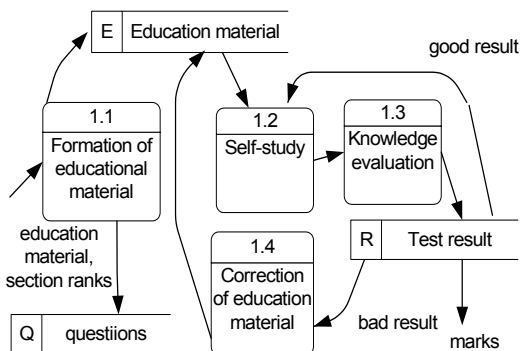

Fig. 2. The details of the process of "Training"

Then we built the sequence of steps designed for the knowledge evaluation (Fig. 3).
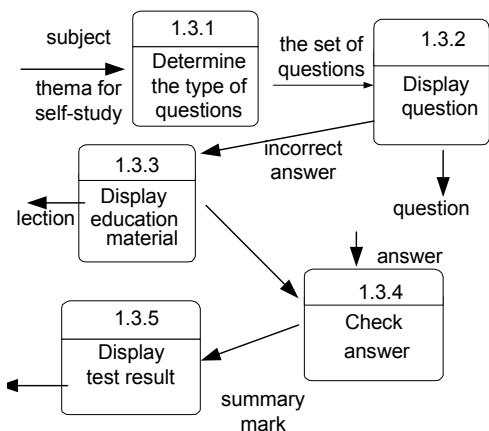

Fig. 3. The details of the process of "Knowledge evaluation"

After starting the program we get the menu window, shown in Fig. 4.

It contains a list of topics concerning the course foundations of the theory of electronic circuits, control questions to sections, examples of exercises for self-control, as well as tests and tasks for learning. Choosing the necessary theme is done by double-clicking on the title.

Short text of sub-topics, examples of solving problems checklist is displayed in the browser. To begin testing by double-clicking selected test required by section. There is a window for testing (Fig. 5).

In the top of the window there are indicated numbers of questions, the level of its complexity and the number of points that you can get for the correct answer is placed in the bottom slider time.
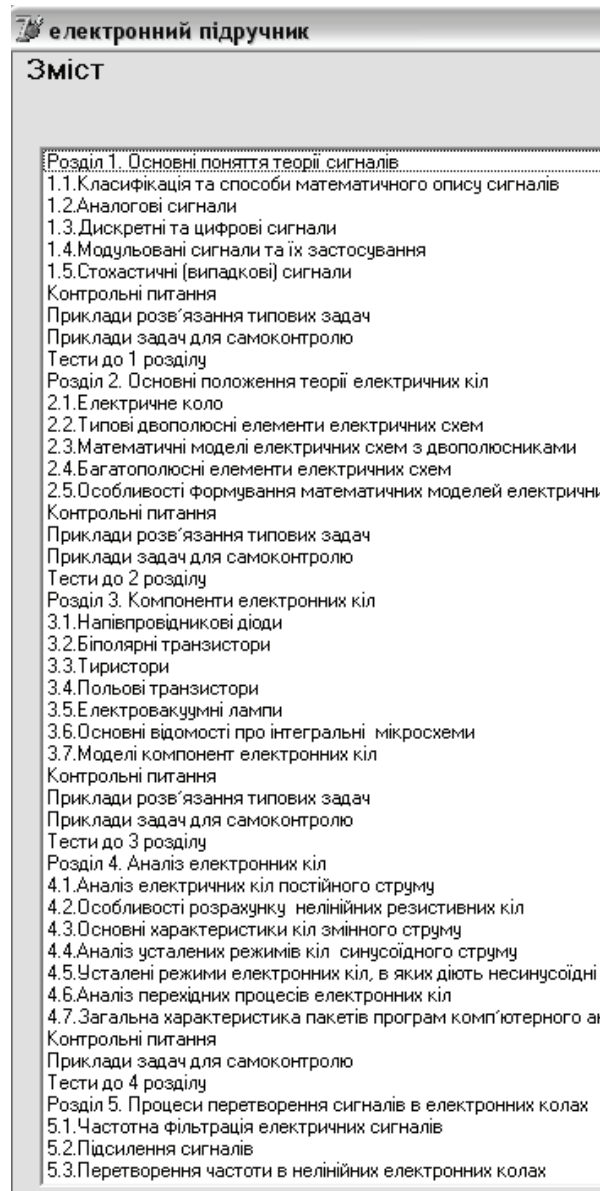

Fig. 4. The main window of program

When the slider reaches the right edge of form, the test is automatically terminated. Forward button, Back button allow you to navigate to the next question or return to the previous one. The user can see the number of points he received for answer. Election answer is done by marking the check box.

Some questions require a response from the keyboard. It also provides a dimension (matrix) filled arrays (Fig. 6). Introduction to cell array is done by clicking the mouse on the appropriate cell and entering the desired value from the keyboard.
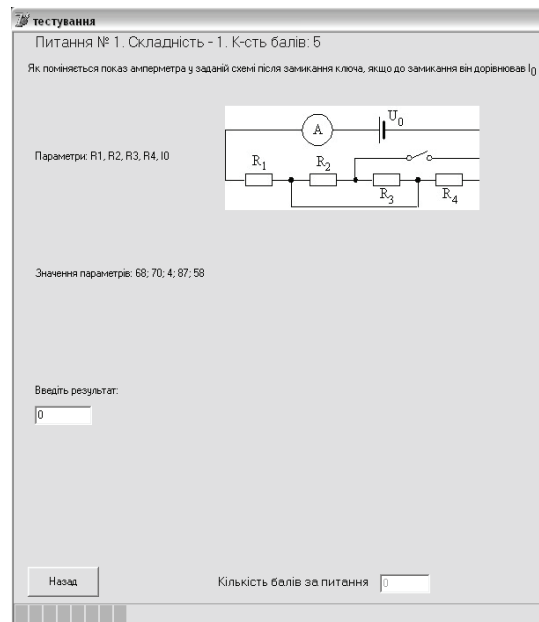
Fig.5. The sub-menu for testing

Fig. 7. The screen for creating questions-exercises.

Testing result is shown in the following form (Fig. 8).
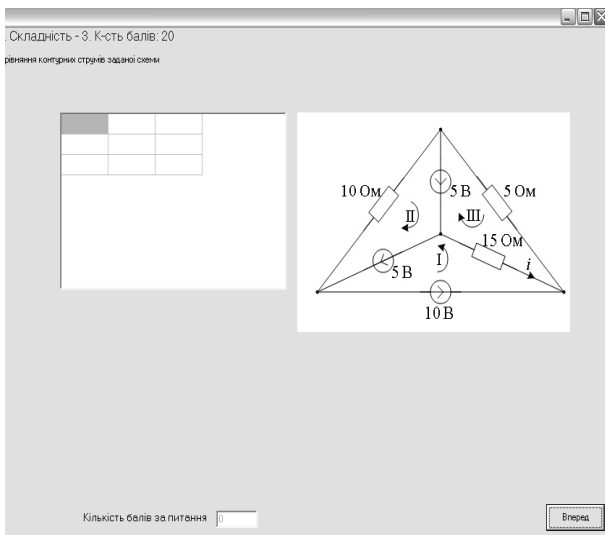

Fig. 8. The screen of results

Fig. 6. The sub-menu for creating questions in the matrix form

Questions - exercises include circuits, the parameters and their values. Parameter values are generated automatically and exercises solves by using proper formulas. Then the student submits his answer (Fig. 7).

When the user answers some questions, but not all of them, he can return to previous questions.

The program displays the number of points obtained by students (the maximum available 100 points) and number of topics or sub-topics that could be learned better.

In addition to the tools the tutor-expert, as EL software testers, may create and test the optimal algorithms and methods for assessing the students' knowledge.

Conclusions

The tutorial demonstrates a new approach to teaching the basic subject for students of electrical and electronic engineering. The electronic form of the textbook allows to make an independent assessment of someone knowledge in an on-line mode.
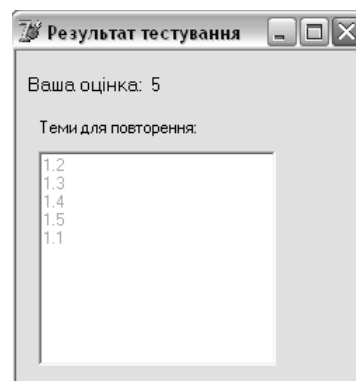
REFERENCES
[1] Elsom-Cook M. Student modeling in intelligent tutoring systems // Artificial Intelligence Review. - 1993, vol.7, n.3-4. - p.227-237.
[2] Moodle. – [Електронний ресурс]. - [Режим доступу]: http://moodle.org/mod/forum/discuss.php?d=133543
[3] Tutor Learning Management Tools. – [Електронний ресурс]. - [Режим доступу]: http://atutor.ca/atutor/docs/index.php
[4] Claroline. – [Електронний ресурс]. - [Режим доступу]: http://demo.claroline.net/index.php
[5] E-college. – [Електронний ресурс]. - [Режим доступу]: www.e-college.ru/education/speciality/manager.htm

Authors: prof. Yuriy Bobalo, prof. Petro Stakhiv, prof. Bogdan Mandziy, Assoc. prof. Natalya Shakhovska,; Assoc. prof. Roman Holoschuk, email: natalya233@gmail.com