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DESIGNING AN INTERACTIVE MULTIMEDIA BILINGUAL APPLICATION FOR THE COURSE “PULSE AND DIGITAL DEVICES”

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***Abstract:** Some tools for designing interactive and multimedia training systems are considered in the paper. Their advantages in teaching students at universities are described. A bilingual interactive and multimedia application has been developed in English and Spanish, the two most widely spoken foreign languages in the world. The application allows students to learn basic concepts of Boolean algebra, minimization with Karnaugh maps, as well as basic functional units of combinational type, such as code converters, decoders and encoders, multiplexers and demultiplexers, arithmetic circuits for addition and subtraction, as well as digital comparators. The application covers various types of testing exercises, in the form of combining in pairs, crosswords, etc. The application will be used in the educational process in the courses “Pulse and Digital Devices”, “Impulse and Digital Circuits”, “Digital Circuits”, “Synthesis and Analysis of Logic Circuits” for the bachelors in the specialties “Internet and Multimedia Communications”, “Information and Communication Technologies”, “Computer Control and Automation”, “Electronics” and “Computer Systems and Technologies” in the University of Ruse “Angel Kanchev”.*

***Keywords:** Pulse and Digital Devices, Active Learning, Interactive and Multimedia Learning.*

INTRODUCTION

Today, the advances of information and communication technologies (ICT) have stimulated the generation of more interesting and effective approaches for teaching and learning. The educational innovations have stimulated more creative developments for interactive technologies in various forms, for example computer-based instruction, integrated learning systems, intelligent tutoring systems, computer aided assessment and computer mediated communication. These new concepts show that the advance in the digital era has expanded the learning process and has enabled higher levels of learner interactions in order to make learning more meaningful for overcoming the shortages in traditional learning. In respect to the advances in technologies and information growth, the delivery of knowledge needs to be more flexible in connecting the learners with the learning resources to support the independent and self-managed learning. Educators are trained to transform from the conventional teacher-centered approach to student-centered learning approach with technology-based learning environment which can better motivate students to participate and interact with others in the learning process for enhancing the quality of learning and encouraging students to demonstrate their understanding in the learning activities (Fui-Theng, L. & Neo, M., 2014). ICT in education are applied in the form of interactive multimedia, which provides facilities to students to learn a material. The use of interactive multimedia applications in learning will improve the efficiency, motivation, thinking and logic abilities and facilitate the active learning, experimental, consistent learning, with student-centered learning. The benefits are as follows: the learning process is more interesting, more

interactive, the amount of teaching time can be reduced, the quality of student learning can be improved and the learning process can be done anywhere and anytime (Wiana, W., Barliana, S., Riyanto, A., 2018). Although interactivity is a widely used term in discussions of multimedia learning, a preliminary look at the literature proves that the definition and the benefits of interactivity are not clear. Some authors have tried to clarify the concept of interactivity and what factors need to be taken into account in the design of interactive systems and to present a unifying model including the user, the learning environment, and a system of connections and concepts that together make up interactivity. Such a model can help inform research, discussion, and design decisions on interactive multimedia instruction (Heidig, S., Schwartz, R. N., Plass, J. L., 2010).

EXPOSITION

Some tools for designing interactive and multimedia systems are considered in the paper. A bilingual interactive and multimedia application has been developed in English and Spanish, the two most widely spoken foreign languages in the world. The application allows students to learn the basic concepts of Boolean algebra, minimization with Karnaugh maps and basic functional units of combinational type. The application covers various types of testing exercises. It will be used in the educational process in the courses “Pulse and Digital Devices”, “Impulse and Digital Circuits”, “Digital Circuits” and “Synthesis and Analysis of Logic Circuits” for the bachelors in the specialties “Internet and Multimedia Communications”, “Information and Communication Technologies”, “Computer Control and Automation”, “Electronics” and Computer Systems and Technologies” in the University of Ruse “Angel Kanchev”.

Functions of LearningApps.org

LearningApps.org is a Web 2.0 application, intended for supporting learning and teaching processes using small interactive modules. These modules can be used directly in learning materials as well as for self-studying. The aim is to collect reusable building blocks, called Apps, and make them available to everyone. The Apps include no specific framework or learning scenario. Therefore, they are not suitable as complete lessons or tasks, but they must be embedded in an appropriate teaching scenario (<https://learningapps.org>).

The most important functions of LearningApps.org are explained below.

To search the Apps collection you can enter keywords (Fig. 1, Block 1). To go to the overview page for knowing what Apps are already available you can click “Browse Apps” (Fig. 1, Block 2). You can create your own Apps using different templates by clicking “Create App” (Fig. 1, Block 3). To use all the possibilities of LearningApps.org you may create a free account that allows you to save your created Apps. You can sign up at LearningApps.org (Fig. 1, Block 4) using your account. You can change the language for the interface of the application (Fig. 1, Block 5) – for example,  English,  Spanish,  German,  French,  Italian,  Russian,  Polish,  Bulgarian, etc.

By clicking “Browse Apps” (Fig. 1, Block 2) you can look at the overview page of all the Apps in more detail (Fig. 2). The category “All categories” is visualized (Fig. 2, Block 1). Each App is shown with a small thumbnail (Fig. 2, Block 2). You can select a category (Fig. 2, Block 1) to filter the Apps by subject. For example, a category “Engineering” (Fig. 3, Block 1) is selected and only corresponding Apps are displayed (Fig. 3), and you can filter by language and school level (Fig. 3, Block 2) – Elementary level, Primary school, Secondary education, High school, Vocational and further education. If you click on an App, the detail page will show up. For example, this is an App about Design Triggers (Fig. 4, Block 1) where the design triggers need to be assigned to their definitions (Fig. 4, Block 2). Each app can be used as a template for a new custom App (Fig. 4, Block 3). You can remove pictures in this example and add new ones. To find this App later you can save it to your account (Fig. 4, Block 4). You will find several links for copying and sharing and in addition, you can embed your App into other websites (Fig. 4, Block 5).

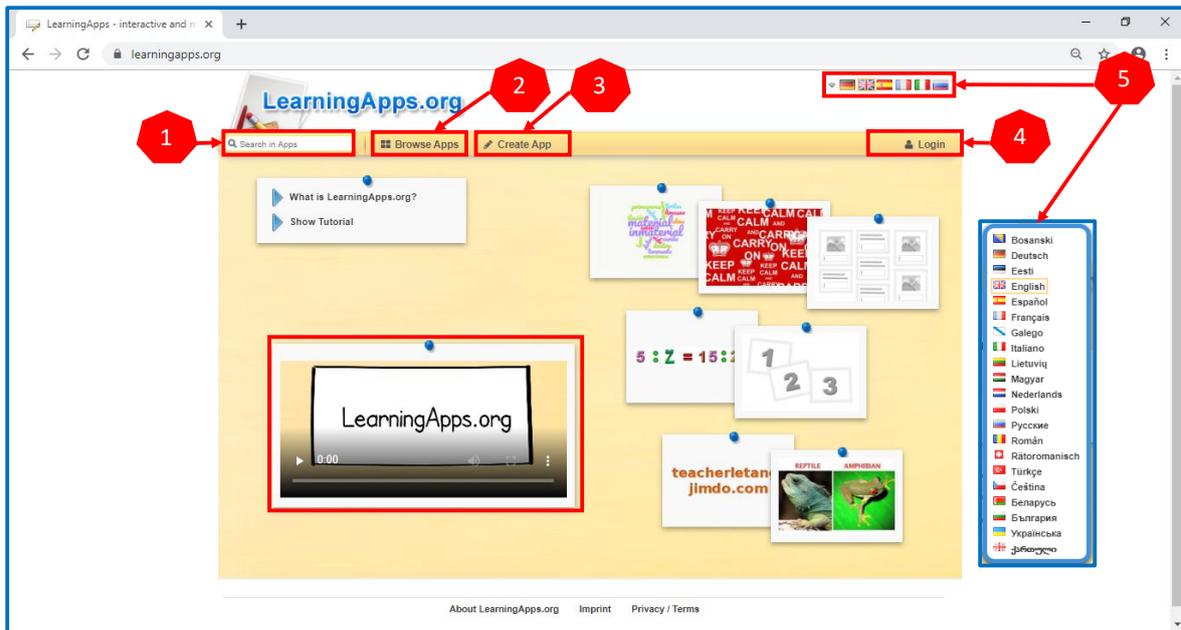


Fig. 1. Main functions of LearningApps.org

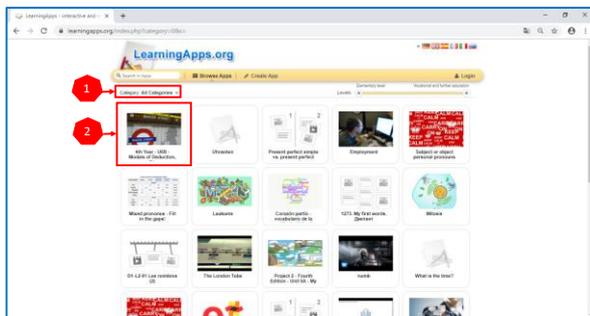


Fig. 2. Browsing Apps in LearningApps.org



Fig. 3. Choosing a category and a level in LearningApps.org

By clicking “Create App” (Fig. 1, Block 3), you can either use existing Apps as a template or you can use empty templates (Fig. 5). Templates are also shown with a small preview (Fig. 5, Block 1).

When selecting one of the templates, for example, Matching Pairs, you can have a look at examples created with this template (Fig. 6, Block 1). By clicking “Create new App” (Fig. 6, Block 2) the selected template will be used for creating the new App. With this template you can create matching exercises. Each template has different settings you can adjust in the form shown in Fig. 7. At the beginning of each form you can specify a title (Fig. 7, Block 1) and a task description (Fig. 7, Block 2). The following settings are specific for each template (Fig. 7, Block 3). After making the changes for creating the new App, you may click on “Finish editing and show preview” (Fig. 7, Block 4) at the end of the form. Afterwards you can customize the App again, or save it to your App collection.

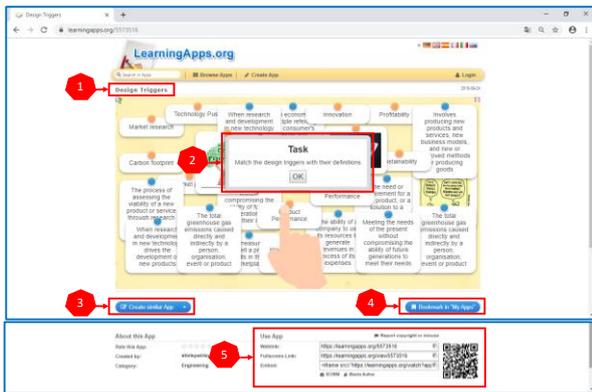


Fig. 4. Choosing an App, creating similar App and bookmark in “My Apps”

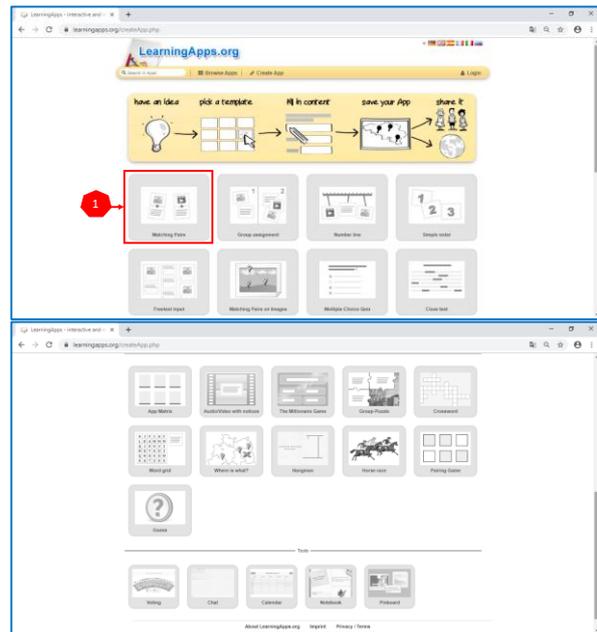


Fig. 5. Creating Apps using templates



Fig. 6. Creating Apps using the template for Matching Pairs

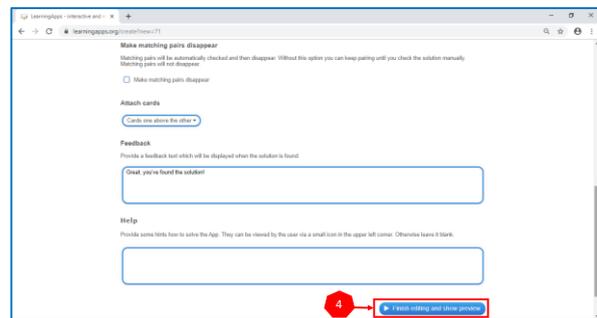
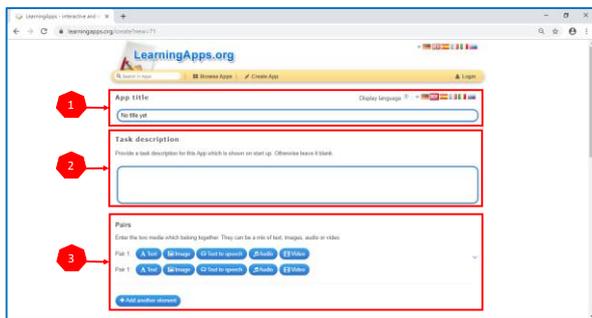


Fig. 7. Creating Apps using templates

Developing a bilingual interactive and multimedia application in English and Spanish

For the purposes of the courses “Pulse and Digital Devices”, “Impulse and Digital Circuits”, “Synthesis and Analysis of Logic Circuits” and “Digital Circuits”, for the bachelors in the specialties “Internet and Multimedia Communications”, “Information and Communication Technologies”, “Computer Control and Automation“, “Electronics” and “Computer Systems and Technologies” in the University of Ruse “Angel Kanchev” a bilingual interactive and multimedia application has been developed in English and Spanish, the two most widely spoken foreign languages in the world. The application allows students to learn the basic concepts of Boolean algebra, minimization with Karnaugh maps, as well as basic functional units of combinational type, such as code converters, decoders and encoders, multiplexers and demultiplexers, arithmetic circuits for addition and subtraction, as well as digital comparators (Maini, A. K., 2007). The application covers various types of testing exercises, in the form of combining in pairs, crosswords, etc. The application is intended to be extended, covering more topics, devices and types of testing exercises, as well as more languages, for example Bulgarian.

The same types of exercises were developed in both languages (Spanish and English), but due to the limited pages of the paper, only a few exercises were given.

For studying the topics “Basic laws of Boolean algebra”, “Logic gates and their truth tables”, “Functional units of combinational type”, testing exercises were developed as the following templates were selected: “Matching Pairs”, “Group assignment” (Fig. 8, in English), “Multiple-Choice Quiz” (Fig. 9, in English), “Hangman” (Fig. 10, in English), “Pairing Game” (Fig. 11, in English), and “Horse race” (Fig. 12, in Spanish).

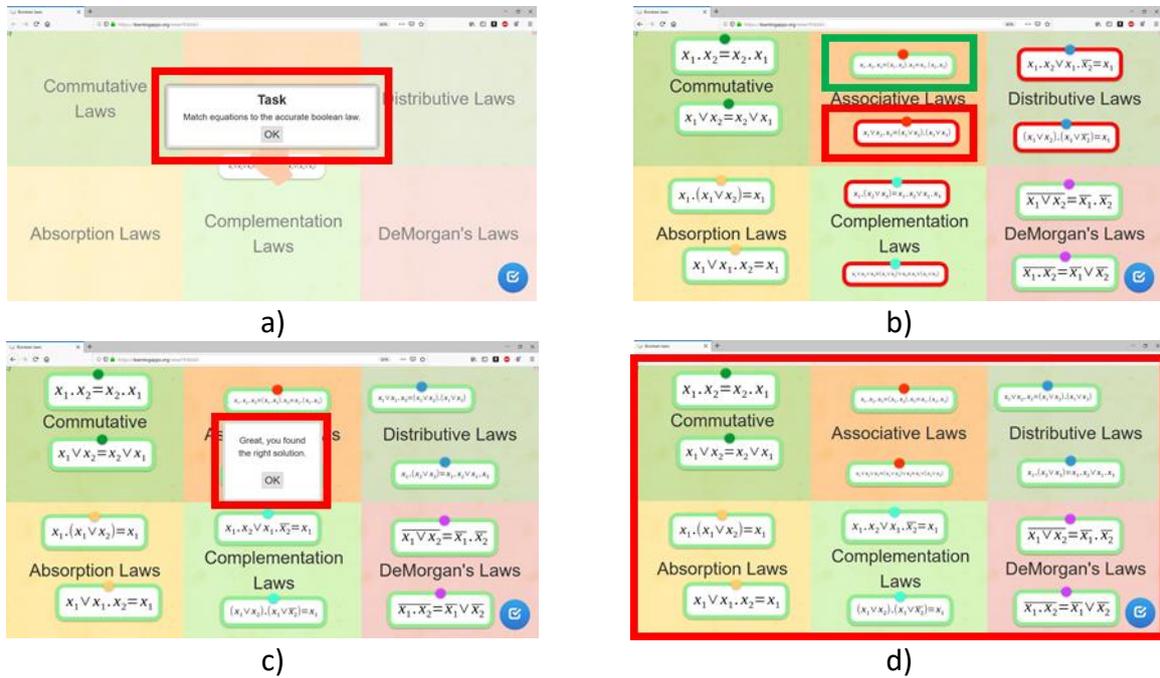


Fig. 8. Creating Apps using the template “Group Assignment” in English: a) formulation of the task; b) wrong choice (the red rectangle) and right choice (the green rectangle); c) greeting message after finishing the task; d) final solution – CORRECT

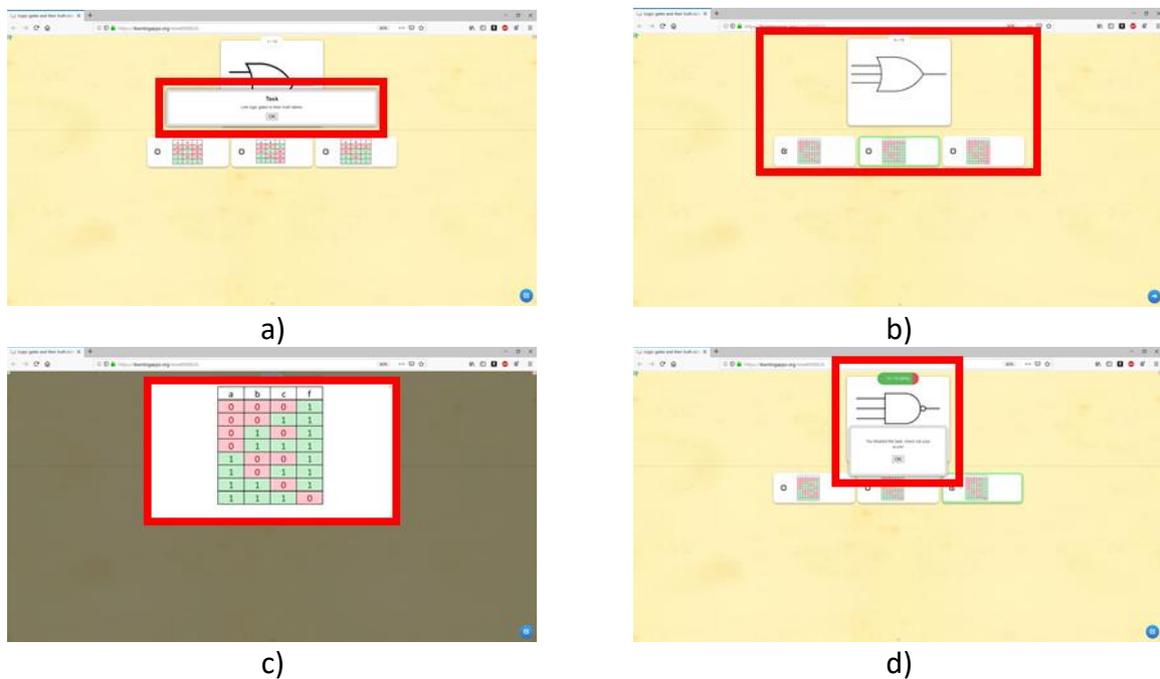


Fig. 9. Creating Apps using the template “Multiple-Choice Quiz” in English: a) formulation of the task; b) making choice; c) enlarging the image of the question or the answer (in this case, the answer – the truth table); d) greeting message after finishing the task and percentage of correct answers from the total number

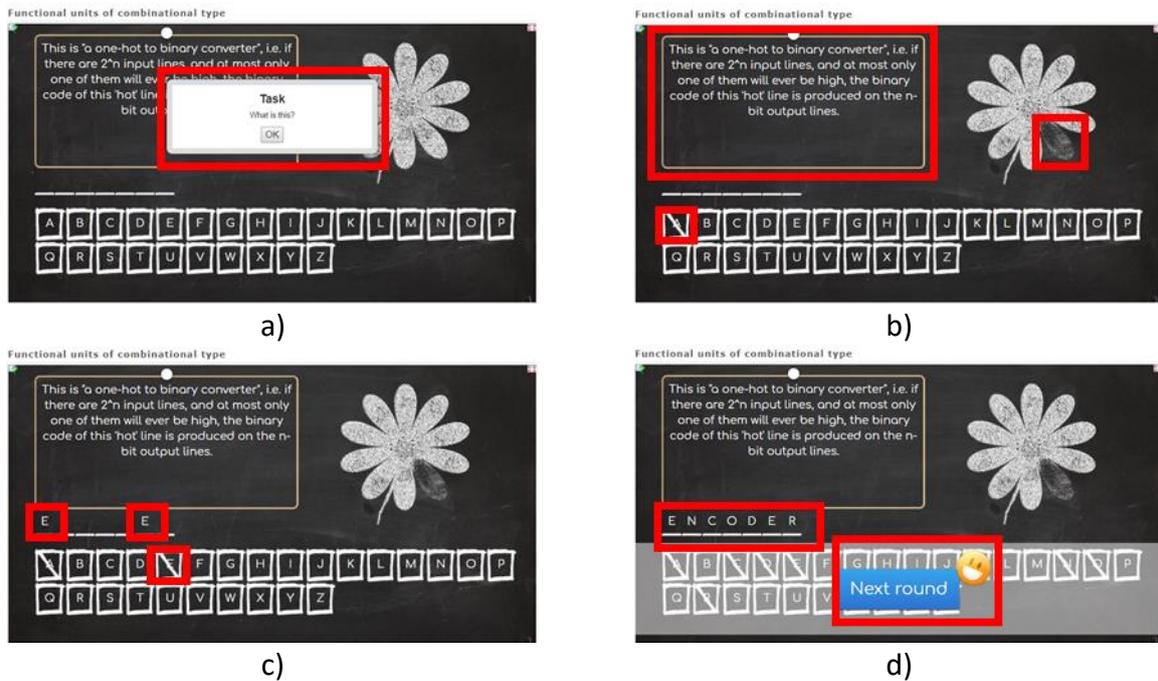


Fig. 10. Creating Apps using the template “Handman” in English: a) formulation of the task; b) wrong choice (the letter A is missing); c) right choice (the letter E is not missing); d) final solution – CORRECT

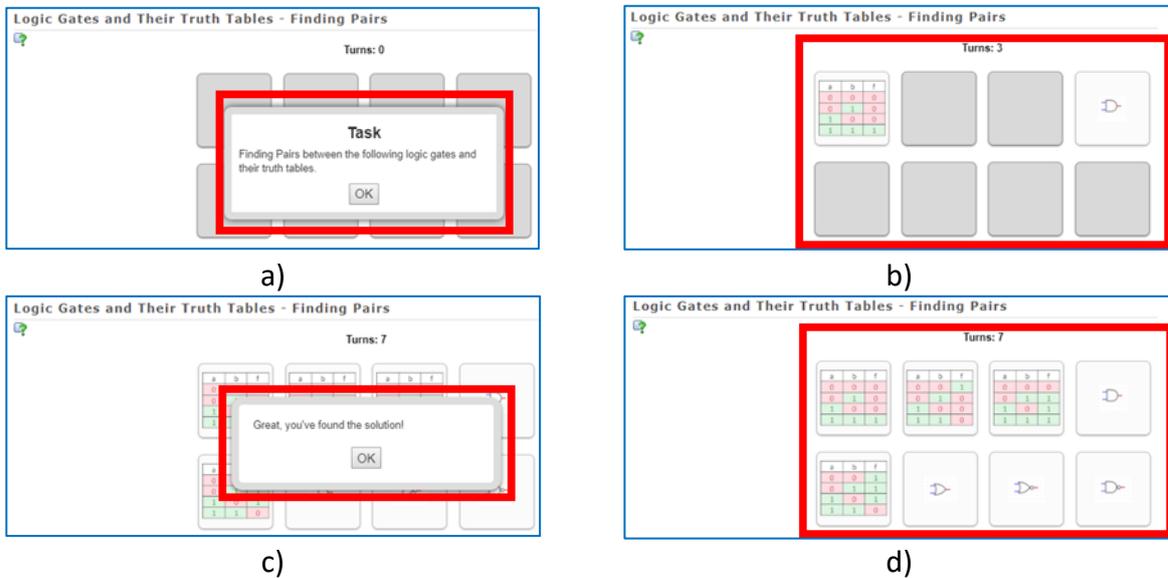


Fig. 11. Creating Apps using the template “Pairing Game” in English: a) formulation of the task; b) partial solution (finding one pair after three turns); c) greeting message after finding all the pairs; d) final solution – CORRECT (finding four pairs after seven turns)

The test, built through the template “Horse race”, contains questions of different nature. This test checks the students’ knowledge on the topics of logic gates and their truth tables, Karnaugh maps, as well as functional units of combinational type, such as encoders, decoders, code converters, etc. The different types of questions as well as the correct answers are shown in Fig. 13 a and Fig. 13 b.

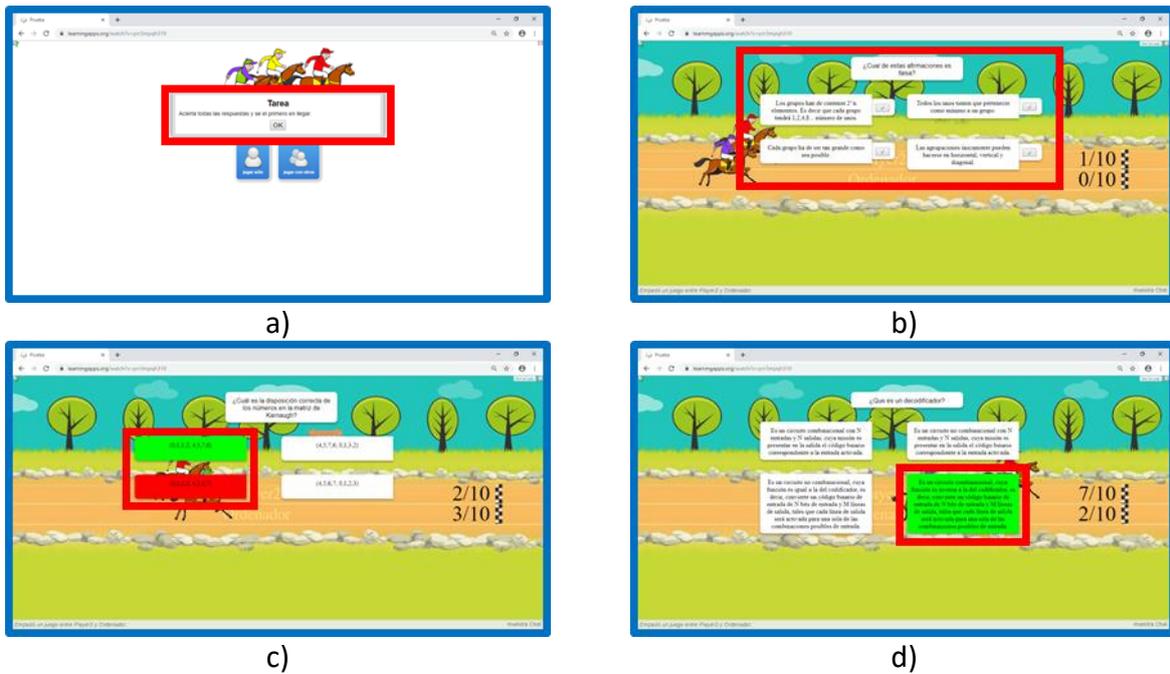


Fig. 12. Creating Apps using the template “Horse race” in Spanish: a) formulation of the task; b) formulating the question with four options for answers (one correct and three wrong answers); c) wrong choice (marked with a rectangle in red with the correct answer marked with a rectangle in green); d) right choice (marked with a rectangle in green)



Fig. 13 a .Different types of questions as well as the correct answers – part I

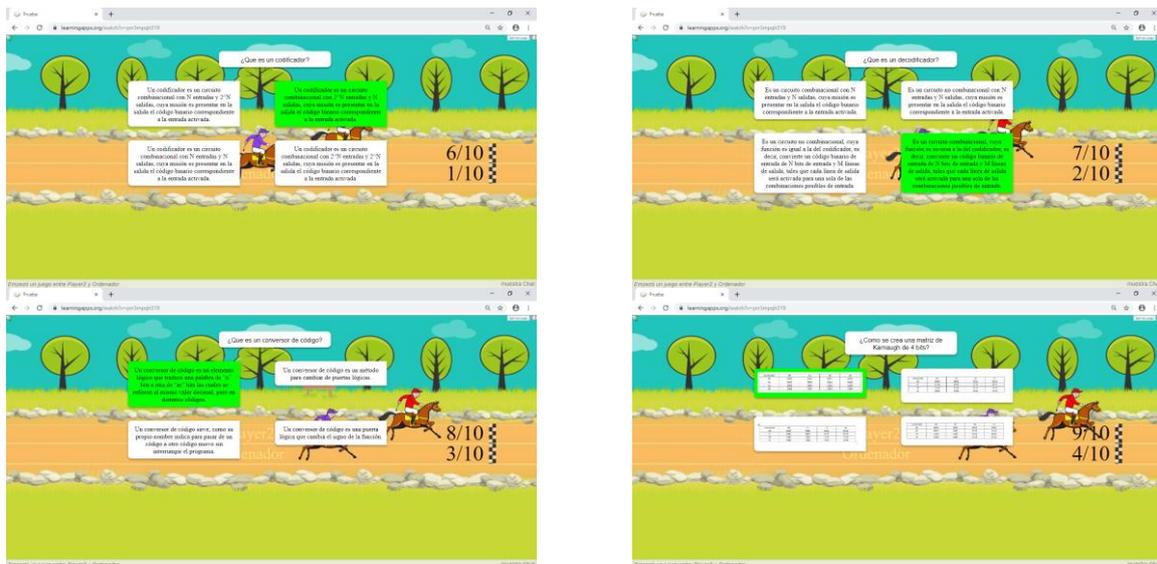


Fig. 13 b .Different types of questions as well as the correct answers – part II

CONCLUSION

The paper presents some tools for designing interactive and multimedia training systems used for attracting students' attention to the material studied in the universities. A bilingual interactive and multimedia application has been developed in English and Spanish. The application allows students to learn basic concepts of Boolean algebra, minimization with Karnaugh maps and combinational circuits. It covers various types of testing exercises, presented in the paper. The application will be used in the educational process in the courses "Pulse and Digital Devices", "Impulse and Digital Circuits", "Digital Circuits" and "Synthesis and Analysis of Logic Circuits" in the University of Ruse. The application is intended to be extended, covering more topics, devices, types of testing exercises, and languages.

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