Integration of remote lab exercises into standard course packages

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***Abstract*— We propose to integrate remote lab exercises into standard course packages. A standard course package consists in classroom sessions, exercise sessions and lab sessions, the whole completed by homework for following up and preparing the different sessions. Homework is crucial in the learning process and we have developed a dedicated platform integrating four levels of activities accompanying each lesson. The first level recalls the learning objectives and learning contents of each lesson. The corresponding exercises are proposed in a second level. An auto-evaluation can be done in a third level. Finally, lab exercises are proposed for each topic in the forth level. The whole is organised in a hierarchical tree structure for easy navigation and a good overview.**

***Index Terms*— hands-on laboratory experimentation, interactive learning, remote laboratories, practical lab courses**

I. INTRODUCTION

Web-accessible laboratory experiments emerged in the mid 1990s and are widely used because they provide students remote access to measurements with real equipment while making efficient use of resources [1]. The first order approach was the use of remote lab experiments as a replacement of existing lab sessions with the benefits of the 24 hours availability and the constraints of a fast and working Internet connection, which is, at the time being, standard for most countries. The next step was to integrate lab experiments into classroom lessons [2], which permits highlighting the specific behaviour of the circuits under investigation. Students are particularly captured and participate voluntarily defining the stimuli values to be applied to the circuit. The stimuli response given through real measurements challenge the students and their analysis helps definitely getting a deeper understanding of the phenomena. We propose now to go further and to integrate remote lab exercises into standard course packages. A standard course package consists in classroom sessions, exercise sessions and lab sessions, the whole completed by homework for following up and preparing the different sessions. Homework is crucial in the learning process and we have developed a dedicated platform integrating four levels of activities accompanying each lesson. The first level recalls the learning objectives and learning contents of each lesson. The corresponding exercises are proposed in a second level. An auto-evaluation can be done in a third level. Finally, lab exercises are proposed for each topic in the forth level. The whole is organised in a hierarchical tree structure for easy navigation and a good overview. The time the students need to accomplish the homework is about 30 to 60 minutes. Eleven different homework sessions have been realized.

II. IMPLEMENTATION

Figure 1 shows a screenshot of a typical webpage. The left window gives the course structure. For each course, a special sub window occurs on the right side, which is organised in the following way: On the upper part, the learning contents are recalled. This is done very synthetically; the student has to assist to each course to locate the different items. In no way it is intended that this tool may replace the classroom sessions. Below this part, on the left side a link gives access to exercises, some are in a multiple-choice form, other are in text form where calculations and circuit analysis are required. On the right side, a link gives access to the solutions of the former exercises letting perform an auto-evaluation. Finally, on the lower part remote lab exercises are added for deeper understanding and further in-depth illustration. This platform has been implemented in our remote lab environment (http://www.real-lab.org) and can be accessed with username “icml” and password “icml07” [3].Position figures and tables at the tops and bottoms of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be centered below the figures; table captions should be centered above. Avoid placing figures and tables before their first mention in the text. Use the abbreviation “Fig. 1,” even at the beginning of a sentence.

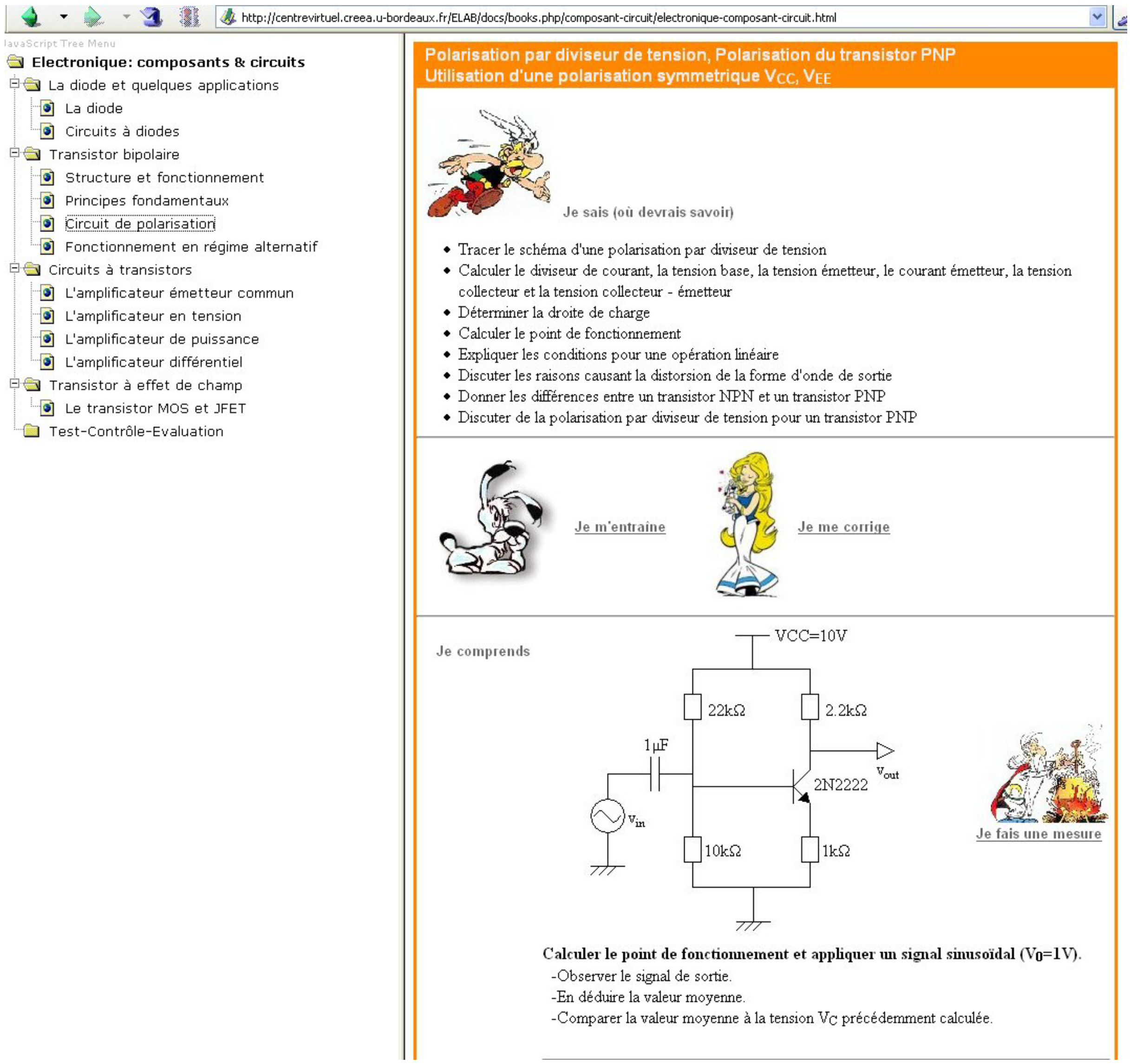

Figure 1. Fig. 1: View of a typical pedagogical page http://www.real-lab.org

III. DISCUSSION

This platform represents a benefit for standard course packages. The design has been done is such a way that it is attractive: a comic strip layout has been applied which corresponds to readings where students are very familiar with. The navigation through the web page is very easy. The design is modular and the reuse for related subjects is straightforward. The content is quite complete concerning the area "electronic devices and circuits", each classroom session has its complementary webpage where theoretical aspects and practical labs are mixed up. The learning program is progressive and students can adapt it to their personnel level. Auto-correction and auto-evaluation will help them to progress rapidly. This playful tool is very flexible and adaptive for mobile learning.

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