"TESTING RESISTANCE" Experiment Courseware based on FlashAR

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Abstract: Experiments play an important role in electrophysics learning. However, due to inaccessibility to equipment and safety risks, electrical experiments can only be conducted in schools. In this paper, we design and develop a novel "TESTING RESISTANCE" experiment courseware based on FlashAR, which can provide a direct interaction for learners who have a computer with a camera. Learners can control the wiper of the slide rheostat by moving the AR marker instead of the mouse or keyboard. Meanwhile, the real-time current and voltage values can be read on the virtual voltmeter and ammeter. The courseware also includes a problem-based learning method to encourage deeper understanding. It presents a real situation in daily life and guides learners to obtain related knowledge and finish the electronic report. Feedbacks are given to learners on whether they should go back to certain parts where they have made mistakes. After inviting a few experts and students to use it, we have already acquired some positive feedbacks showing that this courseware, which combines the virtual and the reality and enables natural interaction, effectively promotes learners' understanding and improves their interest and motivation in electrophysics learning.

Keywords: *Augmented Reality, Flash, electrical experiment, Problem-Based Learning*

1. Introduction

With laboratory means introduced perfectly, physics became an independent course. Thus experiments occupy an important position in physics. Nevertheless, in domestic environment of physical experiments in middle school, undeveloped equipment sometimes just can't match the requirement of accomplishing all teaching processes of the courses. Besides, due to inaccessibility to equipment and safety risks, the electrical experiments can only be conducted in school, tremendously limiting students' learning and exploration.

With an eye to this situation, we design and develop a novel "TESTING RESISTANCE" experiment courseware based on FlashAR. Under the guidance of courseware, students will learn all the related knowledge step by step, and have a perfect practice in the part of experiment by moving the AR marker freely and getting the needed data to finish the electronic report in real time.

We referenced a lot of pioneers' work, including some researches and studies applying AR in science experiments abroad. Almost uniquely, under the guidance of thorough instruction design, we choose FlashAR coding the core part, the experiment.

2. Methods

Before development, analysis of teaching materials has been done to get the conclusion of teaching contents and goals. With the help of expert physic teachers, the key and difficult parts have also been confirmed. The courseware is divided into four parts. Students will be given a related problem in daily life firstly, which, as a question-based part, can arouse the interest of learners. In the second part, students will learn the fundamental knowledge and get some immediate tests. After doing experiment and analyzing data in the third part, the courseware will offer students a test, and give them appropriate feedbacks if they make mistakes in specific parts, which including asking students to go back and consolidate relevant knowledge. To encourage students, the bulb on the left side will light up little by little, every time they finish one part of study. (Figure 1)

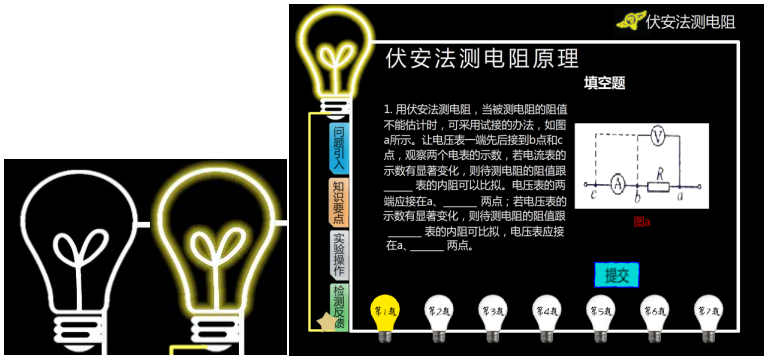

Figure 1: Bulb light up after every part of study finished

In the AR experiment part, all the instruments are 3D modeling by 3ds MAX. With Flash 3D and PV3D, the courseware achieves the interaction function. And the combination of 3D model and augmented reality with Flartoolkit finally form final virtual teaching tool. We have tested the program for several times to adjust the identification and enhance the robust and humanity of it.

Flash can easily combine four kinds of media elements: text, image, sound and video, being an excellent courseware tool for its convenience to take advantage of multimedia. Meanwhile, Flash is a browser-based application, whose player, named Flash player, has a share of more than 97% in the market. Such a fairly broad popularity ensures that the users do not need to install complex software plug-ins. The integration of AR brings a leap to natural interaction, benefiting the users' possession of

better experience. Besides, the FlashAR based courseware provides a more real environment. Both of these will promote learners' learning experience, which has been confirmed in researches.

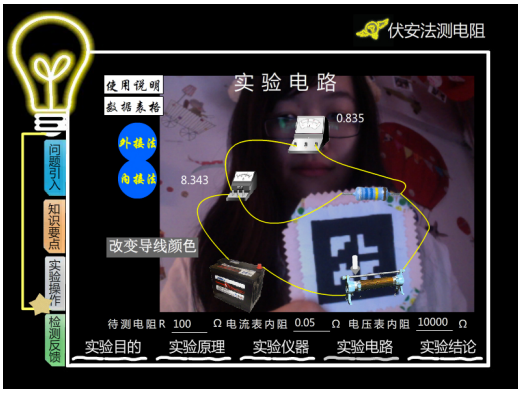

Figure 2: AR experiment-"TESTING RESISTANCE"

3. Discuss

The courseware aims to provide students adequate support to understand and experience step by step. Based on the existing parts, it will certainly be better to have more friendly supports. For example, a virtual study partner can guide students better. And the test part will be more efficient if the questions are better designed.

Also, in the AR experiment part, more tests are waiting to be done as the location of 3D model easily affected by many factors, such as: the angle of the camera, the orientation of the marker, even the light of experimental environment. More accurate and more realistic location control will greatly enhance the users' experience.

4. Conclusions

The courseware presents a real situation in daily life. Direct interaction and problem-based learning method are embodied everywhere. With the help of real-time data in AR experiment and feedbacks based on thorough instruction design, students can not only do self-learning outside school, but also gain better experience and deeper understanding.

After inviting a few experts to use and evaluate the courseware, we have already acquired some positive feedbacks showing that the courseware effectively promotes learners' understanding and improves both their interest and motivation in learning "TESTING RESISTANCE" experiment. An empirical research is looking forward to be conducted in the future. Further attempt in generalization of FlashAR in the teaching and learning of the whole electrophysics, and even of other subjects is expected.

Reference

Mannus, F., Rubel, J., Wagner, C., Bingel, F., & Hinkenjann, A. (2011). Augmenting magnetic field lines for school experiments. In *Mixed and Augmented Reality (ISMAR), on 10th IEEE International Symposium*. 263-264.

Matsutomo, S., Miyauchi, T., Noguchi, S., & Yamashita, H. (2012). Real-time visualization system of magnetic field utilizing augmented reality technology for education. *Magnetics, IEEE Transactions on*, *48*(2), 531-534.

孙伯耳. (2010). Flash 课件在物理实验教学中的应用. *实验科学与技术*, *8*(005), 49-50.