The Improvement of Experimental Teaching Method of "The Use of Oscilloscopes"

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***Abstract*—The physics experiment "The Use of Oscilloscopes" is one of the compulsory experiments in the ordinary college departments of sciences. In order to solve the phenomenon that it is difficult for students to grasp the oscilloscope, in this paper, the simulation software for producing experimental preview is developed, and the conditions of preparation of physical experiment course are also improved; the experimental teaching mode is reformed, and students' interest in learning is also stimulated, so the teaching effect of physics experiment course is improved.**

Keywords-oscilloscope; experimental preview; experiment teaching

I. INTRODUCTION

The oscilloscope is an electronic measuring instrument, which can directly observe the voltage waveform, and be able to observe the quantity of electricity that can be converted into a voltage signal and the non-electrical quantity [1-2]. The oscilloscope has been successfully used in experiment, engineering and technology and so on. So, this experiment "The Use of Oscilloscopes" is one of the compulsory experiments in the ordinary college departments of sciences. But the authors find that, in the process of teaching, a lot of students do not complete the experiment, and even coming to an end in the classroom, some of the students know very little experimental principle, and can not be independent of the operating instrument [3]. Through the analysis of these phenomena, as well as communication with students, we found that some reasons: firstly, the working principle of oscilloscope is hard to understand; secondly, more knobs on the control panel, whose function is complex; thirdly, the instrument of the oscilloscope can not be brought out the laboratory after class.

To solve the above phenomenon that it is difficult for students to grasp the oscilloscope, in this paper, the simulation software for producing experimental preview is developed, and the conditions of preparation of physical experiment course are also improved; the experimental teaching mode is reformed, and students' interest in learning is also stimulated, so the teaching effect of physics experiment course is improved.

II. THE DEVELOPMENT AND PRODUCTION OF PREP SOFTWARE TO IMPROVE THE PRELAB ENTHUSIASM OF STUDENTS AND EFFECTIVENESS OF THE PRELAB

Preparing lessons before class is the important start and an integral part of physics experiment. In order to enable students to make full use of the limited class time to complete the experimental task quality, the prelab before class of students is not only very important but also very necessary. The preview effect a direct impact on the implementation of the experiment and the realization of the purpose [4-5]. But we found that the preview effect of students is far from ideal, and the main reason for this phenomenon is caused by the preview environment that does not provide students with the necessary rehearsal conditions. In general, physics experiment course preview process of students is to look at textbooks and to see the process of the guide book. It is difficult for freshman to learn the incomprehensible principle, complicated content, and unfamiliar instrument of the instructions. Although students can be asked to write prelab report, but they usually copy books directly, so this leads to an ineffective preview of the physics experiment. The best way to solve the problem of physics experimental preview is to let the students to preview, communicate and discuss with teacher on the spot. But, because of the large number of college students, limited laboratory and experimental equipment, fewer instructor, and serious shortage of experimental teaching resources, this kind of preview is difficult to implement. How to solve the contradictions between the shortage of teaching resources and the improvement of student's prelab effect, while at the same time to improve the students' interest in the prelab?

Figure 1. Simulation picture of instrument in software

In order to solve the problem mentioned above, we develop and produce the simulation software for experimental preview. By means of FlASH software, the preview software is a designed virtual oscilloscope according to the actual oscilloscope. We take pictures of all instruments related to this physics experiment. From the FLASH

technology, the preview software gives the students a very intuitive feeling, just like the real instrument (See Figure 1).

The preview software is composed of the purpose of experiment, the principle of experiment, the introduction of instrument, performance demonstration, and announcements.

The purpose of experiment The purpose of the experiment and data processing requirements are described by concise text. During the simulation process, it can help students to understand the purpose of experiment.

The principle of experiment Delete the large segment of narrative used to describe the principle of experiment in textbooks, which are boring, abstract, and indecipherable and switch to animation to performance, which is vivid and easy-to-understand.

The introduction of instrument The level of understanding of the experimental apparatus, directly determine the good and bad effects of the experiment. In the preview software, we use the real photos of oscilloscope and signal generator involved in the experiment, and they are handled by the hot zone detection technology in the FLASH software. This not only makes operating knobs of preview software are entirely consistent with buttons on the instrument panel with real oscilloscope, but also achieves the function that the corresponding mouse clicks instrument knob to display the corresponding knobs name, function introduction and the use and effect of clicking the knob. Students can click on an "effect" button (See Figure 2), ant then they can see the display of adjusting effect (See Figure 3). Students can observe the changes in the waveform by adjusting the knob on the oscilloscope physical map. For example, by adjusting the "y gain knob", they can see the waveform amplitude changes; by adjusting the "scanning knob", they can see the changes in the number of complete waveform displayed on the screen; by adjusting "the position knob", they can observe the waveform change in the vertical or horizontal position. By personal clicking operation, students can also observe the experimental phenomena, and enhance the awareness and understanding of the experimental content. This not only makes the students a comprehensive understanding of the instrument, narrowing the distance between the preview to experiment, but also stimulates students' interest in learning, and mobilize the enthusiasm of students' learning.

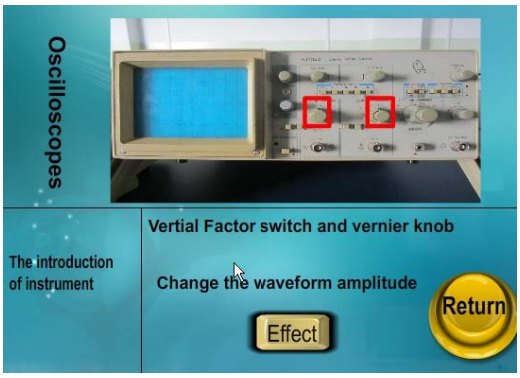

Figure 2. Simulation picture of instrument in software

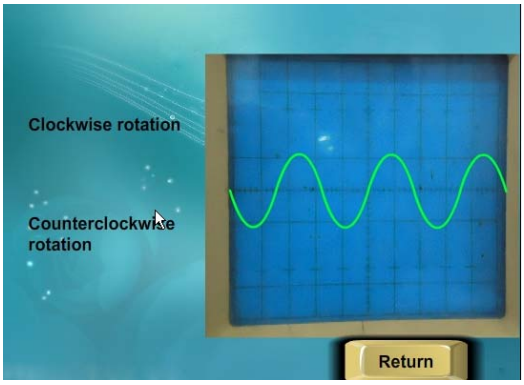

Figure 3. Display of adjusting effect

Performance Demonstration According to the experimental content, this function of the preview software prompts learners to control the animation play of each step, instruments learners simulation process, and fully embodies the main role of the learner.

Announcements Using clear and concise text prompts that students should pay attention to the problem of debugging instruments and experimental procedures.

The prep software simulates the interactive features of the complex oscilloscope operation panel knobs and buttons with a simple block diagram and plays an active and important role in experimental teaching demonstration. Students can not subject to the restrictions of time and space, just like in the operation of real oscilloscope, and they can simulate operations and preview oscilloscope experiment before class. The successful application of preview software, makes the prelab effect and students' interest in experiments be significantly improved.

III. IMPROVE PHYSICS EXPERIMENT TEACHING MODE

A. Adding the two links of "Demonstration experiment" and "Discussion", deepen understanding and mastery of the experimental principle

When students come into laboratory, teachers are not in a hurry to explain the experimental principle to students and let them do experiment, but use the new process consists of experiment phenomena demo, raising some questions, students' discussion and guiding the analysis to solve the problem. Combined with preview software, this new teaching mode can inspire students' learning initiative and enthusiasm, change the way that students learn, and increase students' interest in the experiment.

When explain the principle of oscilloscope, first, we demonstrate "fault waveform ", and ask students to think about the following questions:

1. The measured signal is a voltage signal changing with the form of sine function, but what is displayed on the screen is a vertical line. What is the reason about that?

2. Why is the waveform displayed in the oscilloscope unstable? Why is the waveform displayed in the oscilloscope always running?

The given problems can activate students' thinking and discussion, and students may draw their own answers according to the preview. Then teachers can guide and analyze the mentioned problem, give the correct answers of those problems, and analyze the oscilloscope principle by means of animation at the same time. This not only allows students a profound understanding on the principle of oscilloscope, but also makes students take the initiative to identify problems in the process of debugging instrument and solve these problems. When introduce the X-Y working mode, firstly, we let the students plus a sine wave in the X channel, and plus a square wave or triangular wave in the Y channel at the same time; secondly, we ask the students to observe the waveform on the phosphor screen and compare it with the Lissajous in the textbook; finally, let the students discuss the reason why there is difference between those waveforms, and this can deepen the students' understanding of the X-Y working mode. Based on the above steps, we let the students plus, respectively, the sine wave in the X, Y channels, observe Lissajous, deeply understand their synthesis principle, and determine the frequency of the signal to be measured based on Lissajous.

This learning method is not only to make the students familiar with the oscilloscope, but also make they know experimental phenomena changing with the change of the experimental conditions, and so cultivate their rigorous experimental attitude.

There are some advantages of the reform of teaching methods: the first one is that it can check students' preview; the second one is that it can enhance the students understanding and master of the oscilloscope principle; the third one is that it can stimulate students' curiosity and make them be interested in the experiment.

B. Modular introduced knob function

Degree of familiarity with the function of the instrument knob determines the good and bad effects of the experimental. Functions and operations of oscilloscope, itself has a certain degree of complexity. When we introduce the functions of instrument, we often explain the functions of switch knobs of oscilloscope one by one, and then let the students debug instrument. But, because there are many switch knobs of the oscilloscope, and some of them have complex functions, it is difficult for students to remember the function of each switch knob after the explanation of teacher. When the students debug instrument themselves, some of them do not know how to do it. One reason of this situation is that during the specific debugging waveform process, there may be some relationships between some switches, and so, there will be a switch or knob no regulation in place, and this leads to an inaccurate waveform or an unmeasured waveform. So, when students debug instrument, teacher explains and adjusts switch according to the phenomenon at the same time. For example, when the students meet the problem that "there is an input of signal at the CH1 channel / CH2 channel, but the screen did not display the measured signal waveform", there may be some common reasons as follows: 1. The position of position knob is not fit; 2. The position of brightness knob is not fit; 3. In vertical mode, choose the wrong selection switch; 4. In coupling mode, do not choose the AC/DC, and so on. The teachers analyze reasons to explain the function of each knob, and explain and debug the associated function knob together. This kind of function introduction of instrument makes it easier for students to grasp the knob functions and understand the intrinsic link between each switch knob. Students make their own adjustments instrument quick and smooth, the waveform is also handled very well.

The two adding links, "Demonstration experiment" and "Discussion", stimulate the students' interest to do experiments, and improve the students' learning initiative; "Modular introduced knob function" enable students to master the debugging and application of the instrument quickly, and improve the ability of the students' operation and the ability of analysis of experimental phenomena.

IV. SUMMARY

"The Use of Oscilloscopes" is an important physics experiment. How to make students understand the principle of oscilloscope, skillfully use a variety of oscilloscope, and improve the teaching effect of this experiment is one issue that is worthy of discussion. To solve the phenomenon that it is difficult for students to grasp the oscilloscope, in this paper, the simulation software for producing experimental preview is developed, and the conditions of preparation of physical experiment course are also improved; the experimental teaching mode is reformed, and students' interest in learning is also stimulated, so the teaching effect of physics experiment course is improved.

ACKNOWLEDGMENT

This research has been supported by the Teaching and Research projects of University of Jinan (Nos. J1248 and BMKC11015).

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