Teaching reform of Analog Electronic Technology Experiment Course under the Background of Artificial Intelligence

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Abstract: This paper briefly describes the implementation of the "multi-level" experimental teaching mode of "combination of hardware and software" and "combination of online and offline" in the experimental course of Analog Electronic Technology, and carries out the experimental teaching reform by combining the problem-oriented teaching mode. It has proved that the reconstructed experimental teaching system has effectively stimulated students' interest in learning, and the teaching effect has been significantly improved.

Keyword: Experimental teaching; Double virtual and double real, problem-based learning (PBL); teaching mode; multi-level.

1. Introduction

"Double virtual and double real" teaching mode refers to the use of artificial intelligence technology to bring the real with the virtual and discuss the virtual on the basis of the real. Through the application of "double virtual", that is, virtual simulation software and virtual reality platform, to restore the real engineering scene, combined with "double real", that is, actual engineering cases and physical equipment operation, guided by engineering projects, work-study combination, industry-education integration, to support the teaching objectives.

At present, many foreign universities have begun to implement the exploration of "double virtual and double real" in engineering teaching (especially in, Engineering Electronics, Computing and Control majors). In the stage of in-class experiment and graduation design, on the one hand, the school uses the entity equipment platform to carry out experiments. On the other hand, with the help of virtual software and virtual reality platforms, it simplifies complex problems, instantiates abstract problems, and makes static problems dynamic, so as to make up for the lack of students' understanding ability and less practical operation. In the major of Telecommunication, most courses have the conditions to set up "double virtual and double real" teaching, such as analog circuit, digital circuit, electrical and electronic, single chip microcomputer, embedded system, FPGA, EDA, computer network, EDA and so on[1,2]. At present, Tsinghua University, Shenzhen University, Huazhong University of Science and Technology and other well-known universities are exploring the introduction of "double virtual and double real" teaching mode into the teaching of analog circuit, digital circuit, switching power supply and single chip microcomputer [3,4].

In this paper, the experimental teaching of analog electronic technology has been investigated, and the exploration of "double virtual and double real" teaching mode was carried out among sophomores majoring in electronic information engineering. Combined with PBL experimental teaching method and equipped with corresponding auxiliary measures [5-7], a set of practical and feasible teaching strategies are provided for the experimental teaching reform of analog electronic technology in telecommunication specialty.

2. The current situation of experimental teaching of Analog Electronic Technology.

According to the analysis of the experimental teaching data of electronic technology over the years, the students of non-electrical majors do not have a deep understanding of the basic concepts of electronic technology, are not familiar with the basic circuit principles, are not flexible enough in the application of basic methods, and are not standardized in the experimental operation skills. The reasons for the above phenomena are mainly reflected in the following three aspects.

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1) Teachers and students pay less attention to it.
Because the experimental content involves many knowledge points and the class hours are limited, the non-electrical professional experiments are mainly explained by teachers, and the students operate step by step according to the experimental steps, so the experimental initiative is poor. In addition, there is a big difference in students' mastery of the knowledge points. In the experimental operation, some students fail to fully understand the circuit principle and usually do things perfunctorily. The above situation seriously violates the original intention of cultivating students' innovative thinking ability through experiments.
2) The experimental content lacks systematisms.
Most of the experiments are confirmatory experiments, which mainly verify theoretical knowledge points or classical circuits, lack of interest and challenge, cannot mobilize the enthusiasm of students to participate in the experiment, the experimental process seems to be understood, and cannot associate specific circuits with physical phenomena. However, the number of design experimental projects is small and the difficulty varies greatly, which makes it difficult for some students to cope with, leading to their fear and resistance to experimental courses.
3) Single assessment method
The experimental examination is mainly based on the experimental report, which includes the experimental principle (including circuit diagram), experimental content and steps, and experimental data processing. The attitude of students towards the experimental report is not correct enough, and they lack the analysis, explanation, reasonable inference and general introduction of the experimental results. It can not truly reflect the students' mastery of the experimental content, and it is not conducive to stimulate the enthusiasm of students to participate in the experiment.
In view of the problems existing in the experimental teaching of analog electronic technology in telecommunications specialty, combined with years of practice and thinking in the experimental teaching of analog electronic technology, without changing the objective experimental conditions, this paper puts forward the teaching scheme of combining the double virtual and double real curriculum system with PBL teaching mode, in order to mobilize the enthusiasm of students, stimulate their interest, and promote the interaction between teachers and students. Improve the effect of experimental teaching.

3. The establishment of double virtual and double real curriculum system.

With the help of artificial intelligence technology, the curriculum system of double virtual and double real was built. Double virtual refers to virtual simulation software and virtual reality platform; double real refers to actual equipment operation and actual engineering cases. Through the application of virtual simulation software and virtual reality platform to restore the real engineering scene, combined with the actual engineering case and laboratory equipment operation, guided by the engineering project, the combination of work and study, and the integration of production and education, the teaching objectives are jointly supported. The specific implementation contents are as follows:
1). Multimedia teaching resources.
According to the experimental content of each chapter, the corresponding micro-lessons, small videos or animations are produced, and the preview answer bank and homework in the form of breakthrough are established before class to enhance students' interest in learning, so as to meet the requirements of students' autonomous learning and online and offline learning.
2). Difficulty grading construction of curriculum resources.
For students with different learning abilities, tasks are assigned into stages and difficulties to meet the requirements of fragmented learning and in-depth learning.
3）. Open resource platform.
Strengthen the cooperation between teachers and students, schools and enterprises, build an international English teaching platform.
In addition, at the same time as the construction of the above curriculum system, a number of enterprises have jointly built training centers. Course teaching focuses on the combination of virtual simulation software and training equipment, the application of information technology breaks through the limitations of traditional classroom teaching, deepens students' understanding of equipment and grasp of the overall analog electronics, breaks the limitations that practical exercises can only be carried out in the training room, and truly realizes online and offline mixed teaching.

4. The combination of PBL experimental teaching.

In the PBL experimental teaching mode, the teaching method of "three questions and three answers" is adopted. That are, students preview and ask questions before class, the instructor summarizes the students' questions, and gives targeted explanations in class; the key questions that the experimental teacher asks the students to ignore in the preview; and the basic experimental content, and the students answer them by consulting the literature after class. The experimental teaching method of "three questions and three answers" not only deepens students' understanding of the experimental circuit principle, but also lays a good experimental ability for students. In order

to ensure the effective implementation of the teaching method of "three questions and three answers", the instructor divides the experimental teaching class into several experimental groups according to the students' mastery of the theoretical knowledge of electronic technology, and makes the proportion of "excellent, medium and poor" achievements of the members of each experimental group basically the same, so as to promote students in the classroom discussion of "three questions and three answers". Improve the quality of experimental teaching as a whole.

In order to ensure the effective implementation of PBL teaching, intelligent teaching tools are introduced into the preview, classroom and after-class exercises of experimental teaching to further improve the efficiency of students' experimental learning. The specific working ideas are as follows.

At first, the instructor releases preview tasks through online teaching software; part of the verification experiment content completes the experiment preview content through the remote experiment platform. During the preview process, relevant questions are raised and sent to the experiment instructor after being summarized by the class; For the design experiment, students are required to use Multisim simulation to verify the feasibility of the circuit design in advance, improve the efficiency of classroom learning, and reduce the damage of components and equipment caused by disoperation.

Secondly, Instructors use 5 to 10 minutes to publish preview test questions through online teaching software to examine students' experimental preview.

At last, with the help of the pocket laboratory, the content of the inquiry experiment can be completed, the orderly interaction between class and class can be realized, and the students' innovative consciousness and ability can be fully cultivated.

The examination of electronic technology experiment for telecommunication majors includes three parts: experiment preview, experiment operation and experiment data collation. Among them, the preview results mainly test the students' independent thinking ability; the practical operation results test the students' practical ability and the standardization and proficiency of instrument operation; the data collation part is the students' understanding of the circuit principle, which is designed by the students themselves according to the test requirements, to complete the test and analysis of the relevant data; The integrity, innovation and creativity of circuit function are examined by the score of circuit function and innovation and creativity.

5. Conclusion

The experimental teaching center undertakes the experimental teaching of electronic technology for electrical majors (including machinery, physics, building environment, materials, etc.), with a total of more than 200 students per semester. Taking the electronic information engineering major in the fall semester of 2022 as an example, the teaching effectiveness of experimental class and non-experimental class was compared and analyzed. The item score was 6.31 points higher than that of the non-experimental class, and the comprehensive evaluation score increased by 7.26 points accordingly. This also fully verifies that the teaching reform of electronic technology experiment for non-electrical majors has been recognized by the students in the experimental class, and has achieved certain teaching results.

So, through the comprehensive evaluation and analysis of the electronic technology teaching experimental class of telecommunication specialty, the experimental teaching reform, combined with the professional background, has improved the enthusiasm of students to participate in the experiment, trained the practical operation ability and innovation ability of students, and achieved good results in the experimental teaching reform. At the same time, it also puts forward higher requirements for experimental instructors. Teachers not only need insight into the problems existing in all aspects of experimental teaching, but also need to maintain the enthusiasm for exploration, understand the frontier scientific development of the subject, update the teaching content in time, and constantly tap their potential. There are still some problems to be solved in the process of reform.

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