Construction of Open Virtual Experimental Platform for Communication Engineering

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Abstract. This paper points out the current problems in experimental teaching of communication engineering major in universities, expounds the significance of introducing open virtual experiment platform into experimental teaching, studies and analyzes the functional characteristics of the virtual experimental platform, and proposes the experimental architecture based on virtual laboratory. It shows that combining the practice of communication experiment teaching, the virtual experiment platform is applied to the good effect of experiment teaching in class and extracurricular innovation.

Introduction

In recent years, with the continuous expansion of college enrollment, college enrollment has brought tremendous pressure on experimental teaching, resulting in insufficient teaching resources in colleges and universities. The development of communication technology and the increasing complexity of communication systems have made the traditional experimental teaching methods unable to meet the teaching requirements in the new situation and face the following problems.

1) Laboratory is difficult to achieve a real open.
Because the traditional experimental teaching of communication major relies mainly on the expensive experimental equipment of the hardware, the experimental teaching is limited by the conditions of time, place, manpower and material resources, so that the experimental teaching resources of the school cannot be fully and effectively utilized, which makes the laboratory unable to realize the real open [1].

2) Teaching goals is difficult to implement.
In the traditional experimental teaching session, students mainly conduct confirmatory experiments based on experimental instructions. Students cannot preview the theoretical and experimental equipment well before the experimental class, the teaching objectives are hard to achieve, and the design and innovative experiments are even more difficult to carry out [2].

3) Commonly used simulation software lacks authenticity.
Although Matlab and SystemView are excellent simulation modeling software, they have played a great role in the experimental teaching of Communication Engineering major of Harbin Institute of Technology at Weihai for many years. However, due to limitations of Matlab and SystemView, it cannot be separated from Matlab and SystemView integrated environment work, and the preparation of a graphical user interface is relatively weak, students use this simulation software to simulate the communication system, compared with the actual system is still different.

According to the current situation of experimental teaching in communication engineering and the lack of initiative and creativity of students, e-Labsim open virtual experiment platform is proposed to be introduced into the communication simulation experiment teaching, and an open virtual experiment platform for communication is established. At the same time, we try to make a modest connection between Matlab and e-Labsim platform in experimental teaching, break through the existing teaching mode, and explore an innovative talent training diversified experiment teaching reform mode.
Features of Open Virtual Experiment Platform

Experimental teaching is an important way to cultivate innovative talents. The "12th Five-year Plan" of Harbin Institute of Technology at Weihai clearly states: "Improve the practical teaching system, coordinate practical teaching resources both inside and outside the school, and promote the construction of experimental teaching resources sharing platform and laboratory opening ". In order to further deepen the reform of experimental teaching and improve students' ability of practice and innovation, according to the core of communication professional training mode, the open virtual experiment teaching platform of communication engineering is established which aims to strengthen student's ability of innovation and practice in experimental teaching culture. e-Labsim virtual experiment platform can provide experimental simulation of many courses, including communication principle, mobile communication and optical fiber communication. It mainly uses the technology of large-scale simulation software and the combination of timing simulation, CSDA network architecture and software framework, through the deployment of the user's server, you can achieve a good open experimental resources, to build up a learning and innovative design environment for students [3, 4]. e-Labsim can simulate the real experiment environment and provide operable virtual experiment instrument. Due to e-Labsim's unique "simulation nucleus" technology, e-Labsim can fully simulate the appearance and behavior of the hardware so that students can realize it from the simulation environment to the actual hardware environment "Seamless" switching, which should be unique to e-Labsim. E-Labsim virtual experimental platform functional layout is as shown in figure 1.

Due to more specialized communication courses, experimental classes are different; corresponding to the depth and difficulty of the experiment is also different. Therefore, in the process of building a virtual laboratory, we should consider the setting characteristics suitable for our communication experiment course, focusing on the overall realization of the communication system and the local principle of the design and performance improvement, taking into account the needs of students at different levels of foundation to provide a variety of experimental platform sexual. This determines the virtual laboratory should have the diversification of experimental subjects, experimental projects can be reorganized, and the platform structure should be open [5].

Figure 1. E-Labsim virtual experiment platform functional layout.
Construction of Experimental Architecture Based on Open Virtual Experiment Platform

After continuous exploration and practice of experimental teaching reform, combined with many years of experimental teaching experience and the functional characteristics of virtual laboratory, this paper proposes an experimental system consisting of four experimental levels: basic, comprehensive, design and innovation.

1) Basic Experiments

Emphasis on basic theory and basic skills training, is the basis for training innovative ability and practical ability. This type of experiment is a basic confirmatory experiment. The students configure, connect and debug the experimental equipment according to the component connection diagram and parameter settings given in the experimental instruction manual, and build the basic communication model to further understand the basic concepts and theories. Such as mobile communications in the "MSK modulation and coherent demodulation" experiment, the purpose is to understand the principles and characteristics of MSK modulation and demodulation, observe the characteristics of I, Q two baseband signals and the relationship between the input NRZ code, as well as I, Q two signal modulation and demodulation process of the signal changes. Based on the basic methods, basic knowledge and basic operation of experiment, students should gradually develop students' abilities to analyze and solve problems and lay a solid foundation for the open experimental teaching.

2) Comprehensive Experiments

This type of experiment is composed of a number of basic experiments designed to enable students to understand and master the connection between different communication system models to help students establish the concept of communication system. For example, "GSM communication system" experiment is to orthogonally modulate and demodulate the experimental module strings up, so that students establish GSM communication system to understand the composition and characteristics of the GSM communication system. Finally, the system setup and simulation on the virtual experiment platform are completed, and the changes of signals in various parts of the GSM communication system are observed.

4) Design Experiments

The first two types of experiments in the experimental instructions are given in the connection diagram and component settings, and design experiments only give the block diagram, students need to apply the basic knowledge of professional knowledge, design their own connection diagram, this part of the experiment mainly used in the students independent thinking, analysis, problem solving ability to further training. Such experimental mode is to ask students a question, which is not limited to the method of solving the problem. The students think and analyze the basic concepts and basic theories of the major by studying and put forward the design scheme and realize it, and get familiar with e-Labsim virtual experiment environment under the complex system design. Such as "PSK signal carrier recovery" experiment, students first need to check the information to find out what carrier extraction method, and then choose their own design, design component connection diagram, and design a related demodulation system as a test case to verify the design availability and correctness of carrier extraction methods.

5) Innovation Experiments

Because e-Labsim virtual experiment platform has a complete secondary development and innovative design module built-in, students can easily carry out innovative design. The function of student design can completely replace the original module of the system. To enhance students' interest in innovative practices, functional modules designed by students can also be validated in e-Labsim's system experiments. Since such experiments are aimed at talented outstanding students to help them further their training in innovation capability, they should be encouraged to innovate independently, put forward some challenging questions, participate in some domestic and foreign innovation competitions, apply for and complete innovations fund projects, such as college students innovation and entrepreneurship training programs and national college students innovative experimental programs.
Organization and Implementation of Open Virtual Experiment Platform

In view of the problems that e-Labsim virtual experiment platform may encounter in communication experiment teaching and how to combine in-class experiment and extra-curricular innovation activities in experiment teaching so as to achieve the best effect, according to many years of experimental teaching experience, combined with the characteristics of the virtual simulation platform, the following set of experimental teaching reform and innovation of the specific implementation plan is given.

1) Reform experimental content and ways to increase students’ interest

Through the reform of experimental contents and methods, students’ innovative ability and practical ability should be strengthened in experimental teaching based on the existing communication hardware experiment, supplemented by virtual simulation experiment platform. Its main purpose is to instruct students to do hardware experiment before, through the virtual experimental platform, using components to complete the modeling and simulation of the experimental system to verify the experimental results, to play a theoretical guidance for the next hardware experiment to avoid the blindness of the experiment. Encourage students to participate in the research and development of virtual labs, carry out autonomous learning activities under the guidance of teachers, conduct in-depth analysis of communication systems, continuously develop new components required, design corresponding experimental projects, enrich experimental teaching materials and encourage students to conduct research in the field of communication. And as an opportunity to organize students to participate in university students and other innovative fund projects and competitions and other activities for the training of a group of research spirit, innovative ability and broad vision of communications personnel to provide a platform.

2) Use a variety of teaching methods to assist teaching

Through the multimedia with the virtual simulation platform, with vivid images to explain intuitively, demonstrate the experiment in the classroom, can really combine the theory and practice, so that students understand the underlying principles of the course in a timely manner.

3) Take an open and interactive teaching to improve students’ practical ability

Through the virtual experiment simulation platform, students can login to the network experiment classroom anytime, anywhere to set up their own experiments so that each student has his own independent laboratory so as to achieve the purpose of opening up the laboratory. This experiment will no longer be subject to the constraints of time, place and other conditions, according to their own actual situation, choose to enter the virtual experiment scene or watch experimental demonstration. Difficult problems encountered may refer to the virtual platform prompts, or through the communication module to help teachers or students, the main task of teachers is to manage and guide students. After the experiment class, students can freely access to virtual experiment platform forum community exchange experiment experience through personal computer. The teacher answers the difficulties and encourages the students to design their own comprehensive experimental projects on the simulation platform to verify and give the necessary guidance in time. Students using virtual experiment simulation platform to learn, can improve the efficiency of the experiment. By innovating the development of experimental modules, students are encouraged to learn and experiment independently, and can avoid the low-level errors in hardware experiments to reduce the hardware loss.

4) Improve the experimental assessment methods, objective evaluation of experimental results

The experimental platform is equipped with a complete teaching management system. Through the teacher management side of the simulation system, the results of student experiments and the progress of subject experiments can be grasped in real time. Before the experiment, students preview the experiment through the simulation platform and submit the preview report. After the experiment, students submit the experimental data and experiment report through the platform. Teachers analyze the experimental data submitted by students and summarize the experimental report, review and rate.
Conclusion

Combining with the current situation of experimental teaching in communication engineering, the introduction of virtual experiment platform into experimental teaching not only aroused students' interest in studying professional courses, but also improved the quality of experimental teaching so as to make experimental arrangements more flexible and convenient without time and space constraints and reform the traditional experimental teaching a single model. Through the reform and practice of multi-level and Omni-directional laboratory opening up, the defects and shortcomings of experimental teaching in cultivating students' ability of practice and innovation are constantly improved, and the existing experimental teaching system is improved so that students can actively participate in scientific and technological innovation activities. Reached the purpose of improving and enhancing students' scientific research ability and innovative consciousness, and achieved initial success in cultivating students' practical ability and innovative ability.

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References


