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Application and Practice of Virtual Simulation Experiment in Experiment Teaching of Modern Power Supply Technology

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Abstract: In order to meet the needs of the development of new energy technology in China, to cultivate innovative and applied electrical engineering and automation professionals with professional competence as the goal, in accordance with the principle of "combining virtual and real, supplementing the real with virtuality", and relying on the safety of clean energy transmission is the entry point. The design, selection, and realization of professional-related power transmission schemes in the process of energy transmission and subway supply are selected, and simulation simulations such as power supply design and realization, reactive power compensation operations, and electric shock conditions are highly simulated, which effectively solves the problem. There are many restrictions on high-pressure experiments, it is difficult to effectively implement multiple design schemes, and the safety is poor, which effectively stimulates students' interest in learning, mobilizes students' initiative to participate in experimental teaching, and improves students' comprehensive ability to solve complex engineering problems.

Keywords: Virtual Simulation; Energy Transmission; Power Supply Design

In order to meet the needs of my country's new energy technology development, adhere to the "student-centered, practical engineering practice-based, problem-oriented" experimental teaching concept to cultivate innovative and applied electrical engineering and automation professionals with professional competence. However, the current common colleges and universities have the following problems in the practice of electrical engineering related courses: First, the equipment required for the experiment is expensive, covers a large area, the experimental procedures are cumbersome and time-consuming, and the experimental environment is difficult to achieve. Second, there are many experimental restrictions, and it is difficult to compare and analyze different design schemes. Third, the high-voltage-related experiment has a high risk factor, and the live operation is dangerous.

"Modern Power Supply Technology" is a major professional course for electrical engineering and automation majors. The practical links related to the content of this course are also restricted by the above problems, which affect the cultivation of students' engineering practical ability.

Therefore, in accordance with the principle of "combining virtual and real, supplementing the real with virtual reality" and based on the content of the course, construct virtual simulation experiments, taking the safe transmission of clean energy as the starting point, and selecting professional-related power transmission plan design and design in the process of energy transmission and subway supply. In terms of selection and implementation, three-dimensional simulation, human-computer interaction and other technologies have been used to construct virtual simulation experiments for clean energy safe transmission and subway power supply applications to solve the problems of high cost

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and safety in the training of professional talents.

1. Ideas for the construction of virtual simulation experiments

The construction of the subway is an important strategy for alleviating urban traffic pressure, saving energy, reducing pollution, and promoting the rapid urbanization process. When clean energy is used as the driving force for subway operation, complex engineering issues such as the transmission and transformation of high-voltage electric energy will be involved. In the process of high-voltage electric energy transmission and transformation, many equipments, large power capacities, and high prices are involved. Now not only the cost is high, the floor space is large, but if the operation is not careful, it is very easy to cause electric shock accidents.

The virtual simulation experiment selects the main links of system cognition, scheme design, simulation operation and electricity safety according to the typical schemes of clean energy safe transmission of actual engineering projects and subway power supply, and comprehensively uses electrical science and technology, information science and technology, Multi-disciplinary research results of computer science and technology, based on panoramic shooting, created virtual scenes based on real photovoltaics, wind power, thermal power generation sites, converter stations, substations, etc., using 3D modeling, animation and other technical means. Highly simulated power supply design and realization, reactive power compensation operation and electric shock conditions and other simulation simulation realization, and give the results under relevant design parameters and response test curves and test results diagnosis, which is convenient for students to analyze and use modern engineering and information. The technical tools analyze and summarize the problems in the experiment process, the optimality of the experiment scheme, and the credibility of the experiment results. Students can experience the actual scene of the engineering project as if they are on the scene, and can fully interact with the human-computer interaction.

Part of the simulation element interface is shown in Figure 1, and the virtual and real comparison of simulation is shown in Figure 2.

Figure 1. The clean energy safe transmission system.

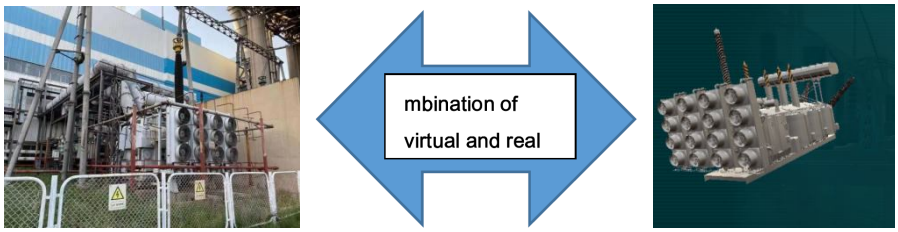

Figure 2. Comparison of actual and simulation models of converter transformer equipment.

2. Experiment content

The teaching objectives of the “Modern Power Supply Technology” course require students to master the design methods of power supply systems and substations, be able to correctly select the type, capacity and quantity of electrical equipment such as transformers, carry out power supply, transmission, and reactive power compensation design, and be able to master safe power usage specifications. And the correct prevention of electric shock rescue. In order to achieve the above experimental teaching goals, students are trained to quickly adapt to engineering design, maintenance and construction work after graduation, or engage in scientific research such as the analysis of power supply and distribution systems, and become higher-level “new engineering” applied talents. This experiment sets up 3 modules of experimental content:

Module 1: Power transmission scheme design understand the main components and basic working principles of the energy safety transmission system, recognize electrical equipment, and on this basis, select the transmission scheme and design the power supply scheme according to the requirements.

Module 2: Reactive Power Compensation Design Build a schematic diagram of energy transmission, perform correct switching operations of the commutation system, check the parameters, calculate the relevant power factor, and determine the flow direction of the current.

Module 3: Electricity Safety Clarify electricity safety knowledge and electric shock rescue and emergency treatment measures, inspect the insulation performance of the casing and other indicators to judge whether there are differences.

3. Simulation design of the core elements of the experiment

According to the teaching objectives and content of the experiment, the core elements of this experiment include:

3.1 System structure and basic principles and electrical equipment cognition

This element simulates the composition of the actual engineering total energy safety transmission system and practical electrical equipment. The content includes the main components of the energy safety transmission system and the basic work theory, different electrical equipment. The basic principles of the analysis machine nameplate parameter recognition and other experimental processes. When students choose different areas, they can analyze and compare the composition of the equipment under different requirements and master the basic working principles and parameter cognition of related equipment, so as to realize heuristic and guided teaching.

3.2 Transmission scheme design

This element simulates the whole process of transmission scheme design for remote power supply and near-end clean energy power supply, and an interactive interface is set in it for students to choose methods, parameter settings, etc.

3.3 Reactive power compensation design

This element is based on simulating the real situation, and through interactive links, it guides students to complete the schematic diagram supplementary construction, view the parameter calculation related power factor, switch station switching operation and judge the flow direction, which can enable students able to simulate actual engineering operations in a virtual environment and have a deeper understanding of correct engineering specifications.

3.4 Electric safety and electric shock protection are simulated through three-dimensional simulation in the real scene of the converter station to simulate common forms of electric shock

Electric shock protection, etc., and through interactive links to guide students to rescue in the event of electric shock, solve the problem of high voltage. The dangerous factors of the experiment and the irreversible operation enable students to master the correct and safe use of electricity and the standard operation of electric shock rescue, which shortens the distance between experimental teaching and engineering practice.

3.5 Recognition and construction of insulation parameter test equipment

The equipment diagram through three-dimensional simulation allows students to fully understand the commonly used experimental equipment for insulation performance testing, such as amplifiers, dielectric Puyi and other equipment, and guide students to build and link insulation test equipment. Test the insulation performance of the casing and other indicators, and simulate the computer parameter setting and data analysis result curve to analyze the experimental results. According to the initial difference of the capacitance and the tanδ value of the dielectric loss, normal and abnormal are judged.

4. Experimental teaching process

The experimental teaching process is designed on the basis of a project-driven and problem-led teaching model. The specific process is as follows:

(1) After the first introduction to the course teaching, give the project design task book and thematic questions.

(2) Before the experimental class, students learn related theories through course theory teaching, textbooks, MOOCs, experimental instructions, etc., and analyze and design the project according to the requirements of the project design task book.

(3) In class, conduct relevant theoretical and technical discussions on the students' design plan, analyze the feasibility of the design plan; Then rely on the virtual experiment system to guide students to independently conduct online experiment operations, complete the plan design, and complete the process. Analyze and correct the design plan for the errors and problems that occur.

(4) Finally, verify the correction plan on the system, submit the experimental results, and write the experimental report. The specific experimental process is shown in Figure 3. The whole experiment process is mainly done by students independently, and the teacher is only responsible for answering questions and guiding the work during the experiment.

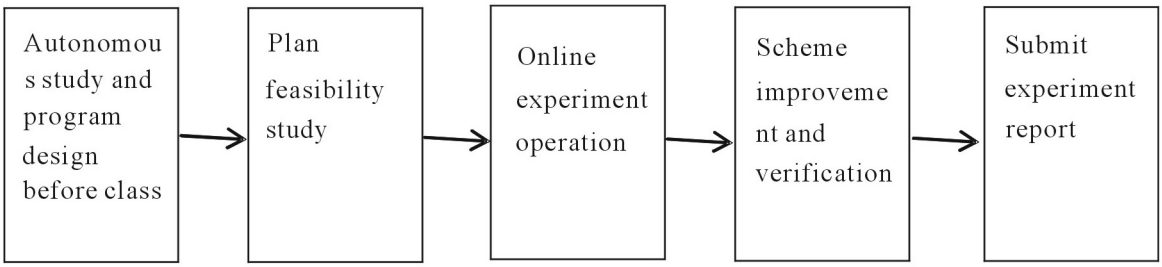

Figure 3 Flow chart of the experimental teaching process5. Conclusion

This virtual simulation conforms to the national norms and standards, ensures the rationality and operability of the design of the power transmission scheme, and conforms to the training goals of electrical engineering and automation professionals with strong engineering practice capabilities, able to analyze and solve complex engineering problems require. It effectively solves the problems of many high-pressure experiment restrictions, difficulty in effective implementation of multiple design schemes, and poor safety, and improves the comprehensiveness and design of experimental content. Under the premise of completing basic experiments, students are guided to solve problems based on actual engineering problems. Independent design and implementation of power transmission schemes, using virtual simulation experiment system to verify the performance indicators and correctness of the design scheme, and convenient independent analysis of the experimental effects of various schemes, and practically promote independent exploration as the main form the application of experimental teaching methods effectively stimulated students' interest in learning, mobilized students' initiative to participate in experimental teaching, and promoted the universal application of problem-based and project-based research teaching methods.

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