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Innovative Research on Experimental Teaching of Power System under the Background of New Engineering

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Abstract: With the increasing digitalization and intelligence of power production, dispatching, and management in the power industry, traditional experimental teaching of power systems can no longer meet the demand for high-quality power professionals in the industry. In response to the call for "New Engineering" construction, power majors in colleges and universities should reform and innovate experimental teaching to continuously improve students' professional capabilities and comprehensive quality. Based on the value implication of experimental teaching innovation of power system under the background of New Engineering and the current situation of experimental teaching of power system, this paper briefly analyzes the innovative strategies of experimental teaching of power system under the background of New Engineering, aiming to provide certain reference for the continuous improvement of the quality of experimental teaching of power majors.

Keywords: New Engineering; Power system experimental teaching; Innovative strategies

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1. Introduction

Power system experiment is an important part of power majors, aiming to enable students to deepen their understanding of theoretical knowledge, improve their practical operation ability, as well as engineering thinking and innovative thinking through experimental operations. Therefore, to achieve the ideal effect of power system experimental teaching, teachers should clarify the dominant position of students based on the industry's demand for high-quality compound "New Engineering" talents with strong engineering practice ability, strong innovation ability, and international competitiveness, reconstruct the content and mode of power system experimental teaching, and cultivate more new-era power professionals with both solid professional ability and good professional quality.

2. Value implication of experimental teaching innovation of power system under the background of New Engineering

2.1. Adapt to the demand of industrial transformation

In the past, the experimental teaching of power systems in colleges and universities mostly focused on teachers leading students to verify classic theories, using physical simulation of experimental devices for traditional scenarios such as synchronous generator regulation and transmission line parameter measurement [1]. With the acceleration of the transformation and upgrading in the field of electrical engineering, the content of experimental teaching of power system in colleges and universities should also adapt to industrial transformation, integrate new demands and technologies such as new energy grid-connected control, energy storage system frequency and peak regulation, power big data analysis, and intelligent distribution network fault diagnosis, allowing students to be exposed to technical scenarios close to or consistent with actual enterprise applications in experimental teaching. In addition, to improve students' professional ability, teachers should innovatively adopt case teaching and experimental teaching, transform real power system experiments into teaching content, and guide students to use their learned knowledge and skills to solve practical electrical engineering problems while cultivating their good engineering thinking to adapt to the demand of industrial transformation.

2.2. Strengthen students' core literacy

On the one hand, the innovation of power system experimental teaching will introduce many open and inquiry-based experimental projects, changing the fixed mode of reducible operations in traditional experimental teaching. For example, in the intelligent distribution network optimization experiment, students are allowed to think about optimization schemes independently, judge the economy and reliability of different schemes through experimental data, and fully exercise their awareness and ability of independent thinking and active exploration [2]. On the other hand, the experimental teaching resources in colleges and universities are increasingly digital and intelligent. Teachers carry out experimental teaching through virtual simulation experimental platforms, which can provide students with repeatable and error-tolerant experimental opportunities. This helps to cultivate students' innovative practice ability. In this process, teachers can also infiltrate ideological and political elements such as energy security, environmental protection, and professional ethics, enabling students to establish correct engineering ethics and social responsibility, thus becoming high-quality electrical engineering professionals.

2.3. Empower the reform of engineering education

The essence of New Engineering construction is to build a diversified and personalized engineering education model. The innovation and practice of power system experimental teaching is an important carrier for colleges and universities to practice the concept of New Engineering, and can also provide reference experience for subsequent reforms, promoting the orderly development of New Engineering construction in college education [3]. With the in-depth application of information technology in the experimental teaching of electrical engineering and automation majors, the problems of traditional power system experimental teaching, such as high cost, difficult maintenance, and slow update, have been greatly improved. Through virtual simulation experimental platforms, cloud experimental platforms, and other means, teachers have broken the limitations of traditional experimental teaching restricted by physical teaching resources and time and space. For example, virtual simulation experimental platforms can simulate scenarios such as extreme equipment failures and major maintenance that are difficult to achieve in reality, expanding the breadth and depth of electrical

system experimental teaching, and transforming engineering education from imparting students' professional knowledge and skills to cultivating their professional ability and literacy [4].

3. Current situation of power system experimental teaching

3.1. Slow update of experimental teaching resources

Experimental teaching resources are an important prerequisite and guarantee for carrying out power system experimental teaching. However, due to limited funds and space, some colleges and universities have problems such as insufficient hardware equipment and backward software systems. At present, the enrollment scale of power majors in colleges and universities is constantly expanding, and the number of existing experimental equipment is difficult to meet the basic needs of experimental teaching. Teachers usually adopt the experimental mode of "multiple people in one group", and students can only operate in turns, resulting in a slow improvement of their practical operation ability [5]. In addition, some colleges and universities have not purchased new energy power generation-related systems in a timely manner, making it impossible to carry out cutting-edge experiments such as wind power and photovoltaic grid-connected control. In terms of software systems, many colleges and universities are still using power system analysis software such as PSASP and BPA. Due to limited funds, they lack professional software widely used in the industry, such as PSCAD/EMTDC, advanced modules of MATLAB/Simulink, and DIgSILENT, leading to a disconnect between experimental teaching content and actual enterprise work.

3.2. Monotonous experimental teaching methods

In the experimental teaching of power systems, the teaching mode is still dominated by class teaching. Teachers first explain the experimental purpose, principles, steps, and precautions in detail to all students, and then students carry out experimental tasks in groups. However, the understanding ability and absorption level of different students vary widely. Unified explanation and guidance cannot meet the personalized learning needs of students, resulting in students with relatively weak foundations being unable to keep up with the progress, while students with better foundations will feel simple and boring, thereby reducing their learning enthusiasm [6]. At the same time, teachers' energy is limited. They cannot provide detailed guidance for each group one by one, nor can they quickly solve or handle the problems they encounter in the experimental process. This easily leads to some students only passively completing the experimental process instead of truly mastering experimental skills.

3.3. Experimental teaching evaluation needs to be improved

Most colleges and universities still take the completion of experimental reports as the main evaluation standard, focusing on the correctness and completeness of experimental data and results, while ignoring the performance of students' core literacy, such as problem-solving skills, teamwork ability, and innovative thinking ability in experiments. This leads students to only focus on the writing of experimental reports, and sometimes even plagiarism or falsification of experimental data occurs, which is contrary to the teaching goal of deepening students' understanding of theoretical knowledge through experimental teaching [7]. At the same time, the evaluation indicators cannot reflect the growth and progress of students in the experimental process, and there is still much room for improvement in the comprehensiveness and scientificity of teaching evaluation. In terms of evaluation subjects, it is mostly dominated by teachers' single evaluation, lacking the participation of multiple

subjects such as students' self-evaluation, peer evaluation, and enterprise evaluation, which easily leads to relatively subjective and one-sided evaluation results.

4. Innovative strategies of power system experimental teaching in the background of New Engineering

4.1. Optimize the top-level design of the power system experimental teaching

Under the background of New Engineering, teachers should clarify systematic and scientific experimental teaching objectives of the power system in combination with the requirements of New Engineering talent training and the characteristics of power majors [8]. At the basic knowledge level, in addition to requiring students to complete the verification of core knowledge, such as circuits, motors, and control theories in experiments, they should also understand new technologies and developments in the power field, such as power system automation, new energy power generation, and power electronic converters, and complete relevant basic experiments. At the experimental ability level, students are required to have the ability to correctly use experimental instruments and process experimental data; have the ability to independently design, simulate and implement small-scale electrical system schemes; for students with good professional knowledge and ability, they are encouraged to carry out innovative experiments such as new energy microgrid optimization control in combination with new technologies [9]. At the core literacy level, through the infiltration of ideological and political education, guide students to establish correct engineering ethics, and have good teamwork and lifelong learning awareness and ability, laying a good quality foundation for their future work. At the same time, teachers should also reconstruct the experimental teaching of the power system, strengthening the organic integration of experimental teaching with industrial needs and cutting-edge technologies. For example, relying on the power dynamic simulation experimental platform of the Electrical Engineering and Automation Laboratory, organize students to carry out the "comprehensive experiment of 500kV system relay protection action characteristic measurement and system fault analysis", allowing students to complete the pre-experiment system construction and calculation of generator startup, grid connection, short circuits under different operating modes and positions, etc.; carry out relevant experimental practices such as operation during the experiment, summary and analysis of relay protection action information, and judgment of system protection schemes, analyze the recorded wave diagram after the experiment, and write a fault report. Thus, it realizes the cultivation of students' familiarity with the actual power field, preliminary accident reporting and analysis ability, and mastery of accident analysis methods.

4.2. Innovate the information-based experimental teaching mode of the power system

In the Internet era, information technology provides multiple possibilities for the innovation of the power system experimental teaching mode. Teachers should make good use of virtual simulation technology, online teaching platforms, and other means to create flexible and efficient experimental scenarios for students, and improve the interactivity and student participation of experimental teaching. Taking the "comprehensive experiment of 500kV system relay protection action characteristic measurement and system fault analysis" as an example, let students rely on the dynamic simulation experimental platform to measure and analyze the fault characteristics under different fault conditions based on the 500kV system, then focus on measuring the protection action characteristics under different fault conditions, and demonstrate and analyze the designed protection scheme through the measurement results [10]. Finally, the experimental results show that the short-circuit current

characteristics are consistent with engineering practice, the protection actions are reliable for internal faults, and the protection strictly does not act for external faults, which are consistent with theory and engineering practice. Such experimental teaching activities not only avoid the loss of physical equipment and safety risks that may occur in traditional experimental teaching, but also ensure the authenticity of power system experimental teaching. At the same time, teachers can use data synchronization technology to compare and analyze the results of virtual experiments and physical experiments, guiding students to deeply explore the reasons for the "difference between simulation and reality" and deepen their understanding of experimental principles [11]. In this process, teachers can also use information technologies such as artificial intelligence and big data to collect students' operation data and other information in real time, use algorithms to analyze students' weak knowledge points and ability shortcomings, and then push them relevant MOOCs of theoretical explanations and experimental demonstration videos, enhancing the personalization and pertinence of experimental teaching.

4.3. Improve the evaluation system of power system experimental teaching

To ensure the effectiveness and educational value of power system experimental teaching, teachers should strengthen exchanges and cooperation with power enterprises and scientific research institutions, and introduce the latest practical cases and power technology R&D projects into experimental teaching. For example, teachers can cooperate with power enterprises to develop the teaching project of "new energy microgrid optimization control", allowing students to have the opportunity to experience how to apply their learned professional knowledge and skills to solve professional problems in the new energy field during their school years, and teachers evaluate students' experimental ability, innovative thinking and professional quality development based on this [12]. In addition, teachers should establish a diversified teaching evaluation system. Emphasize the process evaluation of students. For example, observe whether students can independently complete the basic operations of generator set startup, speed regulation, excitation, paralleling (grid connection), load increase and decrease, disconnection, shutdown, etc., so as to evaluate students more scientifically and accurately. In addition, teachers should also incorporate the assessment standards of relevant certificates and competitions into the students' experimental operation assessment standards, which can also lay a good foundation for students to obtain relevant qualifications and participate in relevant competitions in the future [13]. At the same time, teachers can set up situational tasks that require workplace colleagues to cooperate to complete projects, and use the artificial intelligence technology of the virtual simulation experimental platform to evaluate students' performance and abilities in the process.

4.4. Improve teachers' experimental teaching ability of the power system

Firstly, colleges and universities should formulate a "teacher on-the-job training" mechanism, requiring teachers to take temporary positions in power enterprises and scientific research institutes regularly, participate in practical work such as power system operation and maintenance, and new energy project development, and accumulate on-site experience. At the same time, regularly invite power technology experts and enterprise backbone technical personnel to the school to carry out special training on intelligent equipment operation and simulation software application for teachers, improving teachers' understanding and mastery of cutting-edge experimental technologies in the power field, and further strengthening teachers' experimental operation and problem-solving abilities [14]. Secondly, encourage teachers to actively apply for teaching and research projects related to "electrical experimental teaching reform under the background of New Engineering", carry

out research on core issues such as the reconstruction of experimental teaching content and the innovation of teaching modes, and transform the research results into experimental lesson plans; organize power professional teachers to prepare lessons together and attend each other's classes, learning from each other's strengths and making progress together through sharing and learning. Furthermore, based on relevant policies, colleges and universities should establish a "famous teacher studio" with multi-school linkage, led by teachers with rich teaching experience, to drive the growth of young teachers through mentoring, open classes, teaching demonstrations, and other methods. Build a "power system experimental teaching resource library" using online teaching platforms, allowing power professional teachers to upload and share high-quality experimental courseware, simulation models, teaching videos, and other resources for all teachers to learn and reference independently [15]. Finally, to improve teachers' enthusiasm for teaching innovation, colleges and universities can set quantifiable evaluation standards for the teaching ability of power professional teachers, and link the evaluation results with teachers' professional title evaluation and performance appraisal. Teachers who have made outstanding contributions in the innovation and reform of experimental teaching should be given honors or material rewards, and preferential treatment in professional title promotion to stimulate teachers to actively explore the innovation and practice of power system experimental teaching.

5. Conclusion

In summary, the innovation of power system experimental teaching in the background of New Engineering is an inevitable choice for power education in the new era, and even a profound reform to reshape the experimental teaching paradigm of colleges and universities. With information technology as the pen and advanced educational concepts as the ink, it outlines a new picture of breaking the limitations of teaching time and space and activating students' innovative potential on the scroll of traditional power education. This not only helps to improve the teaching quality and educational level of power professional experiments, but also provides strong talent support for the sustainable development of China's power industry.

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References

[1] Zhao JY, Yu YX, Wu M, et al., 2024, Research on the Reform of Curriculum Experimental Teaching of Electrical Engineering Major under the Background of "New Engineering". Experiment Science and Technology, 22(4): 25–33.

[2] Zhou Y, Zhao W, 2024, Exploration and Practice of Virtual Simulation Experimental Teaching of "Electrical

Control and PLC". Journal of Electrical and Electronic Teaching, 46(2): 237–240.

[3] Liu HM, 2024, Exploration on the Reform of Experimental Teaching of Electrical Control and PLC Technology Course under the Background of New Engineering. China Journal of Multimedia & Network Teaching, 2024(2): 66–69.

[4] Li ZJ, 2023, Exploration on Experimental Teaching of Power System Analysis Based on Virtual Simulation. Journal of Higher Education, 9(32): 76–80.

[5] Xue J, Dai NN, Tan ZF, et al., 2023, Research on Electrical Experimental Teaching Based on VR Virtual Experiment Technology. Science & Technology Information, 21(21): 190–193.

[6] Deng Y, Tai NL, Hu Y, et al., 2023, Exploration on Online and Offline Experimental Teaching of Power System Relay Protection. Research and Exploration in Laboratory, 42(9): 182–185.

[7] Cao J, Liang YY, Zhang S, et al., 2023, Design of Remote Monitoring System for Power System Experimental Platform. Network Security Technology and Application, 2023(8): 110–111.

[8] Ren X, Sun Z, Yu JH, et al., 2023, Exploration on the Reform of Student-Centered Experimental Teaching of Power System Analysis—Taking Xihua University as an Example. Guangxi Education, 2023(21): 157–160.

[9] Li XL, Liu YX, Wang ZG, et al., 2023, Design and Teaching Application of a Comprehensive Experimental Platform for New Power Systems. Experimental Technology and Management, 40(4): 192–199.

[10] Zhang WD, Fang JL, Ni J, et al., 2023, Discussion on the Teaching Reform of "Comprehensive Experiment of Power System" Based on OBE Concept. China Electric Power Education, 2023(4): 75–76.

[11] Tang J, 2023, Preliminary Exploration on the Experimental Teaching Practice of "Power System Automation". Journal of Chengdu Technological University, 26(2): 60–63.

[12] Ai MM, Xia YY, Xu YM, 2022, Exploration on the Application of Virtual Simulation Experiments in Electrical Engineering Major—Taking the Submersible Motor Experiment as an Example. China Modern Educational Equipment, 2022(9): 20–22.

[13] He F, Wang WF, 2022, Discussion on Optimizing Power System Experimental Teaching with the Assistance of Simulation Software. Industrial Control Computer, 35(4): 158–160.

[14] Cai XH, Cen HL, Wang HK, 2022, Reform and Exploration of Experimental Teaching of Power System Analysis Based on the OBE Concept. China Educational Technology & Equipment, 2022(4): 131–133.

[15] Xu WW, Wang Q, 2022, Design and Implementation of Virtual Simulation Experimental Teaching Project for Power System Analysis Course. Science & Technology Vision, 2022(1): 81–83.