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Research on Teaching Strategies of Power System Relay Protection Based on OBE Concept

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Abstract: With the continuous improvement of current science and technology and residents' electricity demand, the power system relay protection course has become a key component of the curriculum for students majoring in power engineering. In this context, the teaching model of power system relay protection faces both new challenges and opportunities. By integrating the Outcome-Based Education (OBE) concept, teachers can reconstruct curriculum objectives and teaching frameworks by clearly defining learning outcomes, thereby enhancing students' practical competencies and innovative thinking. Based on the core connotation of the OBE concept, this paper analyzes the significance of incorporating OBE into Power System Relay Protection teaching and explores effective implementation strategies. The findings aim to offer practical insights for teaching reform and to strengthen the alignment between academic training and industry requirements.

Keywords: OBE; Power system relay protection; Learning outcomes; Teaching reform

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1. Introduction

In the process of cultivating talents in power engineering, the optimization and reform of the power system relay protection course has become an important task in the current curriculum improvement initiatives. However, in actual teaching practice, this course still presents several limitations, such as misalignment between teaching objectives and real-world needs, a weak connection between course content and technological developments in the industry, and a lack of diversity in instructional methods. Therefore, there remains significant room for further enhancement in subsequent teaching implementation. The OBE-oriented teaching model provides strong guidance for improving teachers' instructional effectiveness and overall teaching quality, and this pedagogical concept is increasingly being applied in modern higher education. Moreover, by integrating the student-centered and outcome-oriented principles advocated in the OBE framework, teachers can more flexibly adjust existing instructional strategies to better meet students' personalized learning needs and enhance their comprehensive competence and engineering practice abilities.

2. The connotation of the OBE educational concept

The OBE concept was first proposed by American scholars. It originates from the educational philosophy of outcome orientation, which focuses on students' learning experience and achievements, emphasizing what students have learned and the measurable learning outcomes attained [1]. In the specific implementation of teaching, the OBE concept encourages teachers to prioritize the formulation of teaching content and objectives with students' learning outcomes as the primary reference direction. Starting from the ultimate goal of talent cultivation, it promotes the reverse design of curriculum systems and teaching content. This approach ensures that the future teaching direction is more clearly aligned with the expected learning outcomes, while enabling teachers to allocate teaching resources and time more scientifically and effectively. Furthermore, teachers should recognize that the evaluation criteria for students' learning outcomes must be established based on the highest attainable and measurable achievements demonstrated through assessment [2].

It is evident that the OBE concept differs fundamentally from traditional teaching models. It places students at the center of the educational process, adheres to an outcome-oriented and reverse-engineered approach to curriculum design, and aims to achieve predefined teaching objectives through goal-driven backward planning. This teaching model not only fosters a student-centered learning environment but also preserves the supervisory and guiding roles of teachers, thereby continuously enhancing overall teaching quality [3]. Therefore, the application of the OBE concept in the current teaching system can effectively promote the continuous improvement of the power system relay protection course, enabling teachers' instructional practices to align more precisely with students' ability development objectives. This integration promotes a deeper connection between course content and engineering practice and ultimately facilitates the transformation from knowledge transmission to competency cultivation.

3. The importance of applying the OBE concept in the teaching of power system relay protection

3.1. Enabling accurate alignment with industry job requirements

In traditional power system relay protection courses, teaching methods are predominantly lecture-based and rely heavily on theoretical explanation and case demonstration. During instruction, teachers tend to emphasize formula derivation and theorem proofs, while students remain in a passive learning state. Under such conditions, students are susceptible to developing rigid thinking patterns and struggle to effectively cultivate engineering-oriented thinking and practical problem-solving skills [4]. In contrast, the OBE concept places greater emphasis on beginning from actual industry talent requirements and focuses on student learning outcomes as the core objective. This approach enables teachers to clearly define the competency standards for key professional roles, such as power grid dispatching, operation and maintenance, and equipment research and development. These talent requirements can then be translated into specific curriculum objectives and measurable competency indicators, thereby enhancing the alignment between course content and real-world job competencies and making the teaching process more targeted and practice-oriented [5].

3.2. Strengthening students' leading role

The power system relay protection course integrates multiple disciplines, including high-voltage engineering, control systems, and automation. Although the content is logically interconnected, its abstract nature often makes it difficult for students to develop a systematic understanding. Relying solely on lectures and demonstrations limits students' ability to comprehend and internalize knowledge relationships, which in turn hinders their subsequent application of knowledge and development of practical abilities [6]. The OBE framework, however, emphasizes students' central and active role in the learning process. By reconstructing existing teaching procedures and innovating instructional methods, teachers can effectively foster students' initiative and motivation for active learning. This approach encourages students to independently construct knowledge frameworks and establish a strong foundation for applying what they learn in practice [7]. Additionally, teachers can adopt diversified teaching strategies such as project-based learning, case analysis, and flipped classrooms to promote active student engagement. These methods strengthen students' problem-solving skills, deepen their understanding of industry-related job roles, and improve their professional adaptability in real engineering contexts.

3.3. Promoting the integration of teaching resources

Under the guidance of the OBE teaching philosophy, teachers can systematically integrate the teaching resources utilized in the power system relay protection course. This innovative approach to resource integration effectively overcomes the fragmentation and lack of cohesion that characterize traditional teaching, thereby achieving synchronization between teaching content and industry technological advancements [8]. From the perspective of teaching content resources, teachers can continuously update curriculum case libraries and practical training databases based on the evolving competency requirements of the power industry. They may also incorporate cutting-edge developments in smart grids, new relay protection principles, and emerging technologies, thus achieving an organic combination of theoretical instruction and professional requirements. This enables students to grasp core theoretical foundations while staying informed about the latest technological innovations in the field. At the level of practical teaching resources, teachers can restructure experimental resources to establish a more systematic practical training platform. In addition, they can integrate diverse hands-on learning modes, including virtual simulation, laboratory practice, and field internships, enabling students to apply theoretical knowledge more effectively in engineering practice [9].

4. Effective paths for applying the OBE concept in the teaching of power system relay protection

4.1. Constructing a hierarchical and measurable teaching objective system based on job competency decomposition

In the current teaching system, the existing teaching model still exhibits a traditional tendency to emphasize theory over practice. This model, which is primarily discipline-oriented, often results in students who, despite mastering extensive theoretical knowledge, struggle to apply it effectively to real-world engineering problems, thereby creating a gap between learning and application [10]. The OBE approach, however, embraces an outcome-oriented philosophy that effectively addresses the limitations of traditional teaching, bridging the disconnection between knowledge acquisition and skill development. By gaining an in-depth understanding of industry competency requirements and using this as the foundation to reverse-engineer curriculum structure and teaching content, educators can ensure that students' final learning outcomes align closely with talent cultivation goals.

To implement this hierarchical and measurable teaching objective system, teachers must establish clear and operable learning outcome goals consistent with the OBE framework. These goals should correspond both to current industry needs and to practical feasibility [11]. On one hand, teachers should develop close partnerships with power enterprises, conducting in-depth investigations into the specific requirements of key roles such as relay protection operation, maintenance, debugging, and configuration. This process helps identify core competency indicators for each position and translate them into quantifiable teaching objectives. For instance, the competency "relay protection device debugging" can be further detailed into specific instructional elements such as wiring inspection, parameter configuration, and action logic verification. On the other hand, teachers should design modular teaching content and phased practical tasks around these objectives, allowing students to progressively master essential skills from fundamental to advanced levels and build a solid foundation for further learning and professional development.

4.2. Optimizing and adjusting curriculum content to build a modular system integrating theory and practice

Fundamentally, the OBE framework shifts the instructional focus from "what to teach" to "what students need to learn to achieve defined learning outcomes." This shift encourages teachers to concentrate on the level of competence students can demonstrate through their final outcomes [12]. Such goal-oriented pedagogy not only motivates teachers to design classroom activities around measurable ability outputs but also helps students gain a clear understanding of their own learning objectives, thereby fostering intrinsic motivation for continuous skill enhancement. Specifically, teachers should restructure existing curriculum content with core competency development as the central focus. The course should be divided into multiple modular units, each corresponding to specific competency indicators and measurable evaluation criteria, ensuring that learning outcomes are implemented effectively for every student [13].

Following theoretical instruction, practical and experimental courses should be arranged promptly. Teachers can utilize on-campus electrical protection laboratories to simulate real fault conditions, allowing students to independently complete tasks such as parameter setting, wiring inspection, and fault triggering. Throughout this process, teachers should act as facilitators, guiding students to diagnose and resolve common problems autonomously using the theoretical knowledge they have acquired. After each module, teachers can organize group review sessions using line fault analysis reports provided by power enterprises. This enables students to gain deeper insights into protection scheme design principles and troubleshooting techniques, thus achieving a closer integration of modular learning content with real engineering applications [14].

4.3. Building a dual-teacher teaching team to promote the implementation of school-enterprise cooperation teaching model

At present, practical training in electrical protection involves inherent safety risks, and on-site teaching scenarios are often difficult to replicate. Consequently, students can only acquire basic theoretical knowledge and skills without gaining substantial real-world experience [15]. Therefore, colleges and universities must innovate instructional models through school–enterprise cooperation to provide students with expanded practical learning opportunities supported by industry partners. Under the guidance of the OBE philosophy, universities can invite enterprise mentors to participate in on-site instruction, establishing a dual-teacher teaching model in which academic instructors and industry experts collaborate, thereby enhancing faculty structure and instructional quality in power system relay protection courses. During theoretical instruction, enterprise engineers can deliver industry lectures aligned with course progress, sharing insights on technological innovation and fault-handling practices to help students develop an intuitive understanding of real-world operational scenarios.

Throughout the teaching process, academic teachers focus on guiding theoretical frameworks, while enterprise mentors contribute practical perspectives, thereby effectively realizing the dual-mentor teaching mechanism. When supervising project-based learning, both academic and enterprise mentors can provide phased guidance: in the initiation stage, academic teachers define project requirements; during the midterm phase, enterprise mentors organize supervision meetings to encourage student inquiry and problem-solving; and in the final evaluation stage, both mentors jointly assess student outcomes, helping learners recognize limitations in their knowledge and clarify directions for further professional growth.

5. Conclusion

In conclusion, within the teaching reform of the power system relay protection course guided by the OBE concept, teachers should fully recognize the constructive role of this approach in enhancing instructional quality and learning outcomes. While maintaining steady teaching progress, educators are encouraged to further refine existing instructional methods, update pedagogical philosophies, and ensure that students' acquired knowledge and competencies align with the evolving talent demands of the modern power industry.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Nie Z, Yang J, Zhang J, 2025, Empowerment Strategies and Practical Exploration of AI Technology in the Curriculum Reform of Power System Relay Protection. Information and Computers, 37(15): 233–235.

[2] Luo X, Qin G, Ling C, et al., 2025, Application of New Technology in the Teaching of Power-Related Courses in Higher Vocational Colleges: Taking the Course of Power System Relay Protection as an Example. Equipment Manufacturing Technology, 2025(7): 75–79.

[3] Wang Z, 2025, Paths and Implementation Strategies for Ideological and Political Construction of the Power System Relay Protection Course. Modern Vocational Education, 2025(18): 165–168.

[4] Xiang Z, Yang H, Lu S, 2025, Research on the "Innovation and Entrepreneurship" Talent Training Model from the Perspective of Power System Relay Protection. East China Science and Technology, 2025(2): 143–145.

[5] Yu X, Li W, Gao C, et al., 2025, Exploration on the Teaching Reform of Power System Relay Protection Integrating STEM and OBE Concepts from the Perspective of New Engineering. Education Informatization Forum, 2025(1): 76–78.

[6] Liu H, 2024, Exploration on Teaching Methods of Power System Relay Protection based on the OBE Concept. Home Appliance Maintenance, 2024(11): 38–40.

[7] Huang H, Cao W, Zhang J, et al., 2024, Discussion on the Teaching Reform of "Power System Relay Protection". China Electric Power Education, 2024(8): 79–80.

[8] Mo J, Zuo W, Li C, 2024, Ideological and Political Teaching Reform of the "Power System Relay Protection"

Course. Education and Teaching Forum, 2024(26): 49–52.

[9] Tang Z, Zeng P, Liu J, 2024, Exploration on Ideological and Political Education of the “Power System Relay Protection” Course Integrating the OBE Concept. Education and Teaching Forum, 2024(22): 137–140.

[10] Xu X, Fu Q, Yin J, et al., 2023, Exploration and Practice of Blended Teaching for “Power System Relay Protection”. Journal of Electrical and Electronic Education, 45(4): 77–81.

[11] Liu Y, Zheng S, Chen X, 2022, Effective Measures for the Ideological and Political Teaching Reform of Electrical Engineering and Automation Majors in Colleges and Universities under the OBE Concept: Taking the “Power System Relay Protection” Course as an Example. Western China Quality Education, 8(1): 53–55.

[12] Wang X, Xu L, Wang K, 2021, Reform of Digital Relay Protection Experimental Teaching based on the OBE Concept. China Modern Educational Equipment, 2021(17): 90–92.

[13] Yan B, Hong J, Li X, 2020, Exploration on the Teaching Reform of the “Power System Relay Protection” Course based on OBE. China Electric Power Education, 2020(10): 58–59.

[14] Liu C, Li S, Jin E, et al., 2020, Preliminary Study on the Teaching Reform of Power System Relay Protection based on the OBE Concept. Education and Teaching Forum, 2020(37): 144–145.

[15] Cao J, Zhou J, Guan C, et al., 2020, Reform of Practical Teaching of “Power System Relay Protection” for Engineering Education Accreditation. Education and Teaching Forum, 2020(34): 189–191.