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Constructing a "Cross-Border Integration" Innovative Talent Training Model: Reflections Based on the Training of Master's Students in Energy and Power Engineering

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Abstract: Against the background of the global energy revolution and industrial transformation and upgrading, the demand for innovative talents in the energy and power field presents distinct characteristics of comprehensiveness and cross-border integration. The traditional master's student training model centered on a single discipline can no longer meet the diverse requirements of the industry for talents' knowledge structure, thinking mode, and practical ability. By deeply exploring the construction logic of the "cross-border integration" innovative talent training model, analyzing the limitations existing in the current training of master's students in energy and power engineering, elaborating on the core dimensions of the cross-border integration training model, and proposing specific practical paths, this paper aims to provide ideas for improving the innovation ability and industry adaptability of master's students in energy and power engineering, and help cultivate comprehensive innovative talents who can address complex energy issues and promote high-quality industrial development.

Keywords: Energy and power engineering; Master's students; Cross-border integration; Innovative talents; Training model

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1. Introduction

Currently, the world is experiencing a global energy revolution centered on clean energy substitution, efficient energy utilization, and intelligent energy systems. The development trend of cross-penetration between the traditional energy and power engineering industry and new energy technology, information technology, materials science, management science and other disciplines is prominent [1]. It not only leads and promotes

the transformation and revoluti,on of the industrial pattern in the energy and power industry but also puts forward new requirements for the capabilities and qualities of engineering professionals in the energy and power industry. Cultivating a large number of applied professionals with multi-field knowledge reserves, interdisciplinary thinking ability, and innovative practical ability is the key to solving the bottlenecks and systematic problems faced by the transformation and development of the energy and power industry. Therefore, breaking disciplinary barriers, promoting the cross-integration of multiple disciplines, and constructing an innovative engineering talent training model that meets the requirements of the times have become an inevitable path for reforming the talent training model of master's students in energy and power engineering. "Cross-border integration" is not a mechanical "addition of knowledge", but an organic integration of knowledge, thinking, methods, and resources from different disciplines guided by problems and centered on ability training, constructing a positive interactive relationship of an interdisciplinary innovative ecology [2].

2. Core dimensions of the "Cross-Border Integration" innovative talent training model

2.1. Knowledge dimension: Constructing an interdisciplinary knowledge system

Knowledge innovation is the foundation of innovation ability, and interdisciplinary innovation first requires students to have a complete interdisciplinary knowledge structure. The interdisciplinary knowledge structure of master's students in energy and power engineering should take the core discipline knowledge of the energy and power major as the core, supplement the core knowledge of related disciplines, and form a reasonable and hierarchical knowledge system by sorting out the core and supplementary knowledge. Core discipline knowledge is the professional foundation for students to engage in the energy and power industry. It requires students to have solid basic knowledge in the principles of the energy and power field, energy conversion and utilization technology, power machinery design and control, etc., serving as the foundation for the learning and application of interdisciplinary knowledge. Supplementary discipline knowledge should be centered on new energy technology, information technology, materials science, environmental science, management science and other fields, combined with the existing problems and development needs of the core knowledge of the energy and power major [3]. Knowledge in the field of new energy technology provides students with the principles, technologies, and development trends of the development and utilization of new energy such as solar energy, wind energy, hydropower, and nuclear energy; knowledge in the field of information technology prepares students for the learning of a large number of data analysis, artificial intelligence, Internet of Things and other technologies required by the intelligent and digital needs of energy systems; knowledge in the field of materials science prepares students to understand the performance and application of new energy materials and power machinery materials; knowledge in the field of environmental science cultivates students' awareness of environmental protection and improves their ability to develop low-carbon, pollution-free, and low-emission energy and power technologies; knowledge in the field of management science cultivates students' project management and resource optimization capabilities to meet the diverse demands of the future development of energy enterprises [4].

2.2. Thinking dimension: Cultivating cross-border innovative thinking

Cross-border innovative thinking refers to the ability to break disciplinary thinking stereotypes and analyze and solve problems with multi-disciplinary thinking, mainly including systematic thinking, critical thinking,

and creative thinking [5]. Systematic thinking requires students to regard energy and power issues as an overall complex system, starting from the whole, considering the interaction and connection between various components in the system, and analyzing and solving problems using systematic scientific thinking methods. Energy and power itself is a complex, comprehensive system, from multiple links such as energy production, transmission, conversion, and utilization to the related environment, economy, society, etc., all of which are complex complexes that require careful consideration from multiple parties. Cultivating students' systematic thinking enables them to judge energy issues from an overall perspective and formulate scientific and reasonable solutions. Critical thinking refers to the ability to think independently, question, reflect on inherent knowledge, viewpoints, and methods, not follow authority, and discover problems or deficiencies. In the context of cross-border integration, the knowledge and methods of various disciplines are different and even have certain conflicts. Therefore, cultivating students' critical thinking enables them to scientifically distinguish the advantages and disadvantages of knowledge from different disciplines in the learning and research process, learn from and apply them, and avoid blind application [6].

2.3. Ability dimension: Enhancing cross-border practical and collaborative capabilities

Ability is an intuitive reflection of innovation, and the foothold of the cross-border integration training model lies in improving students' cross-border practical and collaborative capabilities. In addition to solid interdisciplinary knowledge and innovative thinking ability, master's students in energy and power engineering should also have the ability to apply them to practical work, solve practical problems, and cross-border collaborative capabilities to meet the team cooperation needs for carrying out interdisciplinary research and project development. Cross-border practical ability refers to the ability to apply cross-border knowledge and methods to solve practical problems, including practical operation ability, problem analysis and solving ability, technological research and development ability, etc. In the training of master's students, attention should be paid to allowing students to come into contact with practical problems in the energy and power field through practical links, guiding students to apply multi-disciplinary knowledge to analyze the source of problems, formulate solutions to problems, and verify the feasibility of the solutions through practical operations; encourage students to participate in cross-border technological research and development, and exercise technological research and development, innovative practice and other abilities in the research and development process [7].

3. Construction paths of the "Cross-Border Integration" innovative talent training model

3.1. Optimize the curriculum system to consolidate the foundation of interdisciplinary knowledge

The curriculum system is the basic platform for talent training. To formulate a "cross-border integration" innovative talent training model, it is first necessary to construct a curriculum system, break disciplinary boundaries, and establish an interdisciplinary curriculum system. From the perspective of curriculum setting, the principle of "solid foundation, wide scope, and strong intersection" should be adhered to, the curriculum content structure should be adjusted, and the proportion of interdisciplinary courses should be increased. On the one hand, strengthen the construction of core professional courses to consolidate students' professional foundation. Core professional courses should be adjusted around the development trends and core knowledge needs of the energy and power field, retain classic core knowledge, supplement new ideas, new technologies, new

theories, and new methods, and ensure that students have a solid professional foundation. On the other hand, add interdisciplinary elective courses to expand students' knowledge scope. According to the cross-integration direction of the energy and power field, offer interdisciplinary elective courses such as new energy technology, information technology application, fundamentals of materials science, introduction to environmental engineering, energy economy and management, for students to choose independently according to their professional interests and development needs, and construct their personalized interdisciplinary knowledge structure. Pay attention to the organic connection between courses and offer interdisciplinary comprehensive courses. Interdisciplinary comprehensive courses are problem-oriented around the existing problems in the energy and power field, based on the knowledge and methods of multiple disciplines, guiding students to analyze problems and solve practical problems using knowledge from multiple disciplines. For example, courses such as "Energy System Optimization and Sustainable Development" and "Intelligent Energy and Power System Design" can be offered. In the process of course learning, students can truly feel the integration and application of interdisciplinary knowledge, and improve their ability to apply interdisciplinary knowledge [8].

3.2. Innovate teaching methods to cultivate cross-border innovative thinking

Teaching reform is the key to stimulating students' cross-border innovative thinking. The traditional classroom lecture-based teaching should be changed, and diversified teaching methods should be implemented to stimulate students' enthusiasm and initiative in active learning and innovation. Implement problem-oriented teaching methods, using typical problems or hot and focal issues related to the energy and power field as materials, allowing students to learn and explore around the problems. In the entire teaching activity, teachers put forward problems with a wide range of involvement and a large disciplinary span. Under the guidance of teachers' problems, students need to find and learn relevant professional knowledge and materials independently, put forward different solutions to the problems, and participate in discussions through classroom teacher-student discussions and group reports [9]. This method can improve students' enthusiasm for exploring problems, and train and cultivate their ability to analyze and solve practical problems, innovative thinking ability, and expression ability. Implement project-based teaching methods, integrate interdisciplinary projects into teaching, let students form project teams, and conduct research and discussion and practical operation of an interdisciplinary project. In the process of project research, students need to comprehensively apply knowledge from multiple disciplines and carry out team cooperation through different divisions of labor, cooperation, and communication to complete the project, to achieve the goal of cultivating students' cross-border innovative thinking, practical ability, and collaborative ability [10]. Project topics can be combined with the innovative needs of the energy and power field in technological development, such as "Design Optimization of New Energy Vehicle Power Systems" and "Research on Energy-Saving Control Methods for Smart Grids". In the process of completing the projects, students' knowledge integration ability and innovation ability are exercised and cultivated [11].

3.3. Improve scientific research training to enhance cross-border practical capabilities

Scientific training is an inevitable path for cultivating master's students and an important channel for improving their cross-border practical capabilities. The scientific training model should be improved to provide graduate students with more opportunities for interdisciplinary scientific research and practical training. Establish an interdisciplinary scientific research project participation model, encouraging graduate students to participate in

interdisciplinary scientific research projects led by supervisors, or organize and form interdisciplinary scientific research project teams to apply for scientific research projects [12]. Participating in interdisciplinary scientific research project training helps graduate students gain a deeper understanding and mastery of the development process and methods of interdisciplinary scientific research, master the application of multi-disciplinary knowledge to solve specific problems in scientific research and practical activities, and effectively improve their scientific research and innovative practical capabilities. At the same time, supervisors should strengthen the process guidance of interdisciplinary scientific research for graduate students, help and guide them to master interdisciplinary scientific research ideas and methods, and solve problems and difficulties encountered in scientific research. Build an interdisciplinary scientific research and practical platform, coordinate and integrate high-quality scientific research resources inside and outside the university, and establish interdisciplinary laboratories, research centers, and industry-university-research joint bases. The platform should be equipped with interdisciplinary scientific research equipment and resources to provide hardware platform support for graduate students to participate in interdisciplinary scientific research and practice, promote scientific research cooperation between supervisors from different disciplines, form scientific research teams from different disciplines to carry out cooperation, provide graduate students with scientific research guidance from different disciplines, and provide interdisciplinary scientific research and practical training. For example, establish an interdisciplinary research center for energy and the environment, an intelligent energy and power system laboratory, etc., and carry out interdisciplinary experimental research and technology development work on the platform [13].

3.4. Strengthen the teacher team construction to build a cross-border education team

The teacher team is the basic guarantee for the realization of the “cross-border integration” innovative talent training model. Only with an interdisciplinary education team can the goal of cross-border education be guaranteed. Therefore, it is necessary to strengthen the construction of the teacher team and build a reasonable and high-quality “cross-border” education team. First, increase the cross-border training intensity of the existing teacher team in the discipline. Promote academic exchanges and training of existing teachers, engage in interdisciplinary research in other disciplines, expand the interdisciplinary knowledge structure of existing teachers, and improve their teaching and scientific research capabilities in interdisciplinary education. For example, arrange existing teachers to further their studies in other disciplines, participate in interdisciplinary scientific research projects in other disciplines, and attend interdisciplinary education and teaching training courses, enabling existing teachers to accumulate practical capabilities in interdisciplinary education [14]. Second, introduce outstanding talents with interdisciplinary backgrounds. Formulate flexible policies for introducing outstanding talents, recruit doctors, postdoctoral fellows with cross-border backgrounds in energy and power engineering or other related disciplines, or outstanding talents with industry backgrounds to join the teacher team, improving the disciplinary structure of the teacher team. On the other hand, invite senior experts with industry backgrounds and rich cross-border practical experience to join the teacher team as part-time supervisors to guide graduate students’ teaching and scientific research work, enabling graduate students to obtain cutting-edge, cross-field, and cross-industry practical experience. Third, build a cross-border teacher synergy, encouraging teachers with interdisciplinary backgrounds to form teaching teams and scientific research teams to carry out interdisciplinary curriculum teaching, scientific research project tackling, and joint training of graduate students [15].

4. Conclusion

Facing the demand for cross-border integration development in the energy and power field, constructing a "cross-border integration" innovative talent training model is an objective need for the master's education of energy and power majors to comply with the industry development trend and improve the talent supply level. The "cross-border integration" innovative talent training model is based on the construction of "cross-border knowledge," centered on the cultivation of "cross-border innovation" thinking, and aimed at the improvement of "cross-border practice" and "cross-border collaboration" capabilities. By optimizing the curriculum structure, innovating teaching methods, carrying out scientific research training, and strengthening teacher training, it realizes the mutual integration of different knowledge, ideas, methods, and resources, and constructs a good ecosystem of collaborative education. The establishment of the "cross-border integration" innovative talent training model is a long-term exploration and cultivation process. In this process, education managers, teachers, and students must work together to break the constraints of traditional educational concepts and institutional systems, continuously explore cross-border integration paths and methods suitable for the training of master's students in energy and power engineering in practice, and continuously improve the training model in combination with the development needs and talent demands of the energy and power field.

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