

Exploration and Practice of 2+4 Education Model of University-Enterprise Integration for the Major of New Energy Vehicle Power

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Abstract: This research analyzed the characteristics of the current curriculum system of new energy vehicle power and the shortcomings of the existing teaching mode under the background of new engineering education. The existing basis of the university-enterprise integration ‘2+4’ education mode and its feasible contents and objectives are explored. Finally, the problems to be solved as well as the possible implementation ways and methods of the university-enterprise integration ‘2+4’ education mode are proposed.

1. Introduction

New engineering is a strategic action to actively respond to the new round of scientific and technological revolution and industrial change, which is a new direction of engineering education reform in the new era, and a profound proposition related to the future of the country and national revitalization^[1,2]. To this end, it is necessary to speed up the layout of new engineering talent cultivation and reserve talents for industrial development. Multidisciplinary cross-fertilization education has become an inevitable trend in the development of global higher education^[3]. The direction of new energy vehicle power serves the national development strategy. At present, professional learning faces problems such as complex knowledge system, the lack of joint training between schools and enterprises, and the teaching mode and conditions that limit students' theoretical connection with practice. In order to meet the major strategic needs of the country, especially the ‘double carbon’ goal proposed in the 14th Five-Year Plan, it is urgent to explore and innovate the education model with organic integration between schools and enterprises and interdisciplinary intersection^[4,5]. This research aims to build a ‘2+4’ multidisciplinary cross-fertilization education model, such as two dimensions (teaching and practice) and four levels (basic, experimental, engineering and innovation), which organically integrates multidisciplinary content learning and enterprise engineering practice through multi-channel teaching and evaluation links to realize comprehensive training of new engineering students in new energy power. The programme is designed to provide a comprehensive training for new engineering students in new energy power.

2. Research Foundation

Over the years, the School of Automotive Engineering of Harbin Institute of Technology has formed close and in-depth cooperation with enterprises including China First Automobile Group Corporation, Great Wall Motor, FAW Jiefang, and CAC Chuangzhi Technology Co. The foundation for the second dimension of ‘industry-university-research’ collaborative education model has been laid. As the conventional mainstay of new energy vehicle power, lithium-ion batteries and fuel cells have attracted great interest from universities and research institutes at home and abroad. The School of Automotive Engineering has lithium-ion battery and fuel cell testing and system control equipment, equipped with several electrochemical workstations, which provide experimental conditions for practice. The International Joint Laboratory of Hydrogen Energy and

Fuel Cells project, which has established cooperative research with the University of Manchester in the UK, is conducive to broadening the international perspective of the new engineering students.

3. Objectives of ‘2+4’ Cultivation Mode

3.1 To establish a two-dimensional student training path that is applicable to the new engineering discipline of ‘cross-disciplinary teaching’ and ‘solid engineering practice’, in view of the characteristics of the complicated knowledge system of new energy power

The basic knowledge is the key to application. In view of the problem that the current new energy vehicle power curriculum covers a wide range of knowledge but the content is loose, reorganize and streamline the teaching content of ‘chemistry+materials+mechanics’, pay attention to the combing and summarization of knowledge points and coherence, and formulate a new vehicle power curriculum with perfect and new engineering characteristics. We will establish a joint training mode with new energy enterprises to provide students with practical exercises from single-cell experiments based on materials and chemistry to the management of power stack systems.

3.2 Establish a four-level training mode of ‘basic-experimental-engineering-innovation’ to address the problems of engineering students’ lack of depth of knowledge understanding and solidified thinking

Engineering practice is the key to solving the problem of excessive abstraction of engineering teaching contents, and it needs to be understood by students in a short time. For the multidisciplinary course system, we strive to combine lecture content with in-class experiments, so that students can have a deep understanding of the new vehicle power system; the power system part is combined with software simulation and course practice, so that students can have an understanding of the engineering management of multiple power systems; finally, through the cooperation between the university and enterprises, specific engineering design projects are set up. Through the four levels of ‘basic-experimental-engineering-innovation’ training, students can develop their creative and divergent thinking and gain a deeper understanding of engineering applications from basic principles.

3.3 In view of the time and space constraints, there is a gap between the joint education of schools and enterprises, and the introduction of enterprise tutors for the curriculum, through multi-channel evaluation, to achieve the organic integration of school-enterprise education.

At present, due to time and space constraints, there is a gap between the joint education of schools and enterprises, which is not close and deep enough. The most common problem is that it is difficult to match the knowledge learned by students with the engineering practice of enterprises, and the effect of ‘1+1>2’ cannot be achieved. Through the introduction of enterprise tutors in the classroom, students are guided to complete the innovative design of engineering projects to achieve the effect of ‘linking the basic principles with engineering projects and solving new problems immediately’, and through the form of project cooperation and reporting, on the one hand, promoting the integration of knowledge, on the other hand, grasping the development needs of enterprises and fully mobilising students’ initiative. Through project cooperation and reporting, we can promote the integration of knowledge on the one hand, grasp the development needs of enterprises on the other, and fully mobilize students' initiative.

4. Implementation Ways and Methods

4.1 Methods for Interdisciplinary Integration of Teaching

The teaching content is mainly through literature research, field study and exchange with universities and enterprises at home and abroad, observation of famous teachers’ teaching and matching of enterprises’ talent needs, etc. Combined with the cultivation characteristics of Harbin

Institute of Technology, a multidisciplinary cross-fertilization curriculum system is formulated and a teaching method that is easy for students to understand and learn is adopted. In the classroom, through the international joint laboratory project, foreign professors are invited to guide and teach online to broaden students' thinking. For example, if students have difficulty understanding water management within a fuel cell power system, the surface tension between paper towels and table tops on water is used to explain to students in an easy-to-understand way the impact of the hydrophilic properties of the materials inside the cell on the water management of the cell.

4.2 Approaches for Interdisciplinary Integration of Engineering Practice

Based on the interdisciplinary teaching content, the university-enterprise joint teaching and training is established with enterprises in different research directions at the four levels of 'basic-experimental-engineering-innovation', and the way of flipped classroom is adopted to promote students' teamwork and joint discussion to solve the problems encountered in engineering practice. For example, in the case of innovative engineering design for new energy vehicles, students will be the main protagonists and complete the process of 'proposing a project-group solution-team report', independently.

4.3 Ways of Organic Integration between Teaching and Engineering Practice

The basic content is organically integrated with the master classroom and small classroom experiments to deepen students' interest in learning and understanding of the basic knowledge of new energy vehicle power. In the engineering training stage, the problem based learning (PBL) method is used to introduce engineering problems, such as battery thermal management, water management and other outstanding problems, into the classroom to enhance students' participation and knowledge of engineering problems and the process of solving them. In the engineering innovation design stage, students are encouraged to discover engineering problems in their own field, and project reporting, student Q&A and mutual evaluation are used to realize the 'student-centred' approach. In the engineering innovation design stage, students are encouraged to discover engineering problems in the field by themselves, and project presentation, student Q&A and mutual evaluation are adopted to realize 'student-centredness' and actively integrate teaching with engineering practice.

4.4 Optimization of '2+4' Education Model

Through iterative teaching, teaching and engineering practice are improved in response to feedback from assessment results and student questionnaires. Participate in teaching seminars and share experiences and insights with industry experts to promote the continuous improvement of the '2+4' school-enterprise integration education model.

4.5 The Support between Teaching Content and Training Process

In the design of the curriculum, the knowledge system required for new energy vehicle power talents is consolidated, with close cooperation with enterprises around basic principle knowledge (mathematics, physics, chemistry, materials), professional basic knowledge (computer, engine principle, vehicle power battery technology, etc.) and practical applications in society, such as metalworking practice, course design, graduation design, etc. It highlights the teaching of the basic principles and skills required for the training process of new energy vehicle power talents, but also incorporates the integration of theory and practice.

5. Conclusion

Under the background of new engineering education, the existing training mode is not sufficient for students to take into account theoretical and practical training. Based on the existing teaching and internship resources, Harbin Institute of Technology has developed a "2+4" school-enterprise integration model for the training of automotive power students to meet the needs of new engineering education, aiming to achieve "cross-disciplinary teaching" and "solid The

two-dimensional cultivation of “engineering practice”, the establishment of “basic - experimental - engineering - innovation” four-level cultivation, to solve the time and space constraints of the school-enterprise joint education of the problem of a gap, to achieve organic integration of school-enterprise education.

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