Research on Educational Reform of School-Enterprise Collaborative Education under the Background of New Engineering Construction——Taking "Refrigeration Compressor" Course as an Example

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Abstract. "Refrigeration Compressor" is an important elective course for energy and power engineering majors, which is characterized by diversification, multidisciplinary and multidisciplinary intersection and fusion. The article aims at collaborative education reform between schools and enterprises, and reforms the teaching of "Refrigeration Compressor" course in the context of the construction of new engineering disciplines: updating the course objectives, refining and integrating the multidisciplinary knowledge related to the course, so as to make it more in line with the requirements of the engineering certification and the needs of the enterprises; constructing a multi-project, school-enterprise teachers' teaching mode, optimizing the teaching projects and class schedules; formulating the course assessment and evaluation methods; and developing the curriculum of the course. We have also optimized the teaching program and class time arrangement, and formulated the course assessment and continuous improvement mechanism, which provides the basis for the subsequent reform and construction of the course.

Keywords: New Engineering; Refrigeration Compressor; Multidisciplinary; Engineering Certification; Collaborative Education.

1 Introduction

Since the issuance of the "Guidelines for New Engineering Research and Practice Projects" in 2017, the construction and reform of new engineering disciplines related to energy industry such as energy and power engineering have been steadily promoted in various universities[1]. Therefore, the transformation of the "new engineering discipline" in the field of energy and power engineering provides a guarantee for cultivating advanced innovative applied talents in related fields.

The "Refrigeration Compressor" course is an important subject and elective course for energy and power engineering majors. It is a pioneering and comprehensive course that undertakes professional basic courses and subsequent professional courses. Its content mainly covers the development of refrigeration compressors, capacity regulation of reciprocating, rolling rotor, vortex, screw, and volumetric refrigeration compressors, and centrifugal refrigeration compressors. It is a typical course that involves diversification A course that integrates

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multiple fields and disciplines. Adjusting course content and reforming teaching methods based on enterprise needs, achieving an effective combination of "new engineering", "engineering education certification", and "school enterprise collaborative education", enhancing students' ability to apply knowledge in practice, and enabling them to quickly adapt to work positions[2].

2 Reform of curriculum objectives

According to the requirements of engineering education certification, the "Refrigeration Compressor" course should update its objectives to better align with the professional talent training objectives. Based on the "Curriculum and Graduation Requirements Association Matrix" of this major, the following course sub objectives should be reformed and set as shown in Table 1.

Table 1. Correspondence between training requirements and course objectives

Program Objectives	Training Requirement	Teaching objectives of the course
Course Objective 1	1.Knowledge of specialized knowledge in refrigeration and thermal equipment.	1.1 Master the basic structure, working principle and thermal performance of each type of refrigeration compressor. 1.2 Master the knowledge of mechanical, automatic control and other related disciplines required for this specialty. 1.3 To master the thermal and dynamic process of refrigeration compressor.
Course Objective 2	2.Ability to utilize the theoretical knowledge, research methods and experimental skills analytical methods learned to solve energy and power engineering problems.	2.1 Understand the basic design methods of various types of refrigeration compressors. 2.2 Understand the control of vibration and noise in refrigeration compressors. 2.3 Have the basic refrigeration compressor design ability.
Course Objective 3	3. Ability to plan and design solutions in terms of power equipment, and ability to analyze and judge professional issues.	3.1 Ability to design basic refrigeration compressors. 3.2 Ability to analyze compressor failures, determine compressor performance, and solve energy and power engineering problems. 3.3 Master the disassembly and assembly steps of refrigeration compressors.

Course Objective 4	4. Have certain humanities and artistic literacy, cultivate the spirit of rigor and truth-seeking, good quality, safety, service and environmental protection awareness, and establish the concept of energy saving and emission reduction.	4.1 To develop a correct outlook on learning, achievement and employment. 4.2 Have a certain spirit of innovation, entrepreneurial awareness and innovation and entrepreneurial ability. 4.3 Develop hands-on and collaborative literacy.

3 Refinement and integration of multidisciplinary knowledge of the curriculum

Based on the above course objectives, decompose and analyze the teaching content of the existing "Refrigeration Compressor" course, extract professional technical knowledge of various disciplines required in the course, combine various interdisciplinary content required by the new engineering construction teaching mode, integrate corresponding disciplinary knowledge and technology application with the course teaching content[3]。

Combining the current trend of diversified development of compressor products and their technologies, as well as emerging industries such as new energy technologies, new materials, and intelligent networking in the macro system of energy services. The curriculum teaching content after the reform mainly covers 7 project contents, including the development of refrigeration compressors, reciprocating system, rolling rotor type, vortex type refrigeration, screw type refrigeration, capacity adjustment of volumetric refrigeration compressors, and centrifugal refrigeration compressors. Corresponding interdisciplinary knowledge has been extracted and summarized in the corresponding course projects. The following are examples of projects with significant changes in knowledge structure.

In the "Reciprocating Refrigeration Compressor" project, based on the existing knowledge of refrigeration principles and equipment, the spirit of craftsmanship is integrated to enable students to have an optimistic attitude towards life, a pragmatic scientific attitude, and a tolerant attitude towards life. Based on the existing knowledge of refrigeration device design and cold storage process design, integrating the spirit of independent innovation, cultivating students to cultivate a spirit of exploration that is down-to-earth, proactive, and hardworking.

4 Construction of a collaborative education model between schools and enterprises in the curriculum

According to the latest professional training plan, this course has a total of 48 hours. In order to meet the requirements of the new engineering construction, the course is divided into 7 projects for teaching. The specific teaching hours are shown in Table 2.

Table 2. Curriculum hour allocation plan after the reform

Project	teaching model	Period Distribution
Development of refrigeration compressors	On campus classroom teaching	4 class hours
Rolling rotor refrigeration compressor		4 class hours
Vortex refrigeration compressor		4 class hours
Capacity adjustment of volumetric refrigeration compressors		4 class hours
Centrifugal refrigeration compressor		4 class hours
reciprocating refrigeration compressor	Collaborative teaching between schools and enterprises	14 class hours
Screw refrigeration compressor		14 class hours
Total		48 class hours

Table 3. Teaching personnel and teaching arrangements for the school enterprise collaborative teaching module of the course

Key project	Teaching staff	Teaching content	Time allocation
Reciprocating refrigeration compressor	On campus teachers	1. Basic structure and working principle; 2. Thermal performance;	6
	Enterprise teachers	3. Overall structure; 4. Vibration and noise.	8
Screw refrigeration compressor	On campus teachers	1. Work process and structural characteristics; 2. Main thermal performance parameters;	6
	Enterprise teachers	3. Stress analysis and main structural parameters; 4. Gas flow regulation.	8

By extracting and summarizing interdisciplinary knowledge of corresponding course projects, key projects can be selected based on the current industry and enterprise needs, and a school enterprise collaborative education teaching model for corresponding course projects can be constructed[4]. According to enterprise research and analysis of student employment, it can be concluded that the two teaching projects of reciprocating refrigeration compressors and screw refrigeration compressors are the key projects of this course, and are suitable for the collaborative education model of on campus and enterprise teachers, which is in line with the positioning of professional talents[5].Therefore, two school enterprise collaborative teaching projects were selected from the seven projects according to Table 3, and taught in a school enterprise collaborative teaching method. Each project had 14 class hours, while the remaining five traditional teaching projects on campus had 4 class hours for each project.For the two school enterprise collaborative teaching projects mentioned above, after reallocating the teaching content and corresponding course hours of the school enterprise curriculum, a teaching plan is constructed as shown in Table 3. Each project is taught 6 hours by teachers on campus and 8 hours by enterprise teachers.

Collaborative education between schools and enterprises has the following advantages: Firstly, cooperation between schools and enterprises can provide students with opportunities for internships and practical training; Secondly, cooperation between schools and enterprises can also provide students with career planning and employment guidance; In addition, cooperation between schools and enterprises can also promote the updating and optimization of teaching content; Finally, cooperation between schools and enterprises can provide students with more training in interpersonal communication and teamwork skills.

5 Course assessment and continuous improvement mechanism

In the process of course teaching, there may be difficulties and problems such as overlapping and contradictions in interdisciplinary knowledge integration, scattered knowledge that is difficult to summarize, conflicts in teaching content between schools and enterprises, and uncertainty in teaching time for enterprises. Therefore, evaluating student performance and ensuring that they achieve learning outcomes is an important part of the education process. Standardized tests, homework and classroom performance, projects and reports, self-assessment and reflection, skill demonstrations, questionnaire surveys, and interviews can be added[6]. Finally, in terms of continuous course improvement, the achievement of course objectives should be evaluated based on the annual course assessment results, and suggestions for continuous improvement should be proposed.

6 Conclusion

According to the requirements of the construction of new engineering disciplines and engineering education certification, the curriculum objectives and graduation requirements for "Refrigeration Compressor" have been reformed and updated. Various professional technical knowledge required for the course have been summarized, and the application of corresponding subject knowledge and technology has been integrated with the course teaching content. Seven teaching projects have been set up, including the development of refrigeration compressors, reciprocating refrigeration compressors, and rolling rotor refrigeration compressors, Two projects that are closely related to the needs of industry enterprises were selected as school enterprise collaborative teaching projects, and a school enterprise collaborative education teaching model was constructed; We have developed a curriculum assessment method and continuous improvement mechanism under the collaborative education model between schools and enterprises.

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