Exploration of Heat Exchanger Principle and Design Course Group Reform Based on "New Engineering and Technical Disciplines"

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Abstract: The paper combined with the "New Engineering and Technical Disciplines" construction proposed by the Ministry of Education, the problems existing in the teaching process of the "Principle and Design of Heat Exchanger" course of the energy and power engineering specialty in traditional engineering education are analyzed. The teaching reform plan for the construction of the "Principle and Design of Heat Exchangers" group is proposed, which mainly solves the design of teaching content that combines theory with practice, talent training and social needs. Through the course teaching methods for the construction of "New Engineering and Technical Disciplines" and the construction and exploration of teachers, it can provide reference and reference for the engineering quality education and teaching reform of energy and power majors.

Introduction

At present, a new round of science and technology and industrial revolution around the world is driving the formation and development of the new economy. Accordingly, the reform of higher engineering education has received unprecedented attention and universal attention[1].China promotes innovation-driven development, implements major strategies such as the “The Belt and Road”, “Made in China 2025, and Internet +”, and the vigorous development of a new economy represented by new technologies, new formats, new models, and new industries. High requirements urgently need to accelerate the reform and innovation of engineering education [2].In February 2017, the Ministry of Education issued the “Notice of the Higher Education Department of the Ministry of Education on the Research and Practice of New Engineering New Engineering and Technical Disciplines”. “New Engineering and Technical Disciplines" corresponds to emerging industries. First, it refers to specializations in emerging industries, such as artificial intelligence, intelligent manufacturing, robotics, and cloud computing. It also includes the upgrading and transformation of traditional engineering majors[3].Compared with the old engineering discipline, the "New Engineering and Technical Disciplines" places more emphasis on the practicability, cross-cutting and comprehensiveness of the discipline. The construction of the "New Engineering and Technical Disciplines" has brought unprecedented pressure and challenges to traditional engineering disciplines. The major of energy and power engineering, as a traditional engineering specialty, is very practical. Among them, the teaching of heat exchangers is essential, but there have been difficulties in how to play its good role for a long time. For this reason, it is necessary to explore and practice the teaching reform of the heat exchanger principle and design course based on the construction of "New Engineering and Technical Disciplines".

"New Engineering and Technical Disciplines" Requirements for Talents

Compared with traditional engineering talents, the emerging industries and new economy in the future need high-quality composite "New Engineering and Technical Disciplines" talents with strong engineering practice ability, innovative ability, and international competitiveness. The characteristics that should be possessed:

(1) Not only deep academic studies in a certain discipline, but also the characteristics of "interdisciplinary integration;

(2) Not only can use the acquired knowledge to solve existing problems, but also the ability to learn new knowledge and new technologies to solve problems in future development, and play a leading role in future technology and industry;

(3) Not only technically excellent, but also economic, social and management, and have a good human quality.

Problems in the Teaching of the Principle and Design of Heat Exchangers in Traditional Engineering Education

Deviation from Engineering Practice and Industry Standards. The principle and design of the heat exchanger itself is a fusion of principle and engineering practice. Practitioners must not only consider the function of the heat exchanger, but also consider the safety and economy of the heat exchanger. Engineering students generally have the concept of “emphasizing theory and neglecting practice”, that is, attaching importance to the theoretical realization of heat exchangers, and using this as the center of design, and for industry technical standards such as structures, materials, and construction involved in the design of heat exchangers The degree of attention is low, and even the technical factors of the industry are ignored in the concept of the heat exchanger. This misaligned engineering thinking makes it difficult to make the process design and structure design of the heat exchanger cooperate with each other closely and cause a disconnection. Traditional engineering education is mainly based on basic principles. For such a relatively practical and equipment-related course, the previous engineering practice teaching content is obviously insufficient, and it lacks the content of national industry technical standards for learning and penetration. This leads to the opposite thinking of actual engineering, which often starts from the details and lacks the grasp of the overall plan, so it cannot meet the actual requirements of engineering, and the students' practical application ability cannot be improved.

Contradiction of Teaching Content Method and Class Hours. This course was originally an elective course. It is open to energy and power engineering majors. The number of teaching hours is 32 hours, all of which are theoretical teaching in the classroom. The teaching plan is designed according to the selected teaching materials. Teachers are loosely connected, lack communication and exchange with other courses, and there is overlap in teaching content. In addition, for such a relatively practical and equipment-related course, there is a lack of course teaching settings for practical teaching. At the same time, energy and power engineering majors have limited teaching content and class hours on mechanical structure design, strength checking, etc., resulting in a large amount of teaching content and extensive coverage of heat exchanger principle and design courses. Due to the relatively small number of class hours and the lack of courses Design, field research and other practical links, so it is difficult to achieve teaching and learning effects.

Weak Foundation for Students' Professional Basic Courses. This course is mainly designed and a large number of formula calculations. For the specific explanation process, it often causes students to be fatigued and tedious. The course teaching is easy to form a relatively rigid teaching, and students have little interest in learning. At the same time, students lacked professional education and guidance in the lower grades, and gradually formed the wrong idea of focusing on principles but not engineering practice, disapproving the importance of engineering practice knowledge, not mastering the basic knowledge well, and weak professional foundations. The difficulty of learning in subsequent courses has become more difficult and the learning effect is not satisfactory.

Teaching Reform of Heat Exchanger Principle and Design Course Based on "New Engineering and Technical Disciplines ".

In order to meet the requirements for talent training of "New Engineering and Technical Disciplines", and to solve the problems existing in traditional engineering education, this paper proposes a teaching reform and exploration plan for the construction of heat exchanger principles and design courses based on the construction of "New Engineering and Technical Disciplines".

Optimize Talent Training Programs. According to the survey of social needs and feedback analysis of graduates, the principle and design of heat exchangers has been changed to a compulsory course. It is an important professional course for the training of professionals in energy and power engineering. Because the class time is only 32 hours, this course alone cannot To achieve the teaching effect of heat exchangers, Therefore, in the process of adjusting the professional talent training plan, through enterprise research and professional teacher discussions, the teaching content and form of the heat exchanger in the professional talent training plan were reasonably reformed and optimized, although there were no adjustments in class hours. However, major changes have been made in combination with professional talent training programs.

First, adjust the curriculum setting and teaching content of the training plan, learn the basic theoretical knowledge of heat transfer through the heat transfer course that was previously established, and deepen the students' intuitive understanding of the heat exchanger through the practical training of disassembly and assembly of energy power devices. Understanding of different structural forms of heat exchangers, through the training of engineering software, the expression of two-dimensional engineering drawings and three-dimensional modeling and analysis of heat exchangers, to deepen students' in-depth understanding of heat exchangers of different structural forms, Combined with the comprehensive experiments of heat exchangers (virtual simulation experiments) to strengthen the students' ability to combine theory and engineering practice, deepen their understanding of the theory, and strengthen engineering practice capabilities, Through the design of heat exchanger courses in combination with engineering examples and national industry standards, students' awareness of engineering design and application is improved. Combining the principles and design of heat exchangers with the reasonable arrangement and organization of each course content, in order to achieve the goal of cultivating students' overall theoretical and engineering practical ability of heat exchangers.

Secondly, although the content of the course is mainly lectures, it is not limited to teaching materials and the transfer of pure theoretical knowledge. It is also recommended that students refer to the content of heat exchanger design manuals, national and industry standards to assist in the study of the relevant knowledge of the course. Engineering practice and national industry standards to explain real cases; For the teaching design of this course, the foundation is to complete the two aspects of principle learning and design learning. However, the information feedback during the application and further education of students finds that this is not the only way to satisfy subsequent learning and applications, and the content needs to be expanded and optimized. Therefore, the teaching content is divided into five major aspects: heat exchanger principle, heat exchanger design, heat exchanger production and testing, heat exchanger optimization, and heat exchanger performance evaluation.

Finally, the foundation of students' practical application of engineering is strengthened by strengthening principle teaching.After completing this course, add a heat exchanger disassembly training course, and select a more commonly used heat exchanger type through the course design, and complete an overall design process based on specific structural parameters to deepen the understanding of the design content .The comprehensive experiment of heat exchangers with added testing, performance optimization, and performance evaluation content will guide students to learn the operation and management of heat exchangers while conducting learning design check, laying a deeper foundation for subsequent learning, work, and advanced studies.

The courses and teaching goals of heat exchanger principle and design are shown in Table 1.

Table 1. The courses and teaching objectives of heat exchanger principle and design course group

No.	Course Name	Teaching Aim
1	Energy Power Equipments Disassembly/Assembly Training	Students deepen their intuitive understanding of heat exchangers and strengthen their understanding of different structural forms of heat exchangers
2	Engineering software training	Representation of 2D engineering drawings and 3D modeling and analysis of heat exchangers to deepen students' deep understanding of heat exchangers with different structures
3	Comprehensive experiment of Heat Exchanger	Combining theory with engineering practice to deepen theoretical understanding and strengthen engineering practice capabilities
4	Principle and Design of Heat Exchanges	Comprehensive understanding of heat exchangers in accordance with national industry standards, enabling students to comprehensively and systematically master the principles of heat exchangers and engineering design application methods
5	Course Design of Heat Exchanges	Design with engineering examples and national industry standards to improve students' awareness of engineering design and application

Optimizing Course Teaching Methods. Teaching methods have an important effect on students' learning and mastery of teaching content.Based on the nature of this course group and the importance of teaching, in the teaching process, teachers take the main purpose of improving students' professional technical quality and ability, and apply engineering awareness, practical ability and innovation awareness to the principle and design group of heat exchanger throughout the teaching process.

(1) In the course of classroom lectures, curriculum design and experiments, and various image teaching activities, it can be explained as far as possible in combination with practical engineering application cases, using computer multimedia and network technology [4].

(2) Through the thermal energy equipment disassembly training course, let students practice the disassembly process of the heat exchanger, feel the overall structure of the heat exchanger.

(3) Using AutoCAD, UG, Ansys and other engineering software training to perform 2D engineering drawing expression and 3D modeling analysis on the heat exchanger.

(4) Introduce the principle and design of various specific heat exchangers in combination with the industrial application background during the teaching process.

(5) Let students carry out design experiments of heat exchangers through comprehensive experiments of heat exchangers and virtual simulation experiments.

(6) Set design topics similar to the actual project through the design of the heat exchanger course.

Faculty Construction for "New Engineering and Technical Disciplines". The construction of engineering teachers directly affects the quality of talent training, and is also the prerequisite and guarantee for the training of discipline professionals. Combining the characteristics of heat exchanger principles and design courses, the teaching team must also emphasize the combination of teaching and new domestic and foreign scientific research results and engineering practices.Teaching must be arranged with teachers with practical experience. Therefore, front-line teachers are required to have experience in heat exchanger research or corporate technical cooperation, as well as rich teaching practice experience. Our school has traditional professional advantages in the field of energy and power. There are many teachers engaged in scientific research on heat exchangers. The teaching team formed by the school has a solid overall level, a high level of structure, rigorous teaching, rich scientific research experience, and remarkable results. The formed team of teachers can ensure that the theory and practice are not disconnected, with the depth and breadth of the development of the frontiers of the discipline, and at the same time have a wealth of curriculum teaching expertise, engineering

awareness, and awareness of national industry standards. Through the construction of a high-quality teacher team, the teaching quality of the heat exchanger principle and design course group was ensured, and then the construction of the "New Engineering and Technical Disciplines " of the energy and power engineering specialty was promoted.

Conclusion

The development of engineering education for new engineering disciplines should not discard traditional engineering disciplines, but should make traditional engineering disciplines more in line with the laws of scientific development and meet the requirements of the new economy. The concept of the new engineering subject should be implemented through the curriculum system, and the construction of a new curriculum system is also the core of engineering education [5]. Through the teaching reform and exploration of the construction of heat exchanger principles and design courses, we will gradually promote the upgrading of the major of energy and power engineering. Based on the teaching concept of new engineering, the goal of professional construction of "New Engineering and Technical Disciplines " can be achieved through the reform of teaching content, the improvement of teaching methods, and the construction of teachers.

References

[1]. A.H.Wu, Y.F.Hou and Q.B.Yang: Research in Higher Education of Engineering,(2017)No.1,p1-9. (In Chinese)

[2]. Z.W. Zhu, H.F. Zhou and M.G. Li: Chongqing Higher Education Research,Vol.5 (2017)No.3, p15-21. (In Chinese)

[3]. H.Li, N.Hu and Z.S.You: Research in Higher Education of Engineering, (2017)No.4,p16-19. (In Chinese)

[4]. X.Y.Cui, S.D.Sun and Y.Wan: The Chinese Journal of ICT in Education,(2013)No.10,p56-58. (In Chinese)

[5]. M.Ye, H.Qian: Research in Higher Education of Engineering, (2017)No.4,p5-9. (In Chinese)