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Courses Teaching Research and Application of Advanced Fluid Mechanics under the Integration of Industry-Education

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Abstract: The integration of industry and education is an education mode that combines industry and education. Through the deep cooperation between industry and education, the close combination of talent training and industrial demand can be realized, and the win-win situation of industrial upgrading and talent training can be promoted. With the deepening of the integration of production and education, the teaching of advanced fluid mechanics is facing new challenges and opportunities. Based on the analysis of the teaching status of the advanced fluid mechanics course, this paper discusses the teaching reform and practice of the advanced fluid mechanics course under the background of the integration of production and teaching, in order to improve the teaching quality and train the fluid mechanics talents with innovative and practical ability.

Keywords: Integration of production and education, Advanced fluid mechanics, Teaching reform

1. Introduction

The teaching concept of industry-teaching integration originated from western developed countries, and has been widely recognized due to its obvious effect on the enhancement of students' innovation and practical ability in the cultivation of talents in colleges and universities[1].For example, the approach to industry-education integration used in the United States is cooperative educational practices, whereby work-learning alternates[2].Students study in universities and enterprises respectively in different semesters, and apply the theoretical knowledge learned in school through practice in enterprises, which contributes to the significant improvement of practical ability and innovation ability. Due to the obvious effect of talent training, this mode of integration of production and education has been widely promoted and valued in the world. In addition, there are also the "sandwich" model in the United Kingdom, the industry-academia-government model in Japan, the "dual system" in Germany and the "teaching factory" in Singapore. These modes of personnel training through the integration of industry and education have achieved great success in their respective countries. With the gradual deepening of reform and opening up, more and more colleges and universities in China realize the benefits of industry-teaching integration mode for talent cultivation, and gradually begin to try and explore in the teaching process. Fluid mechanics is an important basic discipline in the field of engineering, which plays an important role in cultivating students' engineering practical ability. Under the background of industry-teaching integration, the teaching of higher fluid mechanics courses needs to pay more attention to the combination of theory and practice, and cultivate students' innovative ability and practical ability.

Advanced fluid mechanics is an important professional basic theory course offered by colleges and universities for postgraduates, which plays a crucial role in the training of engineering postgraduates. Due to the numerous and abstract basic concepts of the course, students are easy to fall into complex mathematical formulas, while ignoring the thinking and understanding of the physical nature of flow characteristics. At present, the basic concepts of advanced fluid mechanics courses are many and abstract, and the traditional teaching methods are out of touch with the development of modern science and technology and the real needs of industry. The traditional teacher-led one-way teaching mode focuses on the explanation of basic concepts and the derivation of formulas, and does not involve the actual problems in enterprise production and technology research and development. Although some colleges and universities have begun to use modern educational technology to reform the advanced fluid mechanics curriculum, there is still no perfect teaching system combining with engineering, so it cannot meet the requirements of training research-oriented innovative talents in the field of fluid mechanics, and restricts the development of graduate education. More and more colleges and universities realize that the integration model of production and teaching is not perfect for the course of advanced fluid mechanics, so they gradually begin to try and explore in the teaching process.

2. Current problems encountered in teaching

Under the background of the integration of production and education, the teaching research and practice needs of advanced fluid mechanics courses are combined with the actual industry needs to cultivate students' practical ability and the ability to solve practical problems. At present, there are some problems in the process of industry-teacher-research cooperation: There is a big difference between students' practical ability and industry

demand; The enthusiasm of enterprises to participate in the integration of industry and education is not high; The lack of single teachers and "double-qualified" teachers leads to the inability to meet the requirements of application-oriented personnel training; The government, universities and enterprises do not cooperate strongly. These problems lead to the lack of depth of the integration of production and education, which can not play a role in the cultivation of practical ability, innovation ability and employ-ability. Therefore, in view of these problems, this paper carries on the research and practice of advanced fluid mechanics course teaching under the background of the integration of production and education[3-5].

The integration of production and education promotes the mechanism of collaborative education of innovation and entrepreneurship in colleges and universities, and strengthens the innovation and entrepreneurship ability of college students. Collaborative education requires the government, enterprises and schools to coordinate with each other, mutual benefit and common development, in order to achieve the goal of cultivating diversified talents, otherwise it will be merely a formality and will not play a practical role.

3. Teaching content reform and research

Under the background of industry-education integration, the teaching content of higher fluid mechanics needs to be reformed to meet the development needs of the industry. The reform of the teaching content of higher fluid mechanics is discussed through the combination of theory and practice, the introduction of industry case studies, the enhancement of experimental links with engineering projects, the emphasis on cultivating students' engineering awareness and application ability, the emphasis on cooperation and communication with the industry, and the establishment of a course evaluation system that is in line with the industry.

(1) Combine theory with practice

Advanced fluid mechanics is a highly theoretical subject. As the basic concepts of the course are numerous and abstract, students are easy to fall into complex mathematical formulas and neglect the thinking and understanding of the physical nature of flow characteristics. The traditional teacher-led one-way teaching mode focuses on the explanation of basic concepts and the derivation of formulas, and does not involve the actual problems in enterprise production and technology research and development. However, in practical engineering, the application of theoretical knowledge needs to be combined with specific situations. Therefore, in the reform of teaching content, we should pay attention to the combination of theory and practice, so that students can understand its application in practical engineering while mastering theoretical knowledge.

(2) Introduce industry case studies

Introducing industry case studies can help students better understand the theoretical knowledge, and at the same time, it can make students understand the latest development of the industry. Through case studies, students' ability to analyze and solve problems can be improved, laying a foundation for their future careers.

(3) Strengthening the interface between experimental sessions and engineering projects

Experiment is an important part of advanced fluid mechanics teaching, through which students can deepen their understanding of theoretical knowledge. In the reform of teaching content, we should strengthen the connection between experiment and project, make the experiment content closer to the actual project, and improve the students' practical operation ability.

(4) Focus on developing students' engineering awareness and application skills

The teaching goal of advanced fluid mechanics is not only to let students master the theoretical knowledge, but also to cultivate their engineering consciousness and application ability. Therefore, in the reform of teaching content, emphasis should be placed on cultivating students' engineering consciousness and application ability, so that students can use their knowledge to solve practical problems.

(5) Emphasize cooperation and communication with industry

Cooperation and communication with the industry is an important way to reform the teaching content of higher fluid mechanics. Through the cooperation and communication with the industry, we can understand the latest dynamics and needs of the industry, and at the same time, we can provide more practice opportunities for students and improve their practical ability.

(6) Establish a curriculum evaluation system that is aligned with the industry

Establishing a course evaluation system that is aligned with the industry is an important guarantee for the reform of higher fluid mechanics teaching content. By establishing a curriculum evaluation system that is

aligned with the industry, students can be evaluated for their practical operational and problem-solving abilities, while also providing feedback and basis for the reform of teaching content.

4. Teaching content reform and research

Traditional teaching methods have been unable to meet the needs of modern education. Under the background of the integration of production and education, the teaching methods of advanced fluid mechanics courses need to be adjusted accordingly to adapt to the new educational environment. Yan Xiaokang et al. applied the case teaching method to the teaching of advanced fluid mechanics in postgraduate courses, combining engineering cases related to chemical engineering with traditional theoretical teaching[6]; Chen Liping et al. adopted interactive teaching method to strengthen the interaction between teachers and students, and took the degree of graduate students' participation in the discussion as the focus of assessment[7]. Based on the analysis of the characteristics of the course of multiphase fluid mechanics and the teaching purpose of "student-oriented"; Zheng Ping proposed reform measures from the aspects of innovative teaching schemes, focusing on practical operations and optimizing assessment methods[8]. In terms of the international cooperative teaching of the course, Chongqing University cooperated with the National University of Singapore to introduce full English teaching of fluid mechanics, which not only enabled students to master the course content, but also made them understand the application of the course in engineering and scientific research[9].

5. Strengthening school-enterprise cooperation

As a basic course of science and engineering majors, how to improve teaching quality and students' practical ability through school-enterprise cooperation has become a hot issue in current research.

(1) The significance of school-enterprise cooperation

Through school-enterprise cooperation, students can apply what they have learned in business practice and improve their practical ability and problem-solving ability. Enterprises can obtain talents that meet their own needs and improve their competitiveness and innovation ability. School-enterprise cooperation can promote industry-university-research cooperation between schools and enterprises, and realize resource sharing and mutual benefit and win-win situation.

(2) Develop and implement the teaching plan

According to the actual needs of enterprises and schools, the teaching program of higher fluid mechanics courses is formulated, focusing on the cultivation of practical ability. Under the joint participation of enterprises and schools, the teaching activities of higher fluid mechanics courses are carried out, including theoretical teaching, experimental operation and enterprise practice. Finally, the teaching effect of higher fluid mechanics courses under the mode of school-enterprise cooperation is evaluated and analyzed through questionnaires, interviews and case studies. Strengthening school-enterprise cooperation in the teaching of higher fluid mechanics courses focuses on the practicality of teaching content, the diversity of teaching methods and the comprehensiveness of teaching evaluation, in order to cultivate more excellent talents who meet the needs of enterprises. Meanwhile, the government and the community should strengthen the support and promotion of the integration of industry and education to promote the reform and development of higher education.

6. Strengthen the construction of teaching staff

With the deepening of the integration model of production and teaching, the problem of teacher team construction in the teaching of advanced fluid mechanics has become increasingly prominent. In order to adapt to the new educational situation and improve the teaching quality and students' comprehensive quality, it is particularly important to strengthen the construction of teaching staff. Scholars at home and abroad have done a lot of research on the construction of the teaching staff of advanced fluid mechanics course. The existing research shows that the quantity, quality and structure of teaching staff have an important impact on teaching quality and students' comprehensive quality. However, there are still some problems in the construction of the teaching staff of advanced fluid mechanics courses under the background of the integration of production and education, such as insufficient number of teachers and low teaching quality.

In response to these problems, the use of measures such as strengthening training, introducing talents and optimizing structures will help improve the quality of teaching and the comprehensive quality of students. Meanwhile, future research can further explore how to promote the in-depth promotion of the industry-teaching integration model and improve the quality and level of higher education by strengthening the construction of the faculty. It is also suggested that education departments and schools should strengthen the training and management of the faculty, provide more learning and exchange opportunities for teachers, optimize the structure of the faculty, and improve the comprehensive quality and teaching ability of teachers. This will help

to cultivate more high-quality fluid mechanics talents and make greater contributions to the scientific and technological progress and economic development of the country.

7. Conclusion

The reform research and practice on the teaching of advanced fluid mechanics under the background of the integration of production and education is helpful to improve the teaching quality and cultivate fluid mechanics talents with innovative and practical ability. Through the reform research and practice of teaching content, teaching method, strengthening school-enterprise cooperation and teacher team construction, it can better meet the market demand and improve the employment competitiveness of students. In the future teaching, it is suggested to continue to strengthen the integration of production and education, deepen the cooperation between schools and enterprises, and establish a closer cooperative relationship. At the same time, we should pay attention to the cultivation of students' practical ability and innovative ability, strengthen the construction of teachers, and improve teachers' practical ability and teaching level. Through these measures, we can better promote the teaching reform and practice of advanced fluid mechanics courses, and train more excellent fluid mechanics talents.

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