《Fixture Design and Application》Reform and Practice of Curriculum Teaching

Zhenli Guo, Yunlei Qi, Xiuling Wang, Xiaoli Wang

Changchun Technical University of Automobile, Changchun ,Jilin 130000

Abstract: "Fixture Design and Application" is one of the important core courses for mechanical majors in vocational undergraduate colleges. It teaches welding fixtures, the second largest production process among the four major processes in automobile production. It is a core course that combines theory and practice, closely linking knowledge in multiple fields such as mechanical design, manufacturing processes, and tolerance and fit. It is a key carrier for cultivating students' engineering practice ability and innovative thinking. However, under the traditional teaching model, this course often faces issues such as the disconnect between theory and practice, low student learning enthusiasm, and teaching effectiveness that is difficult to meet industry needs. Traditional teaching methods and curriculum system settings have been unable to adapt to the current teaching effectiveness and the corresponding requirements of talent cultivation goals in higher vocational colleges. In response to the problems existing in the teaching links and curriculum system of the "Fixture Design and Application" course, this paper conducts comprehensive reforms and teaching practices in classroom teaching and practical teaching of the course. Using enterprise cases as a carrier, it visualizes abstract theoretical knowledge and professional knowledge, allowing students to understand the application logic of knowledge in a real workshop production scenario. This has improved and enhanced the teaching effectiveness to a certain extent, strengthened students' innovation ability and practical ability, and achieved the corresponding educational reform goals.

Keywords: fixture design; teaching content; teaching method; reform practice

DOI:10.12417/3029-2328.26.03.006

The course "Fixture Design and Application" is one of the specialized courses in mechanical engineering majors. Its content includes: the development and application of modern welding fixtures, the design principles and specifications of welding fixtures, the design process of welding fixtures, and the digital design of welding fixtures. With the development of modern mechanical manufacturing technology and the widespread application of electronic computer technology, the three-dimensional design of fixtures is also constantly evolving, and new types of fixtures are emerging endlessly. The traditional curriculum system of "Fixture Design and Application" alone is no longer able to meet the market's requirements for talent cultivation in vocational colleges. The teaching content and methods of this course urgently need to be integrated and optimized. This article attempts a comprehensive reform and teaching practice in the classroom and practical teaching of the "Fixture Design and Application" course, which has important practical significance for further curriculum reform.

1.《Fixture Design and Application》Analysis of the current situation of course teaching

1.1 The teaching content is disconnected from industry needs

The traditional teaching content of the "Fixture Design and Application" course primarily focuses on the theoretical explanation of classic fixture structures, such as the classification and working principles of general-purpose fixtures. However, it seldom involves new fixture technologies that have emerged in the context of intelligent manufacturing, such as flexible fixtures, welding islands, and digital design and simulation technologies. In actual industrial production, enterprises place greater emphasis on the efficiency, flexibility, and intelligence of fixtures. Fixture design schemes that can quickly respond to diverse and small-batch production needs are particularly favored. The disconnect between teaching content and actual industry demands leads to difficulties for students in quickly adapting to the working environment of enterprises after graduation, making it impossible for them to meet the skill requirements of enterprises.

1.2 The teaching method is monotonous, and the practical component is weak

In terms of teaching methods, most classes are still dominated by teacher-led lectures, with students passively receiving knowledge and lacking opportunities for active thinking and interactive communication. This "spoon-feeding" teaching model struggles to stimulate students' interest in learning and foster innovative thinking. Students' understanding of knowledge remains superficial, unable to grasp the core essentials of fixture design in depth. Meanwhile, practical teaching sessions often become a mere formality, with practical projects mostly consisting of verification experiments. Students follow predetermined steps, lacking space for independent design and exploration. Furthermore, practical teaching equipment is outdated and limited in number, making it difficult to meet the practical needs of a large number of students. Consequently, students' hands-on operation skills and ability to solve practical problems are not effectively honed.

1.3 One-sided assessment methods and imperfect evaluation system

The current course assessment primarily relies on final exam scores, supplemented by scores from regular homework and lab reports. This assessment method overly emphasizes the memorization of theoretical knowledge and neglects the evaluation of students' practical abilities, innovation capabilities, and team collaboration skills. Students resort to rote memorization of knowledge points to prepare for exams, lacking comprehensive application and innovative practice of knowledge. Furthermore, there is a lack of effective monitoring and evaluation of students' learning processes during the assessment, which fails to comprehensively and objectively reflect students' learning situations and ability levels. This is not conducive to students' personalized development and overall quality improvement.

2 《Fixture Design and Application》Strategies for curriculum teaching reform

2.1 Reconstruct teaching content to align with industry development needs

Guided by industry needs, the teaching content of the "Fixture Design and Application" course has undergone comprehensive reconstruction. On the one hand, the core content of classic fixture design theory, such as the role of fixtures, RPS positioning principle, and design of positioning and clamping mechanisms, has been retained to ensure that students acquire a solid theoretical foundation. On the other hand, cutting-edge technologies and application cases in the intelligent manufacturing field of original equipment manufacturers have been timely incorporated, including flexible fixture design, sensing and control technology for welding islands, and digital design and simulation of fixtures based on CAD/CAM/CAE, to synchronize the teaching content with industry development. For instance, typical cases from actual enterprise production, such as the design and application of slide table fixtures and welding island fixtures in automobile body-in-white welding, are introduced during the explanation of fixture design. This allows students to understand the latest industry trends and practical needs, enhancing their awareness of knowledge application and innovation ability.

2.2 Innovate teaching methods and strengthen practical teaching links

(1)Project-based teaching method: The course content is broken down into several projects with practical application value, such as the design of positioning clamping components, sliding table components, and positioning pin components. Using enterprise projects as a carrier, students are guided to independently complete the entire process from process analysis, scheme design, 3D structural design to simulation verification. During the project implementation process, teachers only act as mentors, providing students with necessary technical support and guidance on thinking. This approach fully leverages the students' subjective role and cultivates their autonomous learning ability, team collaboration ability, and ability to solve practical problems.

(2)Online and offline blended teaching model: Utilizing online teaching platforms, such as XueXiTong, to establish an online learning resource library, including teaching videos, courseware, case analysis, welding process videos, virtual simulations, etc., students can engage in autonomous learning anytime and anywhere according to

their own learning progress and needs. Offline classes, on the other hand, focus on interactive teaching methods, such as group discussions, case studies, practical operation guidance, etc. Through the organic combination of online and offline teaching, complementary advantages are realized, enhancing teaching effectiveness. For instance, students can learn the basic theoretical knowledge of fixture design online, and conduct 3D structural design of fixtures in the training room offline, closely integrating theoretical knowledge with practical operations.

(3)Combining virtual simulation with practical operation: By introducing virtual simulation teaching software such as CATIA and PDPS, students can engage in digital design, assembly, and simulation analysis of fixtures in a virtual environment. This allows them to identify and optimize issues in their designs early on, thereby reducing cost wastes caused by design errors. Simultaneously, laboratory construction is enhanced, equipped with advanced fixture design and manufacturing equipment, providing students with ample opportunities for practical operation. Through the organic integration of virtual simulation and practical operation, both the cost of practical teaching is reduced and students' practical operation and innovative design abilities are improved.

2.3 Improve the assessment and evaluation system to promote the comprehensive development of students

Establish a diversified and comprehensive assessment and evaluation system to comprehensively and objectively assess students' learning progress and ability levels. The assessment content should not only include the mastery of theoretical knowledge but also cover multiple aspects such as practical operation ability, innovative design ability, and team collaboration ability. The specific assessment methods are as follows:

(1)Process assessment: Strengthen the monitoring and evaluation of students' learning processes, including classroom performance, participation in group discussions, class attendance, and quality of homework completion. The process assessment score accounts for 30% of the total score. Through process assessment, timely identify problems that students encounter in their learning process, provide targeted guidance and assistance, and promote their continuous progress.

(2)Practical assessment: A dedicated practical assessment segment is set up, requiring students to independently complete a complete fixture design project, such as the design of positioning and clamping components, slide table components, positioning pin components, etc. The assessment comprehensively evaluates students' practical operation skills and innovative design abilities, covering everything from process document analysis to 3D structural design, and then to dynamic simulation analysis of interference and inspection. The practical assessment score accounts for 40% of the total score.

(3)Final Exam: The final exam combines closed-book and open-book formats. The closed-book exam primarily assesses students' mastery of basic theoretical knowledge, while the open-book exam focuses on their ability to comprehensively apply knowledge and demonstrate innovative thinking skills. The score from the final exam accounts for 30% of the total grade.

3.Practical effects and prospects of teaching reform

3.1 practical effect

By implementing the aforementioned teaching reform strategies in the "Fixture Design and Application" course, remarkable teaching outcomes have been achieved. Students' learning enthusiasm and initiative have significantly increased, and their classroom participation has greatly improved. Their understanding and application abilities of fixture design knowledge have been effectively enhanced. In practical projects, students are able to independently complete fixture design tasks, propose innovative design schemes, and their team collaboration skills and ability to solve practical problems have also been honed. Furthermore, graduates have significantly enhanced their competitiveness in the job market and have received widespread praise from small and medium-sized enterprises.

3.2 Future Prospects

Although this teaching reform has achieved certain results, there are still some shortcomings, such as the need

to accelerate the update speed of educational resources for enterprise welding production lines and further strengthen the construction of practical teaching bases. In the future, we will continue to deepen teaching reforms, continuously improve teaching content and methods, strengthen cooperation and exchanges with enterprises, establish a platform for industry-university-research cooperation, introduce more actual enterprise projects into teaching, and allow students to learn and practice in real engineering environments. At the same time, we will continue to optimize the assessment and evaluation system, explore more scientific and reasonable evaluation methods, promote the comprehensive development of students, and make greater contributions to cultivating high-quality engineering talents and master craftsmen who can adapt to the development needs of intelligent manufacturing in the new era.

4 Conclusion

The teaching reform of the "Fixture Design and Application" course is a long-term and arduous task that requires educators to continuously explore, innovate, and practice. By reconstructing teaching content, innovating teaching methods, improving the assessment and evaluation system, and implementing a series of reform measures, we can effectively address the issues existing in traditional teaching models, enhance the quality of course teaching, cultivate students' engineering practical abilities and innovative thinking, and meet the industry's demand for high-quality engineering talents. In future teaching work, we will continue to be student-centered and industry-oriented, continuously deepen the teaching reform of the course, and contribute to the development of engineering education.

References:

[1] Zhang Jifu.Teaching Reform and Practice of Machine Tool Fixture Design Course[J].Economics and Management Science;Engineering Science and Technology Series I;Social Sciences Series II,2015,6.

[2] Zhu Jiehong,Tan Jinghuang.Teaching Reform and Practice of"Mechanical Manufacturing Technology and Fixture Design"Course[J].Engineering Science and Technology II;Engineering Science and Technology I;Social Sciences II,2023,12.