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Original Research Article

Analysis of the Construction of Comprehensive CNC Training Course for Application-oriented Undergraduate in New Situation

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Abstract: Computer Numerical Control (CNC) comprehensive training courses are the core courses of application-oriented undergraduate mechanical majors. Traditional CNC training has been unable to adapt to the development of society. In order to fit the current teaching system and train qualified application-oriented CNC technical personnel, the teaching content, teaching implementation and quality evaluation of the NC comprehensive training course were reconstructed, and a suitable environment for the current intelligent manufacturing was created under the practical teaching system.

Keywords: NC Comprehensive Training; Application-oriented Undergraduate; Teaching Methods; Teaching Reform

In the context of "Made in China 2025", there is a huge demand for "smart manufacturing" talents. New engineering majors are used for the upgrading of traditional engineering majors such as intelligent manufacturing and robots. Compared with traditional engineering talents, the future emerging industries and new economic need high-quality versatile new engineering talents with strong practical ability, innovative ability and international competitiveness[1]. The CNC comprehensive training course is a professional core course for mechanical majors. The course reform should not only emphasize the transfer of basic knowledge and cultivate professional abilities, but also focus on establishing students' safety awareness, civilization awareness, responsibility awareness, engineering awareness and teamwork ability. Therefore, it is imminent to reform and explore the comprehensive practical CNC courses for cultivating application-oriented undergraduates.

1. The current status of talent demand and the current status of NC comprehensive training

CNC comprehensive training courses are the core courses of mechanical specialties. With the continuous development of the machinery industry towards intelligence, integration and flexibility, in order to improve the market competitiveness of various manufacturing companies, products are constantly updated and upgraded, and the market put forward new requirements for vocational skills[2]. However, the numerical control technology courses in most local colleges in China still use the teaching mode of classroom lectures. The teaching ideas are rigid, the classroom lacks vitality, and the teaching objectives and content are difficult to integrate with the needs of enterprises and are seriously out of line with the needs of enterprises. Some local colleges and universities have integrated the concept of industry-education integration into the courses of CNC technology, but most of them are only changes in teaching methods, especially in Xinjiang. It is difficult to combine the characteristics of students' intelligence, give full play to

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the students' hand-on skills and thinking, and adopt the talent training concepts of "teach during practicing and practice during teaching" and "learn from practicing and learn from teaching", to cultivate skilled and technical talents. College teachers do not work in enterprises, and do not understand the latest development of enterprise products, which has led to difficulties in curriculum construction. The lagging of teaching content and goals is a fundamental problem in teaching reform. Therefore, in-depth enterprise research, development of enterprise technical services, and participation in enterprise product R & D. The content setting, link organization, program implementation and quality evaluation should be reconstructed in order to truly make sure the application-oriented CNC comprehensive training course "derived from the enterprise, but higher than the enterprise".

2. Curriculum reform strategies

The traditional exam-oriented education and subject curriculum system can no longer meet the requirements of modern application-oriented undergraduate courses. In order to comprehensively improve the teaching quality of applied undergraduate professional courses and adapt to the needs of social occupations, project-oriented and task-driven teaching methods are adopted to enhance students' job vocational abilities. CNC comprehensive training is the core course of mechanical specialty. The content of the course is to train students according to the professional requirements, so that students can acquire knowledge and professional skills in the teaching process. The course instructional design should be action-oriented, following the process of "consultation, planning, decision-making, implementation, inspection, and evaluation". In the learning based on professional scenarios, through the interaction between teachers and students and between student cooperation, students can master professional skills and practical knowledge in practice, and actively build their own knowledge system[3]. The course emphasizes that students "teach during practicing and practice during teaching" and "learn from practicing and learn from teaching", and the work process is unified with the learning process. The entire teaching process takes typical work tasks as the carrier and links relevant knowledge. As the subject of learning actions, students have independent planning, implementation and evaluation capabilities when solving practical problems. The teaching content of the course can be based on typical projects, and the design should from easy to difficult, which is in accordance with the cognitive laws of people. The teaching organization requires that every four students form a group, and each student takes turns to play the production team leader, machining technologists, machining programmers and tool operators in four different teaching projects. In this case, students can improve CNC production organization coordination ability, machining process analysis ability, machining programming ability and machine tool operation ability[4]. In addition, teachers should integrate the ideological and political elements into the course, to establish students' national awareness, security awareness, civilization awareness, responsibility awareness, teamwork and engineering literacy awareness, and craftsmanship spirit. Through the teaching reform, the problems such as the unclear positioning of the previous curriculum, the disconnection of knowledge in the learning process of the students, and the difficulty of linking the learning content with the employment market are solved.

The comprehensive CNC training course is a professional main course of Mechanical Electronic Engineering, Robot Engineering, Mechanical Design and Manufacturing, and Automation majors. It carries the core competence training tasks of Mechanical Electronic Engineering, Robot Engineering, Mechanical Design, Manufacturing, and Automation. The course organically integrates the knowledge of mechanical drawing, mechanical manufacturing foundation, CNC machining technology and programming, metal materials and heat treatment, tolerance and cooperation, CNC machine tool fault diagnosis and maintenance, etc., and lays a solid foundation for subsequent training. The design of the course project is based on the knowledge and ability of the professional CNC occupations, and the geometric elements such as outer circle, inner hole, chamfering, groove, undercut, arc surface and triangular thread that consist a typical carrier. It adopts the task-driven method as the main approach, combining the teaching method, on-site demonstration method, group cooperation and discussion method, and guidance text teaching method. It combines theory and practice and has achieved good teaching results.

Student scores are composed of two parts: normal grades and final grades, which account for 40% and 60% of the total grades respectively. Training attendance and training artifacts are the main assessment indicators for students'

performance assessment, and training exams are important indicators for the final grade. The assessment method adopts a hierarchical system, which is divided into five levels: excellent, good, medium, qualified and unqualified. Students obtain corresponding results by participating in practical training and assessment. The scoring criteria include five levels: excellent, good, medium, passing and failing. If students' examination papers are qualified and their training attitude is correct, they can complete the training tasks well and meet all the requirements specified in the training outline, their training report is rich in content and comprehensive, they can use the professional knowledge learned to train the training, and they can analyze the problems that arise and make innovations, then they are excellent students. If the content of the training report is better to be moderate, the exams are basically qualified, the training attitude is correct, the main content of the training is completed, the basic requirements specified in the training outline are met, and the training can be completed, the content is basically correct, but it is not complete enough, the students will receive a pass. If the test paper is unqualified, the training attitude is not correct, the training task is not completed, and the basic requirements specified in the training outline are not met, the student will fail the course. (90-100 is excellent ; 80-90 is good; 70-80 is medium; 60-70 is passing; below 60 is failing)

In order to strengthen practical teaching and improve students' practical ability, the school also needs to strengthen hardware teaching facilities, such as the establishment of CNC training bases, including CNC simulation training room, CNC training workshop, CNC electrical training room, CAD/CAM laboratory. Teaching equipment should meet the teaching requirements such as computer-aided design (CAD), computer-aided process analysis (CAPP), computer-aided manufacturing (CAM) and numerical control simulation, etc., to provide good conditions for students to learn.

3. Conclusion

With the continuous development of the machinery industry towards intelligence, integration and flexibility, various manufacturing companies have continuously updated and upgraded products in order to improve market competitiveness. In order to make the combination of work and learning more closely, teachers should frequently go deep into the enterprise and provide technical services for the enterprise. While serving the enterprise, they should also learn about the advanced technology in the enterprise, increase their experience in practice, update professional knowledge, and improve practical ability in the practice of the enterprise. At the same time, teachers need also to master the new developments of related enterprise products and the new requirements of enterprises on students' professional ability, which provide more powerful support for the further reform of the curriculum.

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