

Research on Teaching Reform in CNC Machining for Vocational Colleges

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ABSTRACT

To conduct CNC Machining practical training Curriculum Reform, first determine the orientation of the practical training teaching reform to achieve work-integrated learning with curriculum-based ideological and political education throughout. Finish the Curriculum Reform top-tier design, dividing the Curriculum Reform into four steps: "enterprise research design of teaching practice research – Reflection and Improvement". In the Curriculum Reform practice, according to enterprise requirement, integrate new processes and technologies, divide teaching module, select real enterprise case as the teaching carrier, compile a loose-leaf workbook incorporating curriculum-based micro-ideological and political content, and improve the Integration of Moral Education and Technical Skills CNC Machining practical training course content. Pay attention to integrating national sentiments, craftsmanship, and quality consciousness. Compile a loose-leaf workbook that adapts to the development requirement of occupation qualities and occupation skills. Conduct online and offline remix teaching. Take advantage of the online Diagnostics incentive feature to reform the rate method and conduct a more comprehensive student rate.

KEYWORDS

Digital control machining training ;School-enterprise cooperation;School-enterprise cooperation;Work-integrated learning

1 Introduction

In May 2020, the Ministry of Education issued the "Guidelines for Curriculum-Based Ideological and Political Education in Higher Education Institutions," emphasizing that curriculum-based ideological and political education should center on comprehensively improving talent cultivation, be fully implemented across all universities, disciplines, and majors nationwide, foster a broad consensus on its principles, enhance teachers' awareness and capabilities in its implementation, improve the mechanisms for its coordinated promotion, and further improve the effectiveness of moral education in universities. In response, universities have actively used Curriculum Reform to align all courses with ideological and political theory courses, creating a synergistic effect. However, the integration of ideological and political education in CNC Machining practical training courses remains superficial, often limited to aspects like "5S management" and "team collaboration" ^[1-4]. Therefore, further research is needed to deepen this integration, ensuring that ideological and political education and technical training are aligned, comprehensively improving the quality of talent cultivation, and fostering high-caliber workers and skilled technicians.

2 CNC machining practical training course reform goal

2.1 Achieve Integration with CNC machining operation occupations

Based on relevant enterprise surveys, it has been discovered that equipment manufacturing enterprises are not satisfied with students' job skills and professional qualities. The root cause is that the technology taught in school courses lags behind the actual production of enterprises, resulting in a disconnect between schools and enterprises. It is necessary to deepen Curriculum Reform and introduce new technologies and processes related to CNC Machining technology into curriculum teaching. For example, as a CNC Machining Practical Training Course, it is necessary to take the enterprise's requirement for talents into account, and take the operation skills of high-end CNC machine tools and related machining processes as the content of the training. Set up training on the operation of CNC multi-axis machine tools, especially five-axis linkage milling machine operation, and turning-milling composite machining machine tool operation. Compile related processes and programs to shorten the gap between schools and enterprises, achieve integration of occupations and courses, and improve the employment competitiveness and sustainable development competency of CNC technology discipline students.

2.2 Implementing ideological and political education throughout the course

Moral education and talent cultivation are fundamental to universities. As a core professional course, it must fulfill the function of nurturing students. CNC Machining practical training under Curriculum Reform should fully leverage the ideological and political resources inherent in the CNC industry and related professional courses. This involves integrating professional quality requirements into technical skills training, organically blending ideological and political micro-

elements, professional micro-competencies, and skill-based micro-behaviors. The aim is to create a "CNC Machining practical training" course that seamlessly integrates professional and quality education. By employing strategies such as "highlighting key points" and "thematic embedding," we can establish a comprehensive educational framework that spans the entire process and curriculum. This ensures the consistent integration of ideological and political education throughout classroom teaching, fostering students' professional responsibility and sense of mission, enhancing their professional qualities, and cultivating a substantial cohort of reliable successors for socialism with Chinese characteristics.

3 CNC machining practical training curriculum reform top-tier design

Focusing on the development trends of occupation skills and occupation qualities required for CNC turning and milling positions, talent specifications, and other core factors under the domain of new technologies, new positions, and new requirements of the intelligence manufacturing industry, the Curriculum Reform is finished through "enterprise research – design of teaching – practice research – reflection and improvement".

First, conduct enterprise research, that is, by parsing the talent standard of posts in the CNC Machining career post group, list the knowledge requirement, skill requirement, and quality requirement of the post that are related to the course. Secondly, conduct design of teaching, that is, jointly study with enterprise personnel, refine and splitting the listed career post competency, and select real enterprise processing case as the teaching case, and integrate the core of the career post competency into the teaching case. At the same time, develop the "basic, project-based, and fast elevation" loose-leaf workbook of "Integration of Moral Education and Technical Skills" to affordance effective support for course teaching. Then, conduct teaching reform practice and innovate the teaching implementation method that adapts to the talent requirement of intelligence manufacturing, for example: consider the quantity problem of high-end machine tools, requisition small class teaching, reform the rate method, standout the procedural rate and occupation qualities rate, etc., open after-school extension training, and realize the integration of course and certificate through competency certification and the combination of education and training, that is, the academic certificate and the occupation skills grade certificate are organically combined ^[1]. Finally, collect course materials, summarize successes and failures, continuously reflect and improve, and enhance student satisfaction and course quality.

4 Curriculum reform practice explore

4.1 Divide teaching module, select course carrier

The new round of industrial technology development revolution has Started to profoundly affect and change the development of CNC talent parenting. Under the background] of new technologies, new positions, and new requirements of the intelligence manufacturing industry, the CNC Machining practical training Curriculum Reform strives to explore] to incorporate the latest CNC scientific research results such as composite turning-milling technology, five-axis linkage machining technology, and [Digital Twins technology into the CNC Machining practical training teaching content ^[5-7]. Therefore, focusing on the technical skill] requirements of programmatic] and Actions of common CNC machine tools, the entire course is divided into three main modules: basic Cognition of CNC machine tool programmatic, programmatic and Actions of ordinary CNC machine tools, and programmatic and Actions of multi-axis CNC machine tools. initiatives and tasks are settings in each module to form a carrier from ordinary machine tools to high-end machine tools, teaching content] from simple to difficult, and skill] training rising in a Helix] manner, with a system architecture that is Focused, Standout, and echoes each other.

4.2 Enhance the curriculum content of CNC Machining practical training for integration of moral education and technical skills

Based on the occupation competency analysis, explore the "occupation targeting → work task → initiative select → content orchestration" technology and Integration of Moral Education and Technical Skills course content development workflow process. Cases such as "focusing barrel mill-turn composite programmatic and machining" and "oblique guide board five-axis linkage machining" are selected from real enterprise initiatives. Course content is orchestrated by combining the workflow process and student cognition rules. Synchronize the construction of the Integration of Moral Education and Technical Skills framework for the course. With the parenting of student qualities as a Islands mainline, design three dimensionalities of "serving the country with passion - craftsman spirit - engineering quality" to construct the Integration of Moral Education and Technical Skills course content.

4.3 Develop the accompanying Loose-leaf workbook for the course

According to the development requirement of the intelligence manufacturing industry, the manifest of occupation competency for CNC Machining positions is determined through deep cooperative with enterprises. Based on the manifest, the required skill actions method and quality standard for each occupation competency are determined, and the common problems and resolution strategy in each occupation competency are condensed ^[8]. Use the standardized actions method and the latest industry quality standard with industry universality, and typical problems to compile the Loose-leaf Workbook, to achieve:

(1) All five teaching projects are repeatedly structured around the sequence of 'machine tool operation – program development – part machining,' to spirally enhance students' basic machine tool operating skills and to establish progressive steps to help students overcome apprehension.

(2) Operational training is conducted following the process of 'educator demonstration, group learning, summarizing key points, student practice, student summarization, and online test', to overcome project processing difficulties and enable students to master the operating essentials of each machine tool through repeated practice.

(3) Each class session adopts an "online—offline—online" blended design, with the offline instruction comprising four stages: introduction, exploration, summary, and testing. This closed-loop design helps students consolidate their learning.

4.4 Comprehensively integrate the content and requirements of provincial, municipal, and school-level competition training into the teaching process

Considering the meeting content of the occupation skills competition for turning-milling complex, all are Sourced From real and typical enterprise stuff and absorb cutting-edge technologies. The occupation skills competition is regarded as an organic component and extrusion of the course to broaden the student's field of view. Each student is strictly trained according to the training standard of the competition. From tool placement habits to processing time controls, from processing according to the route card to the processing of burst situations, the craftsmanship spirit is implemented in every skill training action to comprehensively improve the student's occupation qualities. Finally, the pass rate of students participating in the turning-milling occupation skills certificate examination is hold above 95%. Discover excellent students to participate in the turning-milling complex competition of the occupation skills competition, and win the first award in the national CNC multi-axis processing competition, the first award and the second award in the province, etc.

4.5 Exploring the online-offline blended teaching model for practical training courses

To fully tap into students' learning potential, an online-offline blended teaching model is adopted. Specifically, teaching tasks are assigned online and relevant teaching resources are provided before class, enabling students to review professional basic knowledge by searching for materials. During offline in-class sessions, forms such as group discussions and independent inquiry are used to guide students in completing practice projects. This helps students master the ability to independently complete the entire process of parts from drawing to assembly, meet the assessment requirements of relevant CNC machining vocational skill level certificates, and break through the traditional certificate-oriented teaching model that focuses on repeated lectures and exercises. After class, students are guided to conduct a summary and reflection online, and online tests are assigned to help them identify knowledge gaps and consolidate the knowledge, skills, and literacy required for CNC machining positions. This extension of the classroom has achieved a twice-the-result-with-half-the-effort effect in practical training teaching. Students' offline usage rate of machine tools has significantly increased, which not only strengthens their skill training but also makes them fully aware of the importance of after-class learning—only with hard work after class can they handle in-class tasks with ease.

4.6 Reforming the evaluation method by utilizing the online diagnostic and incentive functions

A combination of process evaluation and result evaluation is implemented. Process evaluation highlights students' efforts and pursuits, and fully recognizes their dedication and initiative in the learning process, including their in-class participation, online learning performance, and project completion status. Result evaluation focuses on the quality of workpieces, mastery of skills, and scores of in-class tests. The organic integration of process evaluation and result evaluation stimulates students' learning enthusiasm and allows each student to see that their efforts have been recognized. In addition, the software of the school's online teaching platform is used to conduct big data analysis on students' learning situations, helping each student recognize their strengths and make the most of their advantages while avoiding weaknesses. Methods such as exhibition board displays and experience exchanges are further used to stimulate students' subjective initiative. Teachers conduct big data analysis on students' situations to understand and analyze their

learning status, implement teaching according to students' aptitudes, and guide them in line with the situation, thereby greatly improving the effectiveness of teaching management.

5 Conclusion

To fully integrate ideological and political education into practical training teaching, it is necessary to fully explore relevant ideological and political resources, construct curriculum content that integrates moral education and technical skills, and organically combine ideological and political micro-points, professional micro-literacy, and technical micro-behaviors during the top-level design stage. Meanwhile, the integration of skill certificate training and professional literacy training should be realized. After nearly a decade of exploration, the college has achieved certain results in the CNC machining practical training courses integrated with ideological and political education. It has obtained excellent results in both the passing rate of CNC turning and milling certificate examinations and students' participation in the national and Jiangsu Provincial Vocational College Skills Competitions, including CNC turning and milling events and multi-axis events. Moreover, its graduates have received positive feedback from employers.

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