Advances in Vocational and Technical Education (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/avte.2024.060511
ISSN 2523-5834 Vol. 6 Num. 5

Research on the Teaching Reform of Cultivating Innovative Talents in Higher Vocational Mechanical and Electrical Engineering

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Keywords: Innovation, vocational education

Abstract: Against the backdrop of intensifying global competition and the rapid development of smart manufacturing, the reform of the innovative talent training model in higher vocational mechanical and electrical engineering (M&E), a crucial foundation for nurturing frontline technical talents in the manufacturing industry, is of paramount importance. This paper aims to explore comprehensive approaches to enhancing the innovative capabilities of M&E students in higher vocational education by optimizing the curriculum system, strengthening practical teaching, building a high-quality and innovative teaching staff, and constructing a comprehensive innovative ecosystem. The paper analyzes the current status and issues in M&E talent training in higher vocational colleges, proposes targeted teaching reform strategies, and forecasts the expected outcomes and future development directions.

1. Introduction

As a key technical field supporting the development of the manufacturing industry, the quality of M&E engineering talent directly affects China's manufacturing transformation and upgrade, as well as its international competitiveness[1][2]. However, the current talent training model in higher vocational M&E programs presents problems such as a disconnect between theory and practice and inadequate innovation cultivation, making it difficult to meet the demand for high-quality and innovative M&E talents in society. Therefore, exploring and implementing an effective innovative talent training model has become a critical issue in the educational reform of higher vocational M&E programs[3].

2. Current Situation Analysis

2.1. Manufacturing Background and Industry Demand

With the rapid advancement of emerging technologies such as smart manufacturing and the industrial internet, the manufacturing industry is undergoing profound changes[4][5]. Enterprises' demand for M&E engineering talents is becoming increasingly diversified, requiring not only solid

professional knowledge and skills but also innovative thinking, interdisciplinary abilities, and teamwork spirit. This poses higher requirements for the talent training in higher vocational M&E programs.

2.2. Current Status of Talent Training in Higher Vocational M&E Programs

The current talent training in higher vocational M&E programs faces several issues: first, the curriculum system is overly rigid, lacking flexibility and forward-looking vision, making it difficult to adapt to the rapid changes in the industry[6]; second, practical teaching is inadequate, resulting in students lacking sufficient hands-on capabilities and problem-solving abilities; third, the teaching staff structure is monolithic, lacking teachers with industry backgrounds and rich practical experience; fourth, the construction of an innovative ecosystem lags behind, depriving students of platforms and opportunities to participate in innovative activities[7].

3. Teaching Reform Measures

3.1. Optimizing the Curriculum System

3.1.1. Constructing a Modular Curriculum System

To address the issues in the current curriculum system, it is recommended to establish a modularized curriculum core. Divide the course content into multiple modules, each focusing on a specific theme or skill. By flexibly combining different modules, the curriculum can meet the learning needs and career development directions of diverse students. Meanwhile, enhancing the connection and integration between modules will form a comprehensive knowledge system.

Taking the course "Multi-Axis Machining Technology" as an example, "Multi-Axis Machining Technology" is a core course in the CNC Technology program. This course, based on the current trends in mechanical machining technology, has redesigned its teaching content into four projects: our-axis CNC oriented machining, four-axis CNC simultaneous machining, five-axis CNC oriented machining, and five-axis CNC simultaneous machining.

Each project is aimed at the intelligent production of a real product and is divided into multiple learning tasks based on Difficulty coefficienty. As shown in Figure 1, project 4 is broken down into three progressively challenging five-axis CNC machining learning tasks and two smart manufacturing production line commissioning learning tasks. By completing these tasks, students gradually master five-axis CNC machining and smart production line commissioning techniques, thereby enabling the intelligent production of the product and gaining knowledge and skills related to five-axis simultaneous intelligent machining.

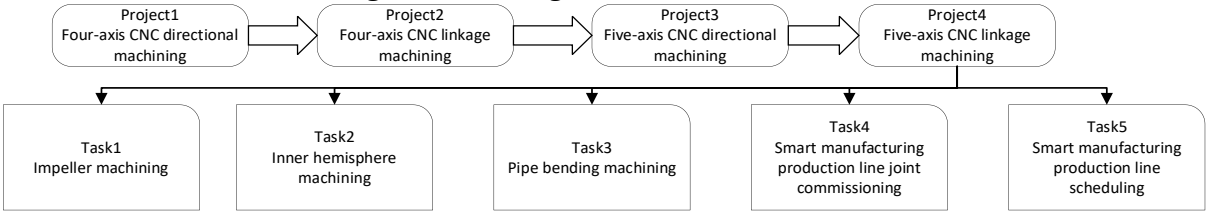

Figure 1: The course structure for Multi-Axis Machining Technology

3.1.2. Introducing Industry Frontier Technologies

Closely monitor industry trends and technological developments, and promptly incorporate frontier technologies into the curriculum. By organizing special lectures, seminars, and other events, students can stay informed about the latest technologies and market dynamics. Additionally,

encouraging students to participate in research projects and technology development activities will cultivate their innovative and practical abilities.

Students could be encouraged to engage in research projects and technology development activities related to multi-axis machining. For example, they might participate in projects that explore the integration of artificial intelligence in CNC systems or the development of sustainable machining processes. These hands-on experiences would not only deepen their understanding of the course material but also cultivate their innovative and practical abilities, making them more adept at solving real-world problems.

By taking this approach, the "Multi-Axis Machining Technology" course would not only teach students the technical skills necessary for mastering multi-axis machining but also foster a mindset of continuous learning and innovation. This would ultimately prepare them to lead in a rapidly evolving industry, where staying ahead of technological advancements is crucial.

3.2. Strengthening Practical Teaching

3.2.1. Establishing On-campus and Off-campus Training Bases

Strengthen school-enterprise cooperation and establish stable on-campus and off-campus training bases. The on-campus training base should be equipped with advanced training equipment and simulation software to replicate real-world work environments. The off-campus training base, on the other hand, should provide real project opportunities and practical platforms. The effective combination of these two types of training bases can enhance students' hands-on capabilities and problem-solving abilities.

3.2.2. Implementing Project-based Teaching

By adopting a project-based teaching model, we can closely integrate theoretical knowledge with practical operations. And students' interest and creativity will be stimulated through designed challenging project tasks. During project implementation, teachers should play a guiding role, encouraging students to explore independently, collaborate in teams, and engage in innovative practices. Through the successful completion of projects, students will not only master professional skills and knowledge but also cultivate innovative thinking and teamwork abilities.

3.3. Building an Innovative Teaching Staff

3.3.1. Enhancing Teachers' Innovative Literacy

Faculty should be encouraged to participate in industry training, academic exchanges, and other professional development activities to broaden their perspectives, update their knowledge frameworks, and refine their pedagogical philosophies. Simultaneously, educators should be guided to actively engage in research initiatives and technical service projects, enhancing their capacity to address real-world challenges and drive innovation. To further support these efforts, research excellence awards and teaching achievement prizes should be established, incentivizing faculty to commit to innovation and continuous improvement in teaching practices.

3.3.2. Introducing Talented Individuals

Efforts should be intensified to recruit exceptional professionals with extensive industry experience and practical expertise to join the teaching faculty. By leveraging their mentorship, the overall quality and innovation capacity of the academic staff can be significantly enhanced. In

parallel, it is essential to establish a robust talent development and incentive system that offers comprehensive career growth opportunities and a supportive work environment, fostering the retention and advancement of top-tier talent.

3.4. Constructing an Innovative Ecosystem

3.4.1. Building Innovation Platforms

The establishment of innovation and entrepreneurship centers, science and technology parks, and other platforms is crucial in offering students opportunities and spaces to bring their ideas to life. By organizing innovation and entrepreneurship competitions, technology exhibitions, and similar events, student enthusiasm for creativity and entrepreneurship can be significantly enhanced. Furthermore, fostering stronger collaboration with government bodies, industry partners, and various societal sectors will help secure additional resources and support, further empowering students in their innovative pursuits.

3.4.2. Fostering an Innovative Atmosphere

Cultivating an open, inclusive, and innovation-driven campus culture is essential. This can be achieved by expanding students' intellectual horizons through academic lectures, technology forums, and other scholarly events. Hosting innovation and entrepreneurship salons, experience-sharing sessions, and similar activities will ignite students' creative thinking and entrepreneurial spirit. Additionally, fostering a strong teacher-student rapport and creating a collaborative learning environment through increased interaction will further enhance the overall academic atmosphere and support student growth.

4. Conclusions

By implementing the aforementioned teaching reform measures, the innovative capabilities of M&E students in higher vocational education can be comprehensively enhanced. Optimizing the curriculum system can increase its flexibility and forward-looking vision; strengthening practical teaching can improve students' hands-on capabilities and problem-solving abilities; building an innovative teaching staff can elevate the overall teaching level and innovation capabilities; constructing an innovative ecosystem can stimulate students' enthusiasm for innovation and entrepreneurship. In the future, we will continue to deepen research and exploration in teaching reform, continuously improve the innovative talent training model, and cultivate more high-quality M&E engineering talents with innovative spirit and practical abilities to support China's manufacturing transformation and upgrade and high-quality development.

Acknowledgements

This work is supported by Construction of a Characteristic Platform for Cultivating Students' Innovation Ability through School-Enterprise Collaboration project of Teaching Reform Research Program of Chongqing Education Commission of China (No: GZ222020).

References

[1] Zhou Jing. Strategies for cultivating innovative technical and skilled talents in higher vocational education under the background of intelligent manufacturing [J]. Journal of Wuxi Institute of Commerce, 2017, 17(04): 79-83.
[2] Li Wei. Research on the reform of higher vocational talent training mode under the background of intelligent manufacturing [D]. East China Normal University, 2018.

[3] Wang Ye. New thinking and new models for the transformation and upgrading of traditional manufacturing under the background of Industry 4.0 [J]. China Equipment Engineering, 2017(10): 117-118.
[4] Hung S. Development and innovation in the IT industries of India and China [J]. Technology in Society, 2008, (1): 2-17.
[5] Zang Jiyuan, Wang Baicun, Meng Liu, Zhou Yuan. The three basic paradigms of intelligent manufacturing: From digital manufacturing, "Internet +" manufacturing to a new generation of intelligent manufacturing [J]. Engineering Science of China, 2018, 20(04): 13-18.
[6] Huang Yonggui. Teaching Reform and Practice of Mechanical Drawing under the Background of First-class Course Construction [J]. Higher Education Journal, 2023(22): 137-140.
[7] Ma Xuefeng, Chen Xiaoming, Xu Zhaoshan. Analysis of the matching between the demand for intelligent manufacturing talents in the machinery industry and the professional settings of vocational schools [J]. China Vocational and Technical Education, 2020, (11): 5-15.