

Intelligent Manufacturing Talent Training System Based on the Construction of College Student Practice Bases

Zhongyong Wang^{1,a}, Yingjing Xu^{2,b,*}

¹School of Automation, Guangdong University of Petrochemical Technology, Maoming, China

²Foreign Language School, Guangdong University of Petrochemical Technology, Maoming, China

^a383858484@qq.com, ^b38205321@qq.com

*Corresponding author

Abstract: In order to meet the needs of intelligent manufacturing talent cultivation in the new social context, a model of intelligent manufacturing talent cultivation driven by the construction of college student practice bases is proposed. By analyzing the current situation and existing problems of intelligent manufacturing talent cultivation, and relying on the practical training conditions, teaching staff conditions, and innovative practice policies of college student practice bases, this paper provides a detailed introduction to the reform plans of innovative talent cultivation systems driven by the construction of practice bases, including curriculum system reform, subject competition system reform, teaching staff construction reform, and practical training reform. The intelligent manufacturing talent cultivation model driven by the construction of practical bases significantly enhances students' innovation ability, and at the same time, the social sharing function also has good social benefits.

Keywords: Practice base; Intelligent manufacturing; Innovative practice; Training mode

1. Introduction

In the context of the new era, the core competitiveness of the global manufacturing industry is undergoing profound changes. Intelligent manufacturing, which deeply integrates information technology and manufacturing technology, is the high point of a new round of industrial competition. The rapid development of technology in various fields urgently requires a large number of intelligent manufacturing talents who master cutting-edge technology and are in line with international technology. Cultivating intelligent manufacturing technology talents with solid basic knowledge, strong engineering practice ability, and high comprehensive quality has become a major change in new engineering education^[1]. The cultivation of talents in the field of intelligent manufacturing must be based on the existing engineering majors, deeply integrating intelligent factors, focusing on the talent cultivation system process of "intelligence+profession", reforming the training mode of practical innovation ability, and paying more attention to characteristic and differentiated development. It is necessary to not only serve the needs of regional economic and industrial development^[2], but also maintain the original characteristics of relevant disciplines in universities.

Under the existing conventional teaching mode, due to the scarcity of practical training resources, the practical ability cultivation of applied undergraduate students is relatively weak, and most students have limited opportunities to participate in practical exercises, resulting in weak practical skills. The main reasons for its occurrence include the following:

1) In the formulation of training models, emphasis is placed on theoretical teaching, while neglecting practical teaching. The practical content is relatively outdated, and practical training resources are scarce. Many practical teaching methods are outdated, and most students have poor practical training results. There is a shortage of "dual teacher" teachers who both understand theoretical teaching and have strong practical abilities, indicating that the practical teaching process is more focused on "imparting" rather than cultivating "innovative practical" abilities;

2) There are insufficient factors in intelligent manufacturing, and the current practical ability cultivation is still traditional teaching, without reflecting intelligent technology factors in the knowledge and ability system, which cannot cultivate professional talents that meet the new needs of society;

3) Students have insufficient awareness of the importance of improving their practical abilities, manifested in a low interest in participating in practical teaching. The characteristic of practical teaching is that self-directed learning plays an important role, and there are not many opportunities for teachers to interact with students. Practical teaching has not achieved the expected results.

The college student practice base is a complete process of cooperation between schools and enterprises, through the practice of innovation ability, gaining social recognition, and finally transitioning to enterprises, to better achieve the cultivation of innovation ability. In response to the problems in the cultivation of intelligent manufacturing talents, Guangdong University of Petrochemical takes the construction of new engineering disciplines as an opportunity and cooperates with Foshan Xiling Robot Technology Co., Ltd. to jointly build a college student practice base, focusing on the cultivation of intelligent manufacturing talents, actively optimizing the intelligent manufacturing talent cultivation system, vigorously innovating talent cultivation models, and exploring new ways of cultivating intelligent manufacturing talents.

2. Functional construction of practical bases

Building an intelligent manufacturing talent training model based on college student practice bases can continuously optimize training conditions and improve students' innovative and practical abilities. At the same time, strengthening the integration of theoretical knowledge and practical abilities can help students quickly integrate into intelligent manufacturing enterprises and broaden their future development prospects^[3-4]. In order to ensure the quality of talent cultivation in the field of intelligent manufacturing, the talent cultivation model based on the construction of college student practice bases is an important approach. Good practical training teaching conditions in practice bases are the key to ensuring the quality of talent cultivation.

Foshan Xiling Robot Technology Co., Ltd. was established in 2013, with over 6000 square meters of well-equipped production workshops. The company has been focusing on the research and development, manufacturing, and application of industrial robots, mainly developing integrated application systems for industries such as ceramics, sanitary ware, hardware, and bathroom, as seen in Figure 1 and Figure 2.

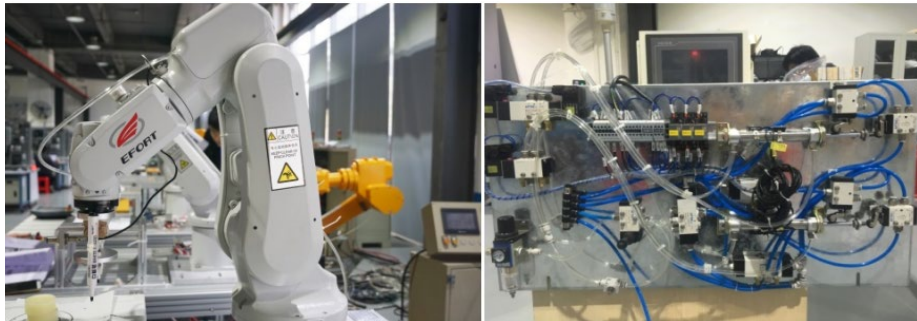


Figure 1: Robot equipment for innovative practical training (1).



Figure 2: Robot equipment for innovative practical training (2).

Guangdong University of Petroleum and Chemical Technology attaches great importance to the cultivation of new engineering talents, continuously carries out innovative practical teaching, promotes curriculum teaching reform, adheres to and develops the ability oriented applied talent cultivation model, especially focuses on the ability cultivation in the field of "intelligent manufacturing", and cultivates various types of intelligent manufacturing engineering technology applied talents for industry and local economic development. Through cooperation with enterprises, the college student practice base adheres to the principle of "matching professional settings with industry needs, course content with professional standards, and teaching and production processes", optimizing production internships and comprehensive professional practices in talent training programs. Teachers can engage in practical training and joint scientific research work with a wide coverage.

The work at the base mainly involves the following aspects:

(1) Promote the integration of multiple disciplines and specialties, actively promote the construction of "new engineering disciplines", closely meet the needs of national development, deepen comprehensive professional reform, optimize professional structure, transform traditional majors, and create distinctive and advantageous majors.

(2) Practical teaching drives curriculum construction, focuses on the reform of applied undergraduate professional courses, constructs a teaching philosophy of integrating theory and practice, and constructs practical teaching course materials that meet industry needs.

(3) Innovative talent cultivation model. Adapting to the development trend of new engineering disciplines, continuously improving applied talent training programs, implementing the teaching system, assessment system, and management system of engineering practice in talent training, and realizing the reform and innovation of applied talent training models.

(4) Strive to create a model of integrating practical teaching with scientific research innovation, providing assistance for student innovation and teacher research.

In the past three years, I have interned in majors such as Electrical Engineering and Automation, Intelligent Science and Technology, Automation, Measurement and Control Technology and Instruments at the College Student Practice Base, involving 1960 college students. Every year, I intern more than 500 times at the base.

3. Intelligent Manufacturing Innovation Practice Ability Training System

The base actively promotes the reform of engineering education practical ability and teaching mode based on the cultivation of intelligent manufacturing talents, and actively carries out subject competitions and the promotion and application of intelligent manufacturing practical ability^[5]. Encourage students to participate in innovation and entrepreneurship and subject skill competitions, encourage excellent teachers to serve as mentors for innovation and entrepreneurship and subject competition, and work with enterprise engineering and technical personnel to provide guidance on students' innovation abilities, providing opportunities for students to deepen their learning in enterprises.

3.1. Building a diversified innovative practical teaching model

Unlike conventional teaching models, the model based on college student practical bases will focus on building an innovative practical teaching system composed of practical teaching objectives, practical teaching content, teaching forms, practical teaching management, and teaching assessment, forming a framework of in class practical teaching system, extracurricular practical teaching system, and innovative education system, and building a practical teaching system characterized by college student practical bases^[6].

The practice base is based on the cultivation of practical innovation ability, project development ability, and social adaptability of college students, and has established a talent training framework based on the project system of the base. The base projects include:

(1) Project approval for disciplinary entrepreneurship and innovation training; This project will integrate engineering projects from schools, industries, and society into professional curriculum teaching, using the project as a carrier to achieve seamless integration between teaching and social needs.

(2) Practical teaching reform project; The project supports the construction of practical teaching reform projects related to the reform of talent cultivation models in the base, and improves the teaching ability of guiding teachers.

(3) Open course construction project. Support the construction of open courses in various forms, and hire excellent teachers with practical construction and guidance experience as guidance teams to provide professional knowledge of course teaching resources to the greatest extent possible.

(4) Project oriented cases. Using the latest industrial practical cases as teaching cases, bring the project into learning, and complete all project operations, drawings, component selection, etc. according to industrial standards. By relying on the technical capabilities and rich practical experience of enterprises, students can gain strong practical training skills.

3.2. Construction of Intelligent Manufacturing Practice Course System

In order to further improve the talent cultivation mode, a systematic reform will be carried out for the existing courses of the intelligent manufacturing professional group, with the job ability requirements of relevant enterprises as the core, and a suitable innovative practical course system will be developed to ensure the effectiveness of talent cultivation. During the construction of the curriculum system, various new technologies and processes can be appropriately integrated into the curriculum, and the main teaching line of the course can be sorted out around the intelligent manufacturing professional group, making the entire teaching activity more smooth^[7].

Optimize the content of intelligent manufacturing professional courses with the entire lifecycle as the core, carry out different teaching activities for different intelligent manufacturing links, and improve students' comprehensive abilities while optimizing the curriculum system^[8]. Content such as equipment operation and maintenance, installation and debugging, product design, and CNC machining can be fully integrated into different professional courses. For the talent cultivation model, as long as the teaching objectives are the core and the curriculum system is continuously optimized, the pertinence of talent cultivation can be improved.

The construction of the curriculum system is based on the actual needs of cultivating talents in the field of comprehensive intelligent manufacturing, establishing the teaching content of core courses, and using core courses to help students achieve knowledge transfer, in order to ensure the overall learning effect of students. In order to enable students to understand their own knowledge reserves during the learning process, an online examination platform can also be constructed for online ability testing. If necessary, relevant certificates from some courses can be combined with ability testing to make online exams more standardized. In addition, under the talent cultivation model based on intelligent manufacturing professional groups, a dedicated resource library suitable for the professional group can also be established. Based on computer and big data technology, network resources can be used to expand teaching content and continuously update data for the teaching resource library.

4. Construction of Management System for Practice Base

The base will be committed to improving the organizational and leadership structure for the construction of teaching bases. Establish a leadership team for the construction of teaching bases, led by the leaders of the college and practice base, with members composed of teachers and supervisory experts with rich professional teaching and management experience. The main function is to discuss the educational laws of practical bases, select and determine practical ability combinations that meet the needs of social development, coordinate and standardize the work relationships and goals of various aspects of practical bases, and comprehensively supervise the effective operation of various aspects of practical teaching bases.

Establish and gradually improve the management methods for teaching bases, so that the construction work of the bases can be organized and followed; Gradually improve the construction of practical base systems, such as quality management, operational management, and student management rules and regulations for practical teaching; Implement measures to ensure the safety and rights of students in the process of practical teaching; Based on the characteristics of relevant majors, gradually integrate teaching resources to ensure the openness of the practice base; In terms of operational mechanism, coordinate and allocate relevant teaching and educational resources to ensure the sustainable development of the practice base. On the basis of the positioning of the leadership and management system of the aforementioned practical teaching base, further clarify the responsibilities

and tasks of both universities and practical support units.

Taking the college student practice base jointly built by Guangdong University of Petrochemical and Foshan Xiling Robot Technology Co., Ltd. as an example, both the school and the enterprise are jointly responsible for the construction of the base. The main responsibilities are to be responsible for the planning and construction of the practice base, as well as the management of all aspects of the base's practical teaching.

Strengthening the construction of teaching staff for both schools and enterprises in the base and improving the level of practical teaching guidance is a necessary condition for the off campus practical teaching base to play its role. It is a direct guarantee for improving the level of practical teaching guidance and rapidly enhancing students' practical skills. On the school side, a combination of training and introduction is adopted, with a focus on both high education and high skills. A professional teacher team with dual teacher qualities and a dual teacher structure is formulated, and teachers are trained in various forms such as on-the-job training at practical teaching bases and conducting various forms of professional teacher practical skills training to cultivate their practical teaching and guidance abilities.

Through the construction of management systems, it is possible to further improve practical teaching, provide a basis, improve practical teaching management systems, standardize practical teaching, effectively manage and monitor practical teaching results, and ensure the quality of intelligent manufacturing talents.

5. Construction of an open sharing mechanism

The college student practice base is open, established through cooperation between schools and enterprises to establish an open and sustainable innovation practice education base. The construction of practical bases closely tracks the forefront of intelligent manufacturing technology development, establishes close cooperation with industry enterprises, explores a technology innovation system that combines industry, academia, research and application, continuously improves the ability of independent innovation and serving society, and provides professional skills training for enterprise technical personnel^[9].

On the basis of meeting the needs of talent cultivation in schools, training services are provided to backbone technical personnel in regional industries, and research on key technologies of intelligent manufacturing and process technology solutions are carried out. The construction of the base adheres to the principles of "integration of industry and education", "enterprise oriented" and "application-oriented", actively exploring an operational mechanism system with its own "hematopoietic" function and social service compatibility. The specific measures are as follows:

(1) Based on the research and development capabilities and comprehensive resources of our own practical teaching team and cooperative enterprises, we conduct economic activities such as training and technology transfer for intelligent manufacturing in public places such as campuses/parks/communities, and carry out vertical and horizontal research and technology transfer activities for various intelligent manufacturing projects in a research group model.

(2) Through school enterprise cooperation and other models, carry out and promote the application of intelligent manufacturing technology, especially the scientific and reasonable utilization of laboratory based robot simulation, robot electrical circuits, robot control systems and other platforms and equipment, as well as venues, and carry out various technological innovation activities that serve society and enterprises.

(3) At the same time as innovative practice, skill training, and production internships, provide their professional skills to social work service institutions, communities, and even social groups, cooperate with relevant enterprises and industries, and undertake the promotion and application of intelligent manufacturing system technology by enterprises.

(4) Implement an open and shared base construction and operation model, and carry out training services on intelligent manufacturing technology for foreign enterprises, institutions, and sister colleges. The base will strengthen and promote the internship system of off campus practice bases, so as to further strengthen and enhance the talent cultivation system of on campus and off campus internships.

6. Conclusion

The college student practice base focuses on cultivating innovative talents in intelligent manufacturing practice, guided by regional industrial demand, and continuously improves the school enterprise collaborative education model with the main line of "optimizing curriculum system, integrating industrial demand, project case experience, and self-improvement". It establishes an innovative talent cultivation model that is oriented towards industry and industrial demand, with a focus on talent cultivation in the fields of intelligent manufacturing and high-end equipment, scientific and technological innovation Industrial transformation and upgrading, resource sharing, deepening the integration of industry and education, innovating the mechanism of school enterprise cooperation and collaborative education, deepening the reform of base industry education integration, and continuously improving the quality of intelligent manufacturing talent cultivation.

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References

- [1] Kong Fanguo; Yu Wenxiao. *The current situation and trend of intelligent manufacturing development [J]. Mechanical Engineer, 2020 (04).*
- [2] Cheng Xiuwen, Song Yingyang, Zhang Xinyi, Guo Ruonan, Gou Jianfeng. *Exploring the cultivation and reform of practical innovation ability among students majoring in environmental engineering in the context of new engineering disciplines[J]. Modern Education Equipment in China, 2022 (05).*
- [3] Wang Lieyan; Zhu Chaofeng, Lin Chuhong, He Jiangqin. *Practice and Experience in Building Off campus Practice Bases for College Students: Taking the Construction of "Beijing Institute of Technology Zhuhai College Fangzheng Technology Engineering Training Base" as an Example[J]. University Education, 2016 (11).*
- [4] Wang Jin, Lin Min. *Construction of off campus practice bases based on school enterprise cooperation model: Taking the City College of Dalian University of Technology as an example[J]. Education Theory and Practice, 2016 (24).*
- [5] Yin Leilei, Xu Youxiong, Cao Jinjiang, Liu Di, Wang Jianhong. *Research on the Practical Teaching System of Applied Undergraduate Intelligent Manufacturing Engineering Major[J]. Modern Education Equipment in China, 2022.*
- [6] Chen Tao, Xiao Yiqi. *Interdisciplinary Innovation Education for Intelligent Manufacturing: A New Paradigm Guided by Design Thinking[J]. Research on Higher Engineering Education, 2023.*
- [7] Sun Lingzhen, Ye Shuo, Wang Xiumin, Liu Jie, Chen Yunsheng. *Innovate the talent training model for new engineering majors based on the "base" platform[J]. Equipment Manufacturing Technology, 2020 (07).*
- [8] Wang Shuting, Li Xin, Zhang Fen, Xie Yuanlong, Wang Junfeng, Ding Han, Shao Xinyu. *Construction of an Intelligent Manufacturing Practice Teaching System for Cultivating the Concept of Large Engineering [J]. Journal of Mechanical Engineering, 2022 (18).*
- [9] Zhang Yinnan, Luo Chaosheng. *Exploration of Intelligent Manufacturing Talent Training Model under the Background of New Engineering [J]. Modern Education Equipment in China, 2019.*