

Research on the Construction of "Three Integration and Three Promotion" Applied Talents Cultivate Mode for Automation Major

Haifei Si, Xingliu Hu, Yujuan Tang, and Zhong Yang

Abstract—The Outline of the National Medium and Long Term Educational Reform and Development Plan (2010-2020) particularly emphasizes the need to "deepen the reform of education and teaching, innovate teaching methods, explore various ways of training, and form a situation in which all kinds of talents are emerging and top innovative talents are constantly emerging". In order to meet the needs of training high-quality and innovative applied talents, Jinling Institute of Technology actively promotes the reform of education and teaching, and promotes the growth of students. Based on the exploration and practice of talent cultivation in recent years, this paper mainly introduces the research and practice of innovative applied talents cultivation mode of "three integration and three promotion". That is to say, beneficial exploration and achievements in such aspects as Production-education integration, science-education integration, competition-education integration, etc. will provide reference for talent cultivation and education and teaching reform in applied universities.

Index Terms—Automation major, talent training mode, industry-education integration, science-education integration, competition-education integration.

I. INTRODUCTION

With the development of economy and society, society and employing units are demanding higher and higher quality of training automation professionals. On the one hand, a large number of students are unemployed after graduation, and they can not find suitable jobs. On the other hand, a large number of enterprises can not recruit suitable talents. Graduates do not meet the needs of enterprises, school personnel training is out of touch with social needs, students do not have development potential and other issues [1]-[3]. In 2008, Jinling Institute of Technology (hereinafter referred to as "our school") Automation Major (hereinafter referred to as "this specialty") began to explore the "three integration, three promotion" innovative and applied talents training mode of

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Automation Major in order to better serve the deep integration of informatization and industrialization and meet the development needs of Jiangsu intelligent manufacturing industry.

II. RESEARCH CONTENTS

A. Orientation of Personnel Training

Automation Major is guided by the demand of Jiangsu intelligent manufacturing industry. It adheres to the front line of intelligent control and automation research and development, production, construction, management and service. It takes the cultivation of innovative and applied talents with strong competitiveness in automation and related professional fields as its training orientation.

B. Construction Measures and Contents

In order to better integrate service informatization with industrialization and meet the development needs of Jiangsu intelligent manufacturing industry, this specialty carries out the research and exploration of "three integration and three promotion" innovative and applied talents training mode of Automation Major, as in Fig. 1.

1) Integration of industry and education and promotion of education through production

Focusing on "Made in China 2025" [4], [5], taking Jiangsu intelligent manufacturing industry demand as the guidance, taking the cultivation of application ability of intelligent manufacturing industry as the core, employer satisfaction as the quality standard, the specialty integrates production and education to cultivate talents. The school-enterprise co-system (revision) formulates the training plan for automation professionals, optimizes the curriculum system, carries out practical teaching reform and personnel training mode exploration, emphasizes "double-qualified teachers" and "application-oriented students", and cultivates innovative and applied talents adapted to the needs of the intelligent manufacturing industry, as in Fig. 2.

1) The formulation of personnel training programs and curriculum system, the strengthening of cooperation with leading enterprises in the intelligent manufacturing industry [6]-[8], and the industrial associations, so as to make the personnel training programs meet the needs of Jiangsu intelligent manufacturing industry. In cooperation with Mitsubishi Motor Automation (China) Co., Ltd., Nanjing Aston Automation Co., Ltd., Jiangsu Automation Society, Nanjing Intelligent Manufacturing Industry

Alliance and other industry associations, a professional steering committee composed of employers, industry experts and university professors has been established. Taking engineering application ability training as the core, optimizing the curriculum system, re-integrating the knowledge system structure, enterprise and industry experts participating in the system (revision) of talent training program, the curriculum system with distinct engineering application characteristics at three levels, namely, foundation, specialty and application, is constructed. As in Fig. 3. Form a training program and curriculum system for automation professionals, which are closely related to the needs of the intelligent manufacturing industry. Engineer-oriented courses such as "Project Management" will be offered. Enterprise executives and enterprise technicians will be invited to participate in the teaching and experimental guidance.

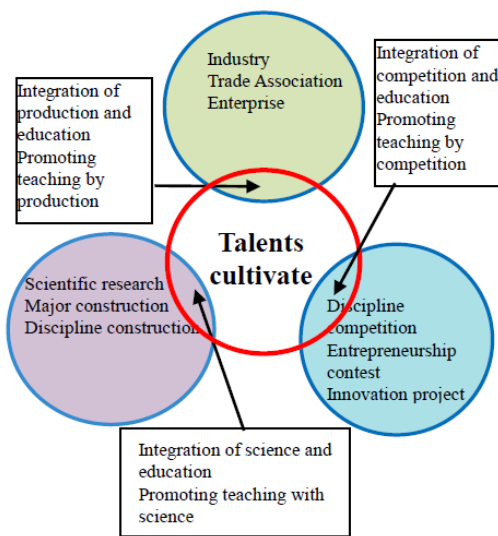


Fig. 1. The structure diagram of "Three Fusions and Three Promotions" applied talents cultivate mode for automation major.

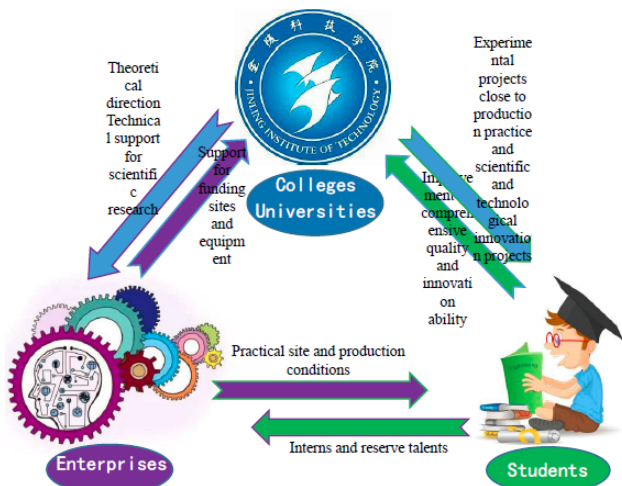


Fig. 2. The talents training mechanism of integration of industry and education, promotion of education through production and cooperation between industry and education.

- 2) Building laboratories and innovation platforms, strengthening cooperation with leading enterprises in the intelligent manufacturing industry [9], so as to adapt the training conditions of talents to the needs of Jiangsu intelligent manufacturing industry. Jointly build Rockwell

Intelligent Automation Laboratory, Siemens Automation Technology Center and ABB Robot Laboratory with Rockwell, Siemens, ABB and other schools and enterprises. Jointly build Nanjing Engineering Technology Research Center with enterprises. Introduce mainstream industry-level software and hardware resources, enterprise intelligence and industrial resources, so as to make the professional practical teaching conditions close to the forefront of intelligent manufacturing industry. To improve the level and quality of personnel training.

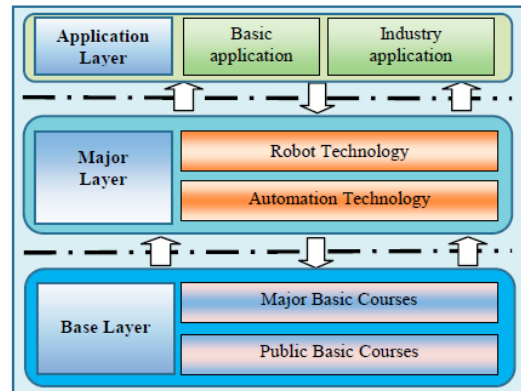


Fig. 3. Architecture diagram of automation major foundation, major and application.

- 3) Teacher team building, strengthening cooperation with leading enterprises in the intelligent manufacturing industry, so as to make the talent training team adapt to the needs of Jiangsu intelligent manufacturing industry. Emphasis is laid on the "double-qualification" of teachers, dispatching first-line teachers to enterprises for training, and conducting training on "Robot Technology Foundation" and "Electrical Control and PLC Application Technology" in Nanjing Aston Automation Co., Ltd. and Mitsubishi Motor Automation (China) Co., Ltd. Jointly with Otega Mechanical and Electrical Co., Ltd., we set up a "doctoral workstation" in the enterprise, and send front-line teachers to lead students to participate in production site organization and technical research. Among professional teachers, 72.2% are "double-qualified" teachers with engineering background. Students' comprehensive internship and graduation internship are also completed in enterprises, focusing on the cultivation of engineering application ability, and combining internship with employment. During the eighth semester of graduation internship, most of the students except for postgraduate entrance examination have been employed in enterprises.

2) *Integration of science and education to promote education through science.*

Focusing on the cultivation of innovative and applied talents in intelligent manufacturing industry, teaching and scientific research are integrated and mutually promoted. Teachers' scientific research projects and achievements are applied to professional teaching and personnel training. Promote the improvement of the level and quality of professional education, promote the construction of professional connotation, enhance students' professional

subject ability and innovation ability, and cultivate innovative and applied talents with potential [10], [11].

- 1) To absorb undergraduates into the research team of teachers' vertical and horizontal scientific research projects, through participating in scientific research projects, cultivate students' ability to discover and solve problems, and cultivate students' innovative consciousness and cooperative ability. Instruct students to apply for national patents and write scientific and technological papers, and cultivate students' ability of summarizing and expressing. Guiding students to obtain 7 authorized national patents and publish 6 papers has improved the quality of personnel training.
- 2) Transforming teachers' scientific research achievements into teaching and experiment contents, so as to make learning content close to the frontier of science and technology and the reality of industrial production. Achieved the second prize for military scientific and technological progress, the research achievement of "Space-Ground Cooperative Emergency Intelligent Control and Command Platform" was applied to the project teaching of "Artificial Intelligence". In the comprehensive practical courses such as "Integrated Application Design of Motor Control" and so on, the practical production subject "Intelligent Monitoring System for Water Supply Network Faults" is introduced to stimulate students' enthusiasm for learning and practice. The design subject is transformed into a practical innovation training program for college students. Teachers guide students to set up five innovation and entrepreneurship training programs for college students in Jiangsu Province. Introduce scientific research results into curriculum development and textbook construction to promote curriculum and textbook construction. This professional teacher presides over two excellent courses at school level, five excellent courses, one research course and six textbooks.
- 3) Teachers lead students to complete technological transformation of enterprises, solve technical problems of enterprises, and realize the transformation of many authorized national invention patents. To cooperate with Nanjing Dubao Industrial Co., Ltd. to industrialize patented technologies such as "window solar photovoltaic power generation system". The patented products that have been promoted have realized sales of 24966 million yuan, added profits of 45.01 million yuan and added taxes of 3.01 million yuan. Compared with coal-fired power plants, 8 256.37 tons of standard coal are saved annually and 22 672.83 tons of carbon dioxide emissions are reduced annually. The industrialization of patent technology has achieved remarkable economic and social benefits.

3) Integration of competition and teaching promotes teaching by competition

Taking the cultivation of students' innovative ability and comprehensive quality as the main line and the scientific and technological competitions and innovative entrepreneurship activities as the carriers, this paper carries out the reform and exploration of the cultivation of practical ability and

innovative entrepreneurship ability, strengthens the school-running characteristics, improves the quality of personnel training, improves students' practical ability and comprehensive quality, and cultivates innovative applications with high comprehensive quality and competence for the development of intelligent manufacturing industry. Type talent.

- 1) Combining the teaching of courses with science and technology competitions to enhance students' interest in learning and their innovative consciousness and ability. This major combines the courses of "Robot Technology Foundation", "Single Chip Microcomputer Application System Design" with China Robot Competition, Blue Bridge Cup National Software and Information Technology Professional Competition, and "Electronic CAD Technology" with the National Electronic Professional Talents Design and Skills Competition. It takes science and technology competition and scientific and technological innovation activities as carriers to cultivate and enhance students' practical ability and improve students' practical ability. Their comprehensive quality. In recent years, teachers have guided students to participate in national and provincial science and technology competitions, winning 22 first-class prizes, 35 second-class prizes, 52 third-class prizes, 18 excellent prizes and 4 group prizes. Science and technology innovation competition has become the grasp and characteristic of improving students' comprehensive quality and innovation ability.
- 2) Combine national, provincial and ministerial competitions with professional self-run competitions to improve the coverage and popularity of students' competitions so that most students can benefit from the competitions. In addition to participating in national and provincial competitions, this major also organizes self-control and automation design competitions, CAD application skills competitions, industrial automation summer engineering practice groups, etc. to create an atmosphere of scientific and technological competitions, enhance students' practical ability and team cooperation ability, innovation consciousness, etc., fully explore students' learning and practical ability, and strive to improve their comprehensive quality. Through the competition to promote teacher-student exchanges, while training students, but also to exercise and improve the practical ability of teachers, innovative ability. In recent years, five teachers in this major have won the title of excellent instructor in national and provincial competitions.
- 3) Combine science and technology innovation competition with Entrepreneurship competition, combine entrepreneurship competition with Entrepreneurship practice, cultivate students' innovation and entrepreneurship consciousness and ability, and improve students' comprehensive quality. In response to the national strategy of "mass entrepreneurship and innovation", this profession selects teachers with high and middle level work experience to guide students to participate in the "Internet +" College Students' innovation and entrepreneurship competition and "Challenge Cup" and other related national and provincial

level science and technology entrepreneurship and innovation activities, so as to cultivate students' awareness and ability of innovation and entrepreneurship. In recent years, teachers have instruct students to take part in the nationwide "Internet +" College Students' innovation and entrepreneurship competition, and "Challenge Cup" and other 6 entrepreneurial activities, and have won three awards and 2 items. At present, four students have started their own businesses.

III. APPLICATION EFFECT

Through exploring the training mode of "three integration and three promotion" innovative and applied talents of Automation Major, its research results have been practiced and tested in Automation Major, Internet of things engineering Major, electrical engineering and automation related Major in our university. These majors have achieved remarkable results in the training of engineering talents in the intelligent manufacturing industry. The training degree of students' comprehensive quality, the attainment degree of vocational ability goal, the degree of students' employment choice, the support degree of teaching and scientific research conditions, and the satisfaction degree of employing enterprises have been significantly improved. They have realized the co-education inside and outside schools, the progress of teachers and students, and the choice of employment, and have significantly improved the education of their specialty. Teaching level, personnel training quality and scientific research service level.

Teachers preside over 25 scientific research and research projects such as the National Natural Science Foundation project, the educational cooperation and education project of the Ministry of Education. He has won 13 awards for scientific research achievements at all levels, such as the Second Prize for Scientific and Technological Progress of the Chinese People's Liberation Army, the Second Prize for Science and Technology of China's Machinery Industry, and the Third Prize for Science and Technology of Jiangsu Province. Teachers have published more than 90 scientific research papers and more than 20 teaching research papers. They have authorized more than 60 national patents, including 20 invention patents, 3 international PCT patents and 2 computer software copyrights.

The research and practice of this project has been widely recognized by students, schools and society. In the past three years, the admission line for automation majors has been more than 20 points higher than that of Jiangsu Provincial Control Second Branch. The annual rate of students taking postgraduate courses is more than 15%, and the rate of students taking postgraduate courses in automation (1) classes reached 25% in 2016. The rate of signing employment agreements for graduates has reached 100% and employers satisfaction has reached 100%. Automation Major was rated as the key construction specialty in Jiangsu Province, the cultivation point of school brand specialty, and the first batch of engineering education certification pilot specialty. The First-Level Discipline of control science and engineering was selected as the key construction discipline in Jiangsu Province,

and the teacher team was named as the scientific and technological innovation team in Nanjing.

IV. CONCLUSION

This project aims to solve the problems of the disconnection between the training of automation professionals and social needs, and the lack of development potential of students. It is universal in many applied undergraduate colleges and universities. The methods to solve these problems have certain reference value and good application value. At the same time, the orientation of Jiangsu Intelligent Manufacturing Industry is also in line with the strategy of "Made in China 2025", so the research and practice of this project can provide theoretical and practical reference for the automation of provincial and domestic Application-oriented Undergraduate Colleges and universities and related engineering specialties oriented to the orientation of Intelligent Manufacturing, which has good application value.

The research and practice of "three integration and three promotion" innovative and applied talents training mode of Automation Major in Jinling Institute of Technology have made beneficial exploration and achieved good application results in such aspects as integration of production and education, promotion of education by production, integration of science and education, promotion of education by science, integration of competition and education, and promotion of education by competition, with a view to personnel training, education and teaching reform and specialty construction of Applied Undergraduate Colleges and Universities. Setting up and so on provides reference and reference.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Haifei SI conducted the research and practice of Industry-Education integration and Competition-Education integration. Xingliu HU conducted the research and practice of Science-Education integration and Competition-Education integration. Yujuan Tang and Zhong Yang conducted data statistics and effect analysis. All authors had approved the final version.

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