Innovative Research on Cultivating Practical Skills of Applied Bachelor Undergraduates in Automation Major

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Abstract: With the aim of cultivating application-oriented talents, focusing on regional economic development, and taking the "one line, two combination, four tiers" practical teaching system constructed by the school as the guidance for the cultivation of practical skills, the main strategies and methods of practical skills cultivation are studied deeply. From the perspectives of constructing of the practice teaching system of the school-enterprise cooperation model, the project-based teaching of professional courses, full integration into the corporate environment, the development of innovative entrepreneurship education, and participation in skill contests, the practices are developed, the practice teaching reform and the results of are continually further studied and the high-quality application-oriented talents with strong professional practical skills are cultivated for society.

The major of automation is to cultivate the comprehensive development of human's abilities. Automation major enjoys high-quality and skilled talents that have the basic knowledge for automation, master the basic knowledge and skills of computer control and be capable of working in the fields of automation, electrical engineering, etc. in enterprises and institutions [4]. With the proposal of Made in China 2025, China is striding forward to a new type of industrialization, vigorously developing and expanding high-tech industries, emphasizing on developing modern manufacturing industries, cultivating strategic emerging industries, and actively promoting intelligent manufacturing. At present, automation professionals have become the urgently needed talents in China's economic development, and played a decisive role in modern production and technological development [1]. Focusing on the training of core professionals from automation major etc., our school has concluded the guiding principles of education and teaching reform of "one center, two main bodies, three main lines, four combinations, and five principles". "One center" means one center in the construction of majors' connotation, learners and educators are the "two main bodies", morality, ability and innovation are the "three main lines", the "four combinations" are the combinations of policies, places, people, and projects, and the "five principles" are based on the region, problem-oriented, full mechanism, teaching according to aptitude, and continuous improvement[5].

Ⅰ. Overall program of practical skills training for applied undergraduates in the automation major

In order to realize the training goal of application-oriented talents in automation major and strengthen the training of students' practical skills, more attention should be paid to practical teaching. Based on the "12345" education and teaching reform guiding principles of our school, the staff of automation major have constructed a "one line, two combinations, and four tiers" practical teaching system, that is, "one line" --- adhere to the four-year continuous practical teaching; "two combinations" --- inside and outside the classroom combines inside and outside the school; "four tiers" --- basic practice, curriculum practice, comprehensive practice, in-post practice. The "124" practical teaching system not only optimizes the students' knowledge structure, but also enhances the students' practical ability and ability to analyze and solve problems.

Ⅱ. Main strategies and methods of practical skills training in automation major

The main strategies and methods for the cultivation of practical skills of automation majors include the following three aspects.

1. Strengthen the reform of practical teaching systems and mechanisms. In terms of practical teaching, it should start with the system construction, such as standardizing laboratory management, strengthening laboratory management, implementing accountability, guiding and encouraging teachers to teach on-site at the laboratory in order to make full use of experimental equipment, timely repair equipment, and improve the efficiency and effect performance of laboratory equipment to improve teaching effect. At present, the courses in the laboratory have been carried out, and the teaching effect is very obvious. The construction of laboratories implemented a system of joint construction of laboratories by professional teachers and laboratory personnel, which effectively alleviated the shortage of laboratory personnel and the management of laboratories. The laboratory construction achieved remarkable results and was implemented effectively.

2. Reform of innovation and entrepreneurship education system and mechanism. Innovation and entrepreneurship education is an important part of talent training. The college conscientiously implements the national, provincial, and school's general requirements for innovation and entrepreneurship education, incorporates innovation and entrepreneurship education into the entire process of “education in all staff, whole process and all perspectives,” and builds an innovation and entrepreneurship education system that is suitable for the cultivation of high-quality and skilled personnel. Innovation and entrepreneurship education activities were carried out positively to promote the cultivation of high-quality and skilled personnel. Innovation and entrepreneurship education is mainly implemented through the following three aspects.

(1) Basing on "professionalism + entrepreneurship", create an innovative entrepreneurship education model that combines "theoretical teaching + skills training + practical training".

(2) Form an innovation and entrepreneurship education team in the mode of "innovation + entrepreneurship + specialty".

(3) Through the mode of "skills competition + entrepreneurship simulation training + practical training" to create a good environment for innovation and entrepreneurship education.

After 3 years of hard work, we have successfully built innovation and entrepreneurship bases such as the electronics design innovation and entrepreneurship training room, embedded innovation and entrepreneurship training room, rapid prototyping technology teaching and integration room, maker laboratory, and e-commerce operation and training center. Through the innovation and entrepreneurship education platform, promote innovation design competitions and entrepreneurship simulation training. At the same time, a series of activities such as the "Entrepreneurship Forum" were actively carried out to form a good atmosphere of innovation and entrepreneurship, effectively promoted innovation and entrepreneurship education, and achieved fruitful results.

3. Reform of school-enterprise cooperation system and mechanism. In order to achieve the connection between talent training specifications and the needs of industrial development, the college explored a long-term mechanism of co-construction, management, and sharing. Schools and enterprises cooperate in educating students. Through the integration of industry and education and group-based education, it combines teaching with professional ability, integrates professional theories with real production, and integrates the curriculum system with the direction of employment [6]. The reform of the school-enterprise cooperation system and mechanism focuses on the following aspects.

(1) Tighten school-enterprise cooperation. Establish a professional teaching steering committee, strengthen ties with industry associations and big as well as medium-sized enterprises, discuss the supply and demand of talents in enterprises, and discuss methods and strategies to improve students' professional abilities.

(2) Strengthen the school-enterprise cooperation platform. Construct and consolidate the school-enterprise cooperation platform, and strengthen the construction of training outside the school bases and on-site productive training bases. Under the leadership of the government, both schools and enterprises will carry out joint construction and shared management of college students'

practical education outside the school bases to promote education supply-side reform and serve the development of enterprises [6].

(3) Innovate the school-enterprise cooperation model. Promote the establishment of productive training bases, technical service and product development centers, and entrepreneurship education practice platforms by schools and enterprises in order to effectively enhance the college's ability to accumulate technical skills and students' ability to find jobs and entrepreneurship. Taking the construction of inside and outside school bases as a platform, introducing enterprise production projects and enterprise technical standards into the campus, alternating work and study processes, and improving students' practical skills, professional ability, and entrepreneurial ability in a targeted manner [6].

(4) Promote group-based education. Focus on the leading companies in the bearing industry in the regional economy, actively participate in vocational education groups, and explore the establishment of a talent training mechanism and operating mechanism that is conducive to industrial development through mutual employment and platform sharing, and effectively improve the professional skills of students, and finally realize the integration and matching of talent training chain and industry chain.

Ⅲ. Effect of cultivating practical skills of applied bachelor undergraduates in automation major

After 3 years of innovative research and exploration of practical skills training for applied bachelor undergraduates in automation majors, fruitful results have been achieved, which mainly shows in the following aspects.

1. Construct a practical teaching system of school-enterprise cooperation model

Follow the law of the growth of technical and skilled personnel explore the training objectives and curriculum content that meet the professional development of students, optimize the public basic curriculum system, and build a modular professional curriculum system. Construction of the professional curriculum system are participated by both the school and the enterprise in the formulation of the project, and have realized the connection between the major and the industry, the connection between the curriculum content and the vocational standards, the connection between the teaching process and the production process[2], and the connection between vocational education and lifelong learning. Based on the analysis of the company's position capacity, a course system is constructed, and the construction of the automation professional practice course system is shown in Table 1.

Table 1 Supporting relationship of competence requirements for centralized practice of automation majors

Skill Requirements / Curriculum System	Analyzing and solving	Innovation and entrepreneurship	Professional skills			
			Electrical design	Electrical maintenance	Automation equipment operation	Automation equipment maintenance
entrepreneurship practices	○	○	○	○	○	○
Second class	○	○				
Metalworking Internship	○			○		
Electrician Internship	○			○		
Electronic equipment	○		○	○		

installation and debugging						
Digital Electronic Technology Course Design	○	○	○	○		
Motor process assembly practice	○		○	○	○	○
Industrial Computer Network and Communicatio n	○	○			○	
SCM Application Technology Course Design	○		○		○	
Electrical CAD practical training	○		○			
Power Electronics Technology Course Design	○	○	○			
Industrial robotics course design	○	○	○		○	
Electrical Practice	○			○	○	○
PLC Application Technology Course Design	○	○	○	○		
Process Control System and Automation Instrumentatio n	○	○	○	○	○	○
Professional ability and comprehensive skills training	○	○	○	○	○	○
In-post placements	○	○	○	○	○	○
Graduation Design (Thesis)	○	○	○	○	○	○

2. Professional Course Projectization

Professional courses are project-driven and task-driven. For example, professional courses such as "MCU Application Technology", "Electrical Control Technology", and "PLC Application Technology" for automation majors all carry out project-based teaching, teaching, learning, and practicing. Through one-by-one tasks, teachers are "teaching in practicing" and students are "learning in practicing", which increases the students' interest in learning and the effect is very obvious.

3. Normalization of dual-environment training

Dual-environment training is to combine the two education environments of schools and enterprises, build a "dual environment" for schools and enterprises to jointly cultivate students' professional ability, and make full use of professional teachers and part-time teachers from industry companies to train students. The automation major establishes a long-term mechanism of school-enterprise cooperation based on mutual benefit cooperation, and jointly develops talents training programs, teaching materials, and the construction of a practical education platform inside and outside the school [2]. Strengthen the "two bases" construction, fully integrate talent cultivation into corporate environment elements, enable students to study and practice in practical education bases inside and outside the school, and truly cultivate high-quality, high-skilled, and application-oriented talents that meet corporate needs. Our school has two kinds of practical education bases: on-campus training bases and off-campus practice bases. The main educational functions are as follows.

(1) On-campus training bases -- metalworking practice factory, electrical practice factory, etc. Meet internship training such as metalworking practice and electrician practice.

(2) Off-campus practice bases -- Wafangdian Metallurgical Bearing Group, China Cable Group, Micropower Technology Dalian Electric Power Branch and many other off-campus practice bases, which can meet the students' professional ability and comprehensive skills training, in-post internships and other internships.

Through the construction of the two kinds of bases, students have the opportunity to exercise in a real corporate environment, which greatly improves their professional ability.

4. Fruitful results of innovation and entrepreneurship education

Relying on "professional + entrepreneurship", the school creates an innovative entrepreneurship education model that connects "theoretical teaching + skills training + practical training", establishes an innovative entrepreneurship education base, completes the comprehensive design of automated products, and applies innovative research and development to help students develop and complete innovative entrepreneurship projects, which enable students to learn professional knowledge and acquire professional skills in the process of being a "creator of happy experience". At the same time, collaborative innovation research and development of new technologies of enterprises is carried out in innovation and entrepreneurship education bases [3]. Students in automation major can create more than 10 innovation and entrepreneurship projects each year. For example, the most representative innovation and entrepreneurship projects carried out by students from 2016 to 2018 are: development and application of the website group system of the college of applied technology, construction of a visualized virtual campus based on vr3dmax, bearing processing and enhancing production lines, the design of an apple bagging and picking device, Internet of things mowing sweeper, intelligent positioning insoles for the elderly, smart luggage, water level process control system of water tank, dream-chaser host team, cherry the fresh and so on. Among these innovation and entrepreneurship projects, there are national project: "Development and Application of the Website Group System of the College of Applied Technology" and the provincial project: "Internet of Things Mowing Sweeper" and many other projects successfully concluded. Also, the dream-chaser host team won the silver medal in the Youth Award. The innovation and entrepreneurship results are fruitful.

5. Normalization of students' participation in skills competitions

Students' participation in school-level, city-level, provincial-level and national-level skills competitions can effectively improve the professional comprehensive ability of participating

students and instructors. The college selects students with outstanding practical results to participate in school-level, city-level, provincial-level, and national-level college student skill competitions, and promotes the increase of the practice teaching level of automation majors by it [3]. In the past 3 years, representative vocational skills competitions attended by school students include chip-level inspection and repair of electronic products and data recovery, design and production of electronic products, design and implementation of photovoltaic electronic engineering, embedded technology and application development, and VR design, modern electrical control system installation and debugging, industrial robot technology application, etc. The education effect of "promoting learning through competition and promoting education through competitions" is obvious.

Ⅳ. Existing problems and improvement measures in the cultivation of students' practical skills in automation major

1. Problem manifestation

First, there are still too few off-campus internship training bases and practical training positions for some majors, and the construction of corporate courses is insufficient. Second, some internship companies do not pay much attention to the practice teaching outside the school, and the content of the arrangement of the practice outside the school is inadequate. Third, the school's assessment of the effect of off-campus practice is not scientific enough.

2. Improvement measures

(1) Further strengthen school-enterprise cooperation and strengthen the construction of off-campus practice training bases. Plan and set reasonably, increase the number of off-campus internship training bases, achieve reasonable layout, and meet the needs of student internship training. Strengthen the content construction of internship training bases, improve the quality of internship training bases, and meet the needs of internship training for students at different levels. Make full use of the company's practical teaching resources, set up some enterprise courses, and deepen school-enterprise cooperation.

(2) Strengthen the construction of school-enterprise alliances. Establish a school-enterprise alliance, form a school-enterprise interest community, strengthen in-depth school-enterprise cooperation, and form a win-win situation for school-enterprise, promote the enthusiasm of enterprises to participate in the construction of internship training bases, and fully use the internship training base functions through product research and development, achievement transfer, technical support, and talents training.

(3) Strengthen the management and assessment of practical teaching. Employ experienced technical staff with high teaching standards as part-time teachers, and train students with full-time and part-time teachers jointly. Strengthen labor education, stimulate students' enthusiasm and initiative to participate in the cultivation of practical skills, and improve their professional ability [7]. Strengthen the management and assessment of the internship process to ensure that the effect of practical teaching is steadily improved.

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References

[1] Li Yingsen, Wang Xiaodong. Discussion on the automated talents training mode with industry characteristics [J]. China Metallurgical Education. 2013-06: 47-48

[2] Deng Xiangrong, Shen Deshun. A Practical Study of Modern Apprenticeship in Metal and Non-Metal Mining Technology Specialty [J]. Chinese and Foreign Entrepreneurs. 2018.10

[3] Pei Zhouqi, Ma Zhenfeng. Research and Practice of Practical Teaching System for Automation Specialty of Applied Undergraduate Courses [J]. Modern Economic Information. 2018.11

[4] Zhang Jing, Teng Liguo. Practice exploration of middle school promotion application undergraduate of automation major based on school-enterprise cooperation [J]. Journal of Jiamusi Vocational College. 2019.1

[5] Ma Zhenfeng, Xing Yingchun. Research on the Training Mode of Application-oriented Talents Based on the Integration of Production and Education and Collaborative Education Liaoning Vocational College Journal. 2019.1

[6] Hou Jing, Shi Leina, Zhang Zhenping. Innovation of talent training model in higher vocational education under the concept of lifelong education [J]. Adult Education. 2012.08.10

[7] Liu Lishan, Hu Meiling. Research on the Status Quo of Internship and Quality Improvement in Newly Established Universities. Journal of Suihua University. 2019.04