Construction and Practice of Higher Vocational Curriculum System under 1+X Certificate System

--[1]+X certificate system pilot based on industrial robot application programming

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Abstract: Based on the policy and standard requirements of industrial robot application programming skill level certificate, combined with the analysis and deconstruction of domestic industry status and professional post ability requirements, this paper reconstructs the professional curriculum system from several aspects such as professional core curriculum, professional curriculum and professional development curriculum, and integrates the examination content of certificate training into professional curriculum to form a curriculum system composed of two coherent main lines. The contents of the course are connected, supplemented, expanded and promoted. The constructed curriculum system fully integrates the training and assessment content of 1 + X vocational skill level certificate, which lays a certain foundation for the assessment and certification of subsequent certificates, and has a certain reference for the curriculum setting of talent training program of industrial robot specialty in higher vocational colleges.

1. Introduction

In January 2019, the State Council issued the "Implementation Plan for National Vocational Education Reform", which proposed to "promote the construction of qualification framework, and explore the interconnection between academic certificates and vocational skill level certificates. And deepen the reform of the training mode of compound technical and technical talents, and start the pilot work of 1+X certificate system "[1]. Students are encouraged to obtain various vocational skill level certificates while obtaining academic certificates. As an important reform and deployment of "20 vocational education", the 1+X certificate system is also a major transformation and upgrading. Industrial robot application programming was selected as the second batch of pilots, and the Ministry of Education issued the Notice on Doing a Good Job in the Second Batch of 1+X Certificate System Pilots in September 2019 (J.S.H. [2019] No.89). It is required to integrate the 1+X certificate system into professional talents training, reconstruct the curriculum system, optimize the teaching content, coordinate the teaching organization and implementation, and deepen the reform of teaching methods and methods according to the "1+X" vocational skill level standard, combining the professional talents training scheme with the vocational skills training assessment module. This is an important way to improve the quality of personnel training, and an exploration of building a national qualification framework.

According to the spirit requirements of the document "Pilot Program for Implementing the System of" Academic Certificate+Several Vocational Skills Level Certificates "in Colleges and Universities", colleges, industries and enterprises will unite, and reflect new technologies, new processes, new specifications and new requirements according to national professional standards and international and domestic advanced standards, and combine the contents of "1+X" vocational skills level certificates for industrial robots with courses to meet the talent training standards [2]

For this reason, this paper takes the industrial robot technology major in ordinary higher vocational colleges as an example, and interprets the content of "1+X" in combination with the tasks in the work field of the industrial robot major. According to the professional skill level standard of industrial robot application programming, after the job task structure, the curriculum system of industrial robot technology specialty is reconstructed from three aspects of knowledge,

ability and quality training requirements, and the method and path to realize the integration of courses and certificates are explored to improve the quality of professional talents training.

2. Job Analysis of Industrial Robot Industry

(1) Industry analysis

Robots are known as "the pearl at the top of the manufacturing crown", and their R&D, manufacturing and application levels are an important symbol to measure the developed degree of a country's high-end manufacturing industry, and an important entry point to realize and promote National Industry 4.0, Made in China 2025 and Robot Industry Development Plan (2016-2020) [3]. With the development of China's industrial robot industry, the country has successively issued policies related to manufacturing industry, and constructed the top-level industrial design from a macro and strategic perspective. The "intelligent" development of robot products has been strongly supported by the state, and the driving role of robot technology in industrial transformation and upgrading has become increasingly prominent.

In 2018, the national level successively introduced the guidance and support ideas for the industrial robot industry, paying more attention to the improvement of the overall management level and industrial level, so as to support the corresponding measures such as the reduction of capital, the VAT rate, the strengthening of brand quality, the revision of industrial standards, and the protection of intellectual property rights. The healthy development of China's industrial robot industry has been encouraged and standardized [4].

It is predicted that the growth period of China's industrial robot industry will enter a high-speed state in the next five years, which belongs to the rapid development stage of R&D, manufacturing and application enterprises of Chaoyang industrial robot industry in China [4].
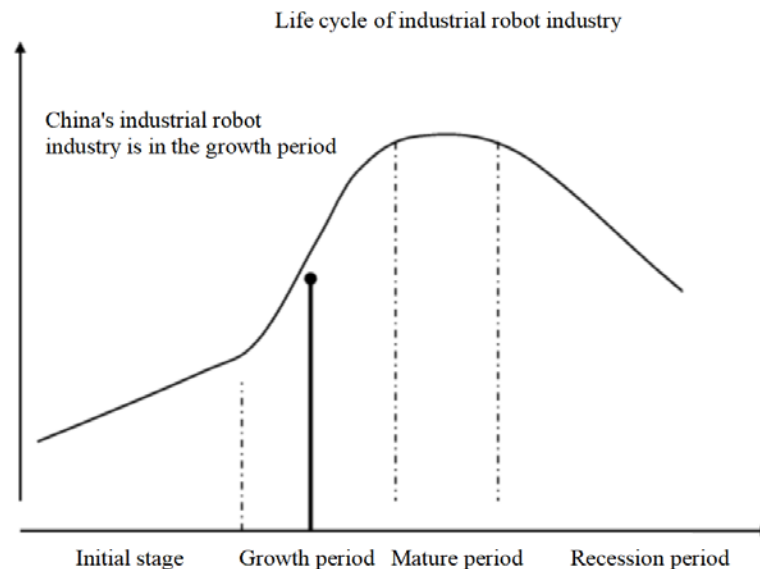
Fig.1 Life Cycle of the Industrial Robot Industry

Industrial robot industry is divided into upstream, midstream and downstream according to industrial chain. It is specifically divided into upstream enterprises that produce reducer, servo system and controller core components; Mid-stream manufacturing enterprises composed of ontology manufacturers; Downstream application enterprises composed of single system integrators and integrated system integrators [4]. Due to the serious lack of core components in China, the cost of industrial robots in China is raised and the development of the industry is restricted. The industrial robot industry is mainly concentrated in ontology and integration.
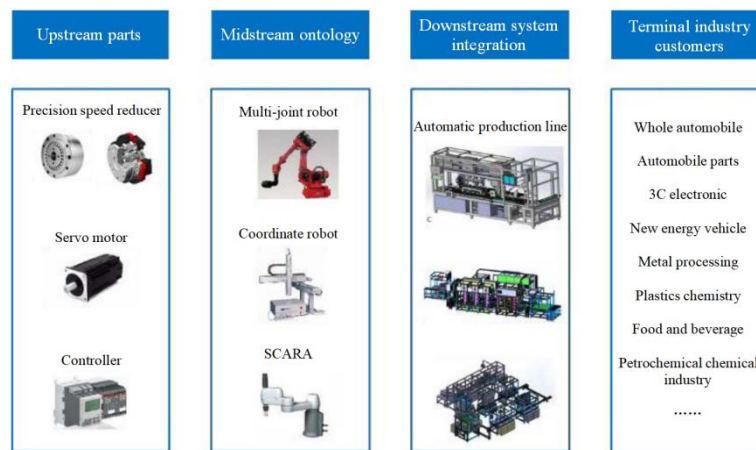
Fig.2 Industrial Robot Industry Chain Diagram

In addition to the automobile, 3C, metal processing, injection molding and other industries where robots are mainly used at present, the demand of many long tail industries is growing, such as medicine, food, logistics, chemical industry, petrochemical and so on. According to the demand growth rate of downstream industries from 2018 to 2020, the growth rate of food and medicine, logistics and semiconductor is in the forefront.

(2) Analysis of industrial posts

According to the analysis of industrial robot industry development trend, industrial chain and application industry. With the application and development of industrial robots in industrial robot body manufacturing, industrial robot system integration, industrial robot generation and application, and industrial robot sales, there is still a lack of applied talents in enterprises, such as on-site debugging, maintenance operation and operation management. This requires more engineers and technicians, and requires employees to master the technologies of industrial robot operation, maintenance, debugging, troubleshooting level system integration and so on. According to the forecast in the Planning Guide of Manufacturing Talent Development, the talent gap in the field of robots and high-grade CNC machine tools will reach 4.5 million by 2025 [5]. According to the needs of the industry, we have obtained the main positions, tasks and professional abilities of students majoring in industrial robot technology in higher vocational colleges.

Table 1 Positions and Professional Abilities of Enterprises

Enterprise category	Job title, main tasks	Professional competence
Body manufacturing	Operation programming, off-line programming and Simulation of industrial robot application system	Production line compliance, debugging, operation, maintenance and overhaul, PLC programming, frequency converter, servo driver application
System integration	Secondary development, integration and maintenance of industrial robot system	Engineering drawing reading, electrical control foundation, PLC programming, frequency converter and servo driver application
Production application	Design and upgrade of automation system	Production process understanding, engineering drawing reading, electrical control foundation, engineering drawing reading, PLC programming, drive controller, and visual application
Technical service	Pre-sales and after-sales support, industrial robot technology promotion, experimental training and robot science popularization	Industrial robot technology foundation, sales skills, communication skills

(3) Analysis of post professional ability

① Professional post ability

After analyzing the positions of vocational college students in ontology manufacturing, system integration, production and application, and technical service-oriented industrial robot application enterprises, we get the job qualification standards required by vocational college students of industrial robot technology: industrial robot operation and application, industrial robot repair and

maintenance, industrial robot workstation installation and debugging and system integration, industrial robot sales and after-sales. After the comprehensive analysis of the industrial robot application enterprise position, combined with the professional ability requirements, the professional ability requirements for vocational students are analyzed specifically. The relationship between professional qualification standard and professional ability is shown in the figure below.

Table 2 Post Professional Qualification Standard and Professional Ability Decomposition

Serial number	Content of post professional qualification standard	Professional ability
1	Operation and application of industrial robot	1. Have the ability to operate industrial robots skillfully; 2. Have linear motion programming, curve motion programming and interpersonal interface design; 3. Have offline programming ability; 4. Be able to compile and adjust the industrial robot control process to meet the working requirements of the production line; 5. Be able to use electrical tools correctly; 6. Try the size PLC communication programming; 7. Have a sense of safe operation, abide by the industry operation procedures, and abide by various process procedures; 8. Flexible application of basic robot operation, coordinate transformation and speed adjustment; 9. Be able to complete the setting of running track in the process of industrial robot completing control requirements; 10. Archive and summarize the completed tasks; 11. Flexibly apply professional new technology, new products and new equipment, and draw inferences from one instance.
2	Repair and maintenance of industrial robots	1. Be able to correctly read the electrical schematic diagram; 2. Ability to select basic electrical components; 3. Correct use of measuring instruments such as multimeter and oscilloscope; 4. Master the method of testing the main performance parameters of electrical components; 5. Master and flexibly apply the basic structure and working principle of automatic control equipment; 6. Solve the running performance and parameter setting of the power control system; 7. Be proficient in operating industrial robots; 8. Be able to use electrical tools correctly; 9. Have the ability of troubleshooting the electrical and mechanical of industrial robots; 10. Master the application of electrical, electronic, hydraulic and pneumatic professional knowledge in industrial automation; 11. Be able to maintain and repair mechanical equipment; 12. Have the ability to install, debug, test and maintain robots and their automatic lines; 13. Master the use, calibration and maintenance of testing instruments.
3	Installation, debugging and system integration of industrial robot workstation	1. Be able to independently complete the installation and wiring debugging of control equipment such as programmable, sensors and drivers; 2. Be able to complete the configuration programming of PLC program and HMI; 4. Apply the learned knowledge to complete the comprehensive test of system integration; 5. Be able to read the electrical control schematic diagram, wiring terminal diagram and component layout diagram; 6. Be able to judge the material, specification, insulation grade of conductor, cabinet specification and protection grade of products; 7. Be able to implement the installation operation procedures of low voltage electrical products;

		8. Be able to use electrical tools correctly; 9. Be able to eliminate the fault of electrical control equipment; 10. Emergency treatment of electric shock and electrical fire.
4	Industrial robot sales and after-sales	1. Have the ability to operate industrial robots skillfully; 2. Be able to work out and adjust the control flow of industrial robots according to the work requirements of the production line; 3. Master the characteristics of industrial robots and have the typical application process construction ability of industrial robots; 4. Master the brand and occupancy rate of industrial robots, and master the performance characteristics and technical indicators of industrial robots; 5. Have the ability to install and debug industrial robots; 6. Be able to analyze and judge product faults and write reports; 7. Be able to analyze and compare the performance and technical indexes of similar products, and make analysis report. 7. Be able to quickly and accurately explain product performance, technical indicators and characteristics; 8. Be able to conduct research and report on product market; 9. Have strong language ability.

② Task knowledge structure of post higher vocational education

On the basis of disassembling and analyzing the professional abilities required by the qualification standards of four types of professional posts, the required knowledge structure is combed. It is found that the knowledge structure required for industrial robot operation and application positions in enterprises where industrial robots are applied is as follows: robot structure principle, electrical control, PLC programming, industrial robot programming, robot end fixture design, hydraulics and pneumatics, robot maintenance and repair, safe power consumption, safe operation procedures, robot off-line programming, industrial interconnection, mechanical foundation, and electronic and electrical foundation. The required knowledge structure of industrial robot repair and maintenance post is: mechanical engineering drawing reading, robot structure principle, electronic and electrical basis, electrical engineering drawing reading, PLC programming basis, industrial robot programming, robot executive component design, hydraulic and pneumatic, industrial robot electrical maintenance, industrial network control, mechanical design basis, mechanical disassembly and maintenance of industrial robot Repair, industrial robot installation and debugging, industrial robot system integration, fieldbus and configuration basis, robot application technology foundation, safe electricity use, safe operation procedures. The knowledge structure required for the installation, debugging and system integration of industrial robot workstation are: mechanical engineering drawing reading, robot structure principle, electronic and electrical foundation, electrical engineering drawing reading, PLC programming basis, industrial robot programming, robot executive element design, hydraulic pressure and pneumatic, robot maintenance and repair, industrial network control, mechanical design basis, industrial machinery Human system integration, fieldbus and configuration basis, robot application technology foundation, safe electricity use, safe operation procedures. The knowledge structure required for the sales and after-sales of industrial robots is: mechanical engineering drawing reading, robot structure principle, electronic and electrical foundation, electrical engineering drawing reading, PLC programming foundation, industrial robot programming, robot maintenance and repair, industrial network control, industrial robot system integration, marketing, safe power consumption and safe operation procedures.

③ Need to set up courses

According to the post professional ability obtained by decomposition, combined with the professional knowledge structure content of industrial robot technology, the required knowledge content is transformed into the course content, and finally the content is transformed into the course required in the process of professional personnel training.

Table 3 Comparison between Post Talent Standards and Required Courses

Serial number	Standard content of post talents	Curriculum settings required for job tasks	Courses required for talent training
1	Operation and application of industrial robot	Mechanical drawing; Electrical and electronic technology; Electrical control and drive; Industrial robot technology foundation; Programmable control technology (S7-1200); 3 D modeling of mechanical products; Industrial robot programming; Industrial interconnection control technology; Industrial robot disassembly and operation and maintenance; Mechanical design basis; Hydraulic and pneumatic technology; Industrial robot operation professional skills training; Occupational safety education.	Mechanical drawing; Electrical and electronic technology; Electrical control and drive; Industrial robot application technology; Programmable control technology (S7-1200); 3 D modeling of mechanical products; Industrial robot programming; Mechanical design basis; Hydraulic and pneumatic technology; Computer aided design (mechanical and electrical CAD); Three dimensional modeling of mechanical products (SolidWorks); Industrial robot system maintenance technology; Field bus and configuration technology; Industrial robot system integration; End fixture and tooling design of industrial robot: Typical working applications of industrial robots; Vocational skills training and appraisal; Occupational safety education.
2	Repair and maintenance of industrial robots	Mechanical drawing; Electrical and electronic technology; Electrical control and drive; Computer aided design (mechanical and electrical CAD); Industrial robot technology application; Programmable control technology (s7-1200); Mechanical design basis; Three dimensional modeling of mechanical products (SolidWorks); Hydraulic and pneumatic technology; Industrial robot programming; Industrial robot system maintenance technology; Field bus and configuration technology; Industrial robot system integration; End fixture and tooling design of industrial robot: Typical working applications of industrial robots; Industrial interconnection control technology; Disassembly, assembly and operation of industrial robots; Industrial robot operation vocational skills training; Occupational safety education.	
3	Installation, debugging and system integration of industrial robot workstation	Mechanical drawing; Electrical and electronic technology; Electrical control and drive; Computer aided design (mechanical and electrical CAD);	

		Industrial robot technology application; Programmable control technology (s7-1200); Mechanical design basis; Three dimensional modeling of mechanical products (SolidWorks); Hydraulic and pneumatic technology; Industrial robot programming; Industrial robot system maintenance technology; Fieldbus and configuration technology; Industrial robot system integration; Industrial robot end fixture and tooling design; Typical working applications of industrial robots; Industrial interconnection control technology; Disassembly, assembly and operation of industrial robots; Industrial robot operation vocational skills training; Typical mechanical mapping and design; Occupational safety education.	
4	Industrial robot sales and after-sales	Mechanical drawing; Electrical and electronic technology; Electrical control and drive; Computer aided design (mechanical and electrical CAD); Industrial robot technology application; Programmable control technology (s7-1200); Mechanical design basis; Hydraulic and pneumatic technology; Industrial robot programming; Industrial robot system maintenance technology; Typical working applications of industrial robots; Industrial robot operation professional skills training.	

Through the analysis of post professional ability, knowledge structure and curriculum content, our curriculum system has been initially constructed. Although the courses in this curriculum system are from simple to deep, from easy to difficult, there are gaps between courses. The cohesion degree of curriculum content is not coherent enough to support the follow-up vocational skills training and appraisal, and students' skill level appears to be difficult after taking up professional posts.
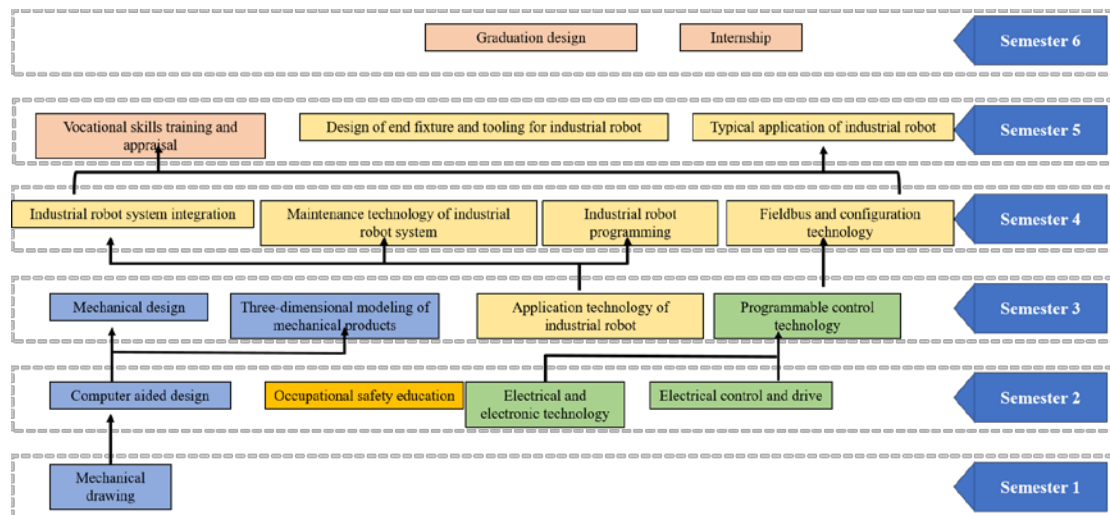
Fig.3 Curriculum System Before the Course Certificate Connection

2.1 + X Certificate Connotation and Professional Orientation

(1) Connotation of 1 + X certificate

1+X certificate is the vocational skill level certificate of vocational college graduates and social workers, which reflects the comprehensive ability needed by professional activities and personal career development [6]. In the 1+X certificate system, "1" is an academic certificate, which is basic and subjective, and is the main body of vocational higher vocational education, based on the realization of all-round development of moral, intellectual, physical, aesthetic and labor training and professional technical skills education. "X" is a number of vocational skill level certificates under the certificate system developed by enterprises, which not only has quantitative requirements, but also provides specific quantitative quality indicators for the quality of personnel training. It requires pertinence, guidance and advancement for the ability training of vocational posts, and it is the enhancement, supplement or expansion of vocational skills, professional qualities or new technologies and new skills of talents in higher vocational personnel training. As the proof of the learning experience and learning situation of the educated, the academic certificate is mainly to train high-quality workers and technical and technical talents to meet the needs of industrial economic and social development. The vocational skill certificate is a proof of the professional knowledge and skill level possessed by the certificate winner, which focuses on cultivating talents with high-level technical skills, and has both commonness and particularity [7]. 1+X certificate system is based on the value of "1" to promote the status of "x", which is an upgrade of the academic certificate system, that is, on the basis of obtaining academic certificates, students are encouraged to obtain various vocational skill level certificates. Academic education and vocational skill level training complement each other. The former is the foundation, while the latter is to upgrade vocational skills and promote the reform of academic education and teaching [8].
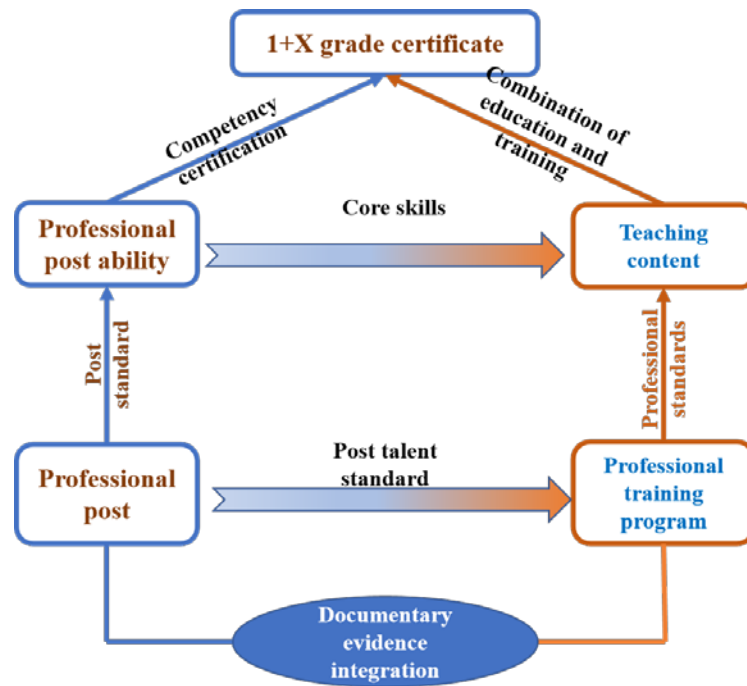
Fig.4 Connotation of 1+X Certificate

(2) Professional orientation

The students of industrial robot technology major in higher vocational colleges mainly engage in industrial robot application system integration, industrial robot application system operation and maintenance, automatic control system installation and debugging, sales and technical support. Through high integration with the industrial robot application enterprises and industrial robot production enterprises in the region, based on the industrial robot talent training center of the Ministry of education, the students' industrial robot maintenance and repair, installation and debugging, operation, system simulation, teaching and offline programming, machine human end actuator design, industrial robot system integration ability are trained as the key points, and the real work is focused Task as the carrier, build a talent training mode of "school enterprise cooperation, integration of theory and practice, and work study integration" of "work study alternation, task driven, virtual and actual combination," and "teaching, learning and doing" integration.

3. Interpretation of 1 + X Industrial Robot Programming Standard

According to the "Industrial Robot Application Programming Vocational Skills Grade Standard", the industrial robot application programming vocational skills grade certificate mainly faces enterprise jobs such as ontology manufacturing, system integration, production application, technical service, etc., and is engaged in operation programming, installation and debugging, operation and maintenance, system integration, marketing and service in industrial robot units and production lines. The main work content is industrial robot application system operation programming, offline programming and simulation, industrial robot system secondary development, industrial robot system integration and maintenance, automation system design and upgrading, pre-sales and after-sales support, etc. It can also be engaged in technology promotion, practical training and popular science.

Industrial robot application programming vocational skill levels are divided into three vocational skill levels: primary, intermediate and advanced. Each level progresses in turn, and the advanced certificate requirements cover the low-level vocational skill requirements. It is necessary to pass the examination to obtain the corresponding level of skill level certificate, and the compound technical and skilled personnel are required to be achieved by the combination courses of different levels of assessment modules.

Taking the intermediate vocational skill level of industrial robot application programming as an

example, the work fields of students mainly include: industrial robot parameter setting, system programming, offline programming test. The main tasks are industrial robot system parameter setting, teaching device setting, system external equipment parameter setting, extended IO application, advanced programming, system external equipment communication and programming, typical system application programming, virtual simulation programming, parameter configuration, TCP calibration and so on. Industrial robot application programming vocational skills level intermediate certificate students need to meet the following professional skills requirements, see Table 4.

Table 4 Intermediate Certificate Students Need to Meet the Following Vocational Skills Requirements Overall

Vocational skill level	Vocational skill requirements	Work content that can be engaged in post
Intermediate	1. Be able to comply with the safety regulations and set the parameters of the industrial robot unit; 2. Be able to connect and control industrial robots and common peripheral devices; 3. Be able to write the industrial robot unit application program according to the actual needs; 4. Be able to build the corresponding simulation environment according to the actual workstation, and program the typical industrial robot unit offline.	Industrial robot system operation programming, automation system design, industrial robot unit off-line programming and simulation, industrial robot unit operation and maintenance, industrial robot testing, etc.

4. Curriculum System Construction

Combined with the students' abilities and the requirements of 1+X certificate of industrial robot application programming, according to the combed professional knowledge content and the comparison table of documentary evidence financing relationship provided by Beijing Saiyuda Company, and according to the professional talent training plan, the curriculum system has been thought of curriculum financing (the table of curriculum evidence financing relationship is as follows.) in the talent training program, the professional curriculum and the 1+X vocational skill grade standard have been adjusted and improved by mutual connection, supplement and expansion.

Fig.5 Comparison Table of Documentary Evidence and Financial Relationship of Industrial Robot Technology Specialty

Comparison of the relationship between documentary evidence and evidence in industrial robot technology specialty

Professional name	Comparison of the relationship between documentary evidence and industrial machinery technology					Level	Junior College				
School name	Kunming vocational and technical college of industry										
Course name	Original credits	Certificate authentication unit	Certification unit credits	Post-transformation curriculum	Credits	Enhance content		Supplementary content		Expand content	
						Content	Credits	Content	Credits	Content	Credits
Mechanical drawing	4	YYBCI01 read mechanical schematic diagram and	0.5	Mechanical drawing	4	Mechanical schematic diagram and assembly	0.5				

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		assembly drawing				drawing of industrial robots and peripherals					
Programming and Simulation of Industrial Robot System	3.5	YYBCI03 uses offline programming software for industrial robots	0.5	Programming and Simulation of Industrial Robot System	3.5	Strengthen the application of off-line programming software RobotStudio	0.5			Typical application of industrial robot	0.5
Modeling of industrial robot application system	3	YYBCI02 carries out three-dimensional modeling on workstation system	0.5	Modeling of industrial robot application system	3	Modeling and simulation according to specific workstations	0.5	Application of off line programming software for industrial robot	0.5	Design of robot fixture based on SolidWorks	0.5
Visual inspection and sensing technology	4.5	YYBCI04 uses intelligent sensor system	1	Visual inspection and sensing technology	4.5			RFID technology	0.5	Communication method between machine vision and industrial robot or PLC	0.5
Industrial Robot Application System Integration	4.5	YYBCI08 industrial robot application system programming	2	Industrial robot application system integration		Industrial robot welding, grinding, spraying, carving, stacking and other technological processes	0.5				
Electrical and electronic technology	4.5	YYBCI05 develops PLC program	0.5	Electrical and electronic technology				Industrial robot workstation system communication programming workstation PLC	0.5	Comprehensive control of RFID and other sensing units	0.5
S7-1200 programming applicati	3.5			S7-1200 programming technolo	3.5						

on technology				gy				programming			
Electric drive and control	3			Fieldbus and configuration control technology	4.5						
Industrial Control Configuration and Fieldbus Technology	4	YYBCI05 uses industrial control network technology to network	0.5	Industrial control configuration and Fieldbus Technology	4.5	Strengthen the application of industrial robot bus technology	0.5		0.5		
Industrial Robot Application System Integration	3	YYBCI07 develops basic SCADA system	0.5	Industrial robot application system integration	3	Definition of machine interface variables and connection method with related controls	0.5	Programming of man-machine interface			
Vocational skills training and appraisal	3	YYBCI08 industrial robot application system programming	2	Vocational skill training and appraisal	3	Advanced programming instruction and its application method	0.5			Multitask programming mode	0.5
Maintenance technology of industrial robot system	3	YYBCI09 inspection and acceptance of industrial robot system	1	Industrial robot system maintenance	3	Setting of IO parameters of industrial robot	0.5			National standard and test method of industrial robot performance specification and test method, inspection and acceptance of industrial robot system	0.5
		YYBCI10 maintains industrial robot system	0.5								
Total credits	43.50		11.5		36		4		2		3

(1) Professional core curriculum setting

Industrial robot application programming must have the ability of industrial robot system integration, communication with peripheral devices, control and so on. It is necessary to offer courses such as "PLC S7-1200 Series", "Fieldbus and Configuration Control Technology", "Off-line Programming and Simulation of Industrial Robot System", "Maintenance Technology of Industrial Robot System", "Modeling of Industrial Robot Application System" and "Integration of Industrial Robot Application System" [10].

The core course mainly trains students to master the programming, installation and wiring of S7-1200PLC basic control circuit, and the programming, installation and wiring of PLC control circuit in the control field. Master the characteristics, basic composition and installation, interface operation and design environment of configuration software, and have the integrated operation and communication capabilities of touch screen, frequency converter and PLC. Mastering the construction method of basic simulation industrial robot workstation, the design concept and method of palletizing, welding, grinding and polishing robot workstation, the modeling function of ABB robot simulation software RobotStudio, and the off-line trajectory programming method of ABB industrial robot can build three-dimensional model of industrial robot workstation system, set industrial robot system parameters, and program and simulate industrial robots. Be able to carry out debugging, inspection and acceptance of industrial robot system, have knowledge of organization and management of industrial robot system and relevant professional post ability. Students should master the characteristics, basic composition and installation, interface operation and design environment of 3D design software, and have the ability of modeling, assembly and drawing of industrial robot system. It can build industrial robot workstation, choose industrial robot and end effector, build machine controller system, set basic parameters and servo parameters of machine controller, test the operation of machine controller, design industrial robot workstation system scheme, choose peripheral equipment of industrial robot workstation, design hardware system of industrial robot workstation, compile and debug control program of industrial robot workstation, and solve common faults of industrial robot workstation.

(2) Professional course setting

As a typical electromechanical integration equipment, industrial robot is mainly used to integrate industrial robot body, control software, application software and peripheral equipment into a system, which is applied to industrial automation such as welding, grinding, loading and unloading, handling and machining [11]. The cultivation of its integration ability needs the general ability of mechanical and electrical posts and the professional knowledge of automatic control, so as to train students to master the basic knowledge of mechanical and electrical engineering drawing, manual drawing and computer drawing. Master the basic theoretical knowledge of mechanical manufacturing process design and typical fixture working principle, so it is necessary to integrate the general education of mechanical and electrical integration specialty, such as mechanical drawing, electrical and electronic technology, C language programming, electrical control technology, computer-aided design (mechanical and electrical CAD), mechanical design basis, industrial robot technology foundation, hydraulic and pneumatic transmission technology, etc Learning content.

(3) Professional development curriculum

Industrial robot system integration technology is a typical integrated application of mechanical and electrical automation technology. In order to train students to master the technological knowledge requirements for the installation and debugging of automatic production lines, they should master the basic knowledge, common methods, maintenance techniques and basic skills of mechanical installation and maintenance; Familiar with the structure and working principle of main typical welding equipment, reasonably formulate welding process parameters for welding quality control, and have the ability to correctly select, use and maintain commonly used welding equipment; Master the NC machining process and program with moderate complexity in NC machining; Master sales skills and after-sales service skills of project management; Courses such as

numerical control technology, AutoCAD electrical, Python program development technology, electrical equipment maintenance, basic operation and application of welding robot, typical working application of industrial robot, mapping design of typical mechanical parts, marketing, project management, etc.

In order to train students to master the technology of assembly, debugging and design of industrial robot machine vision circuit, to be familiar with the working principle and application of common sensors, and to master the performance and technical indicators of sensors commonly used in automatic detection of machine vision circuit, the parameters and technical indicators of detection link will be tested and corrected according to the production process requirements. In order to meet the training objectives of the talent training program, combined with the industrial robot application programming 1 + X vocational skill level standard, and the cognitive learning law of vocational students, the course of "visual detection and sensing technology" is set up in the fourth semester. The target of professional development course is located at the "application" level, which should be different from the general mechanical specialty.

(4) Cohesion of curriculum system

Comprehensive professional basic courses, professional courses, professional core courses, combined with the talent training program, according to the requirements of industrial robot application programming vocational skills level, the curriculum system of industrial robot technology specialty is reconstructed twice. The whole curriculum system has formed two coherent main lines, and the curriculum contents are connected, supplemented and expanded. The constructed curriculum system fully incorporates the training assessment content of 1+X vocational skill level certificate.
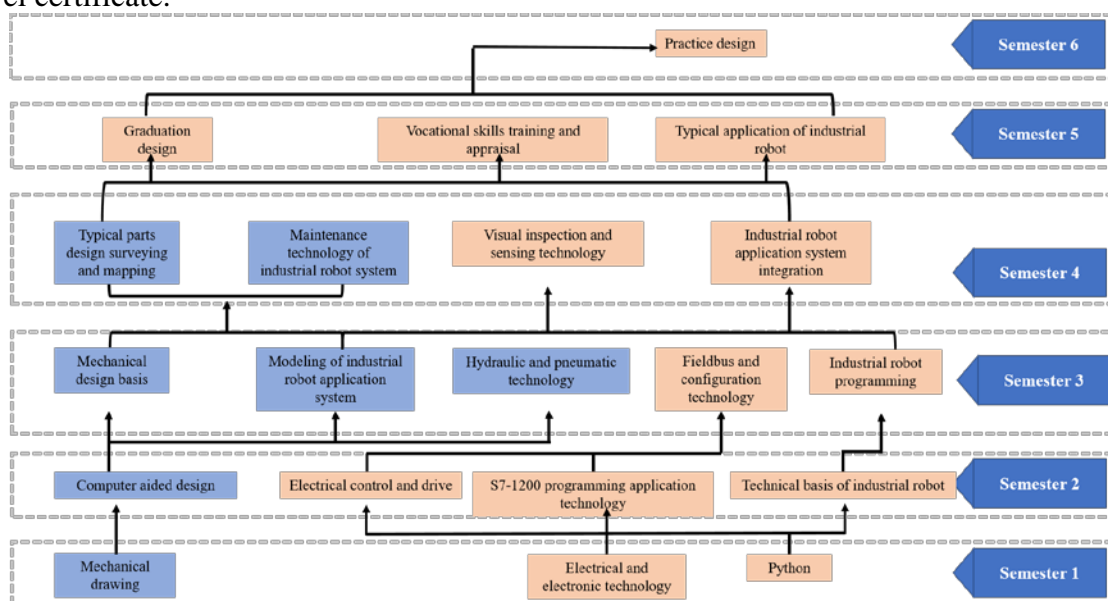

Fig.6 Curriculum System after the Course Certificate is Connected

Fill the reconstructed and perfected courses into the map of integration of courses and certificates provided by Beijing Saiyuda.

Course of study (144	Grade 1		Grade 2		Grade 3	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
Professional basic courses	Mechanical drawing (4 credits)	■Fundamentals of industrial robot			●Integrated curriculum ◆New courses ■Intensive practical training course ★Professional core course	
	Electrical and electronic	Computer aided design (mechanical	undamentals of mechanical design (3.5 credits)			
	Python(2 credits)	Electric drive and control (3 class				
Professional required courses		●S7-1200 programming	■Modeling of industrial robot application system	■Industrial robot application system		
			Hydraulic and pneumatic technology (3 credits)	■Maintenance technology of	Graduation design (8 credits)	
			●Programming and Simulation of industrial			
			■ Fieldbus and configuration control	◆Visual inspection and sensing		
Professional skills training course		Cognition practice (1 credit)	Internship (1 credit)		Comprehensive professional	Internship (18 credits)
		Metalworking Training (1 credit)			■Vocational skills training	
Professional elective course				Visual inspection and sensing		
				Visual inspection and sensing		
					Typical application	

Fig.7 Map of Course Certificate Integration

5. Conclusions

Combined with the development background of intelligent manufacturing industry, according to the professional grade standards of industrial robot application programming jointly issued by institutions of higher learning and industry enterprises such as Industrial Robot Application Programming 1+X Pilot Training and Evaluation Organization, Machinery Industry Education Development Center and National Machinery Industry Industrial Robot and Intelligent Equipment Vocational Education Group, through industry, school-enterprise cooperation, certificate training content is integrated into the talent training program, curriculum setting and teaching content are optimized, teaching organization and implementation are coordinated, and teaching methods and methods reform are deepened. So as to organically transform professional functions such as professional ethics and occupational safety, industrial robot and industry cognition, production process management application, electrical control system of industrial robot, mechanical structure of industrial robot, operation programming of industrial robot, industrial robot control, automatic line management of industrial robot, operation and maintenance, digitization and intellectualization, etc. are organically transformed into courses, forming a process Vocational learning modules, such as industrial robot technology foundation, industrial robot operation and programming, industrial robot system offline programming and debugging, industrial robot production line management and maintenance, form a curriculum system composed of two coherent main lines. The course contents are connected, supplemented, expanded and promoted. The constructed curriculum system fully incorporates the training assessment content of 1+X vocational skill level certificate.

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