Exploration and Practice of Constructing the Teaching System of Electromechanical Major in Higher Vocational Education with Vocational Qualification Certificate

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Abstract. Through the research of industries and enterprises, this article analyzes the demand for talents and the Vocational Qualification Certificate with high recognition, constructs the teaching system of Electromechanical Major in higher Vocational Education by digging the connotation of Vocational Qualification. After several years of practice, it has been proved that in this Major the students have not only improved their skills, but also obtained relevant Vocational Qualification Certificates and employment weights. At the same time, it also promotes teachers to improve teaching methods, attaches importance to the cultivation of students' vocational quality, stimulates students' motivation and interest in learning, and forms a 3-win situation of students, schools and enterprises.

Foreword

Higher vocational education is not only the education of academic qualifications, but also the education of vocational education, which can not only improve the national quality, but also improve the production level of enterprises. It is also a kind of higher education which can enhance the competitiveness of enterprises' products and be popularized at present and in the future. Starting from the concept of "employment-oriented" in higher vocational education and the demand of enterprises for skill applied talents in production line, the students trained in higher vocational education should have a certain theoretical level. At the same time, they should have the corresponding post skill or vocational skill, be able to adapt to and meet the requirements of enterprises for skilled talents in production line. With the socialization of the recognition of Vocational Qualifications and Work Abilities in our country, students from Higher Vocational and Technical Colleges should not only obtain a diploma to attest their education upon graduation, but also obtain the Vocational Qualification (or skill) Certificate related to their Majors or industries, which examined and issued by institutions such as the Labor Department, the Safety Supervision Department, the Trade Association, and so on. This is the "Double Certificates" education in Higher Vocational and Technical Colleges. As early as 2004, in 《Several Opinions on Further Strengthening the Vocational Education Work》, the Ministry of Education and other six departments clearly pointed out that Vocational Colleges and Universities should establish the leading ideology of running schools as "employment-oriented, all-round quality oriented, focus on vocational ability, featuring enhanced application and outstanding skills, carrying out the training system that combines Academic Diploma with Vocational Qualification Certificate", which makes the "Double Certificates" education become the characteristic and positioning benchmark of Higher Vocational Colleges and Universities.

Because of the early start of Vocational Education in foreign countries (western developed countries), the related research on Vocational Education is very rich, and has been institutionalized, normalized, standardized and socialized in Vocational Qualification Appraisal. Vocational Education has been developing at a high speed for more than ten years in our country, great progress has been made in the institutionalization, normalization, standardization and socialization of Vocational Qualification Certificates in recent years. Enterprises attach great importance to Vocational Qualification Certificate, which also puts forward urgent requirements for "Double

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Certificates" education in Higher Vocational Colleges. Based on this premise, the Electromechanical Integration Major of our institute exploring boldly as a provincial teaching reform demonstration Major, we have explored how to construct the teaching system of Electromechanical Major with Vocational Qualification Certificate, and some achievements have been made.

Determine the Vocational Qualification Certificate for Electromechanical Major

At present, the Vocational Qualification Certificate that Higher Vocational College students can obtain is not only issued by Vocational Skill Appraisal Department, but also issued by Industry Functional Department and Industry Association and so on. The phenomenon of "multi-door certificates" is serious, which brings great difficulties to the Higher Vocational Colleges to cultivate talents with "Double-Certificates" education. In order to cultivate students better, we must discard the rough and extract the essence, choose those certificates with higher gold content and social recognition, which can truly reflect the training characteristics of Electromechanical Major in higher vocational education and the students' vocational level.

In order to make the Major education more adapt to the development and change of industry structure and vocational post, our institute attaches importance to strengthen the cooperation with experts and scholars related to enterprises and industries. At the end of 2010, the School-Enterprise Cooperation Office was established, and several thematic seminars were held. In 2011-2012 Electromechanical Integration Technology Major used questionnaires, interviews and seminars, work-study alternation, work-study program, etc., conducted a survey on 8 enterprises including Wuhan Jinhang Science and Technology Development Co., Ltd., Suzhou Mingshuo Group, Wuhan Tianma Microelectronics Co., Ltd., Huagong Laser Engineering Co.,Ltd., Shenzhen Saiyifa Company, Fusikang Science and Technology Group, Shanghai Yingjisi Company, Wuhan Cigarette Factory, to further understand the changes and trends that how enterprises require the talents from Electromechanical Integration Technology on their knowledge, skills and personnel quality. In addition, a questionnaire survey was conducted on the employment situation of previous graduates, formed a comprehensive "development research report on Electromechanical Integration Major".

The employment scope of Electromechanical Major 's students mainly involves the installation, debugging and maintenance of production lines. From the enterprises' recognition of the certificates and vocational connotation included in the certificates, our institute has selected the Employment Post and Vocational Qualification Certificate that the students engaged in specifically, as shown in table 1.

Table 1 Post and Vocational Qualification Certificate

number	Specialization Direction	Major Work Project and Employment Post	Vocational Qualification (name, rank, certification authority)
1	Production Line Technical Operator	Production Line Installation, Debugging and Maintenance, Assembly and Equipment Operation for Electromechanical Products; covering the positions of construction workers, technologists and technicians of the Production Line	pass the Electrician Medium Skill Appraisal, Hubei Provincial Department of Human Resources and Social Security; Electrician License, National Security Check Bureau
2	Production Line Manager	Production Management, Quality Management; covering the positions of inspectors, debuggers, salesmen and technicians of the Production Line	pass the Electrician Medium (Advanced) Skill Appraisal, Hubei Provincial Department of Human Resources and Social Security; Electrician License, National Security Check Bureau
3	Technician	Electromechanical Equipment Maintenance, Product Testing, Product Repair, Customer Service; covering the positions of process designer, technologist, technician, debugger and inspector of Electromechanical Products	pass the Electrician Medium (Advanced) Skill Appraisal, Programmable Control System intermediate designer, Hubei Provincial Department of Human Resources and Social Security; Work License for Electrician, National Security Check Bureau
4	Engineer Assistant	assist engineer in Product Development and Equipment Control; covering the positions of process designer, technologist, technician, debugger and inspector of Electromechanical Products	pass the Electrician Medium (Advanced) Skill Appraisal, Programmable Control System intermediate designer, Hubei Provincial Department of Human Resources and Social Security; Work License for Electrician, National Security Check Bureau
5	Technical Support Staff	Product Marketing, Complaint Handling, Technical Support, etc.; covering the positions of process designer, technologist, technician, debugger and inspector of Electromechanical products	pass the Electrician Medium (Advanced) Skill Appraisal, Programmable Control System intermediate designer, Hubei Provincial Department of Human Resources and Social Security; Work License for Electrician, National Security Check Bureau

Analyze Core Vocational Ability and Innovate Talent Cultivation Mode

According to the results of the investigation, it is determined that the Major field (or direction) for the talent cultivation of the Electromechanical Major in our institute is Modern Automation Production Field, Electromechanical Systems and Equipment Manufacturing Field, and the Technical Service Field for Electromechanical Products. Typical positions corresponding to the Major field include running, operation and maintenance positions of Automatic Production Line and Electromechanical Equipment , installation, debugging and maintenance positions of Electromechanical Equipment, and technical service positions of Electromechanical Equipment. According to these typical jobs and tasks, the vocational abilities of each vocational post is analyzed and summarized, and 10 kinds of comprehensive vocational abilities of Electromechanical Integration Major are finally determined: mechanical map reading and drawing ability, electrical map reading and drawing ability, simple mechanical parts processing and assembly ability, mechanical transmission system assembly and debugging ability, electronic control system assembly and debugging ability, electrical control system assembly and debugging ability, application ability of programmable controller, control motor system assembly and debugging ability, testing and control system assembly and debugging ability, industrial network control system assembly and debugging ability. These comprehensive vocational abilities are subdivided into special skills in the Vocational Qualification Certificate, which provides the basis constructing the curriculum system of combination of work and learning with Vocational Qualification Certificate as the carrier. Through investigation and research, based on the systematization of work process and the analysis of typical work tasks on the Major, we have innovated the talent cultivation mode of "order-oriented, broad base on Major, Multiple-Major direction modules" for Mechatronics Technology Major to meet the needs of enterprises. At the time of admission, the student determines a basic direction in his Major, to complete learning and training of the basic modules on his Major Ability in the first two years. We should carry out four stages of Vocational Education in accordance with the growth law of high-skilled talents, namely the stage of Vocational Ability Cognition →the stage of Vocational Ability Formation → the stage of Vocational Ability Promotion → the stage of Vocational Post Training. In the first two stages, we design that in the teaching of basic courses for each Major, through the integrated teaching method of each course, take each project as the carrier and form students' post consciousness according to the flexible teaching mode. For qualified students to issue the corresponding Vocational Qualification Certificate. The students who get the certificates are recognized by the enterprises. In this way, enterprises also have a guarantee in employing personnel. Schools have goals for teaching and students have goals for learning. This will be a three-win situation.

The first two stages of Vocational Education are completed in the cultivation process in the first two years. And the learning process of work-study alternation is designed according to the characteristics of each stage. In the third academic year, according to the enterprises' order demand, determine the direction module of post demand flexibly. For students who have not participated in the order-training of enterprises, a number of post demand modules are provided for their own choice according to their individual employment intention. The direction module of post demand is flexible, and we will adjust the setting of post demand direction module, module curriculum and curriculum content according to the change of the development trend of new technology and the demand in the job market every year.

Strengthen School-Enterprise Cooperation, and Co-Build the Teaching System of Electromechanical Major Curriculum with Vocational Qualification Certificate

According to the requirements of the talent cultivation mode "order-oriented, broad base on Major, Multiple-Major direction modules" for Electromechanical Technology Major, the basic structure of Curriculum Teaching System is divided into Vocational Basic Module Curriculum, Major Basic Learning Curriculum, Training & Practice Curriculum for Vocational Qualification Certificate and Learning Curriculum for Major Extension Direction. On the basis of fully investigating the needs of

the employers, the specific curriculum teaching system is set up according to requirements of the professional core competence of Electromechanical Integration Technology , as shown in figure 1.

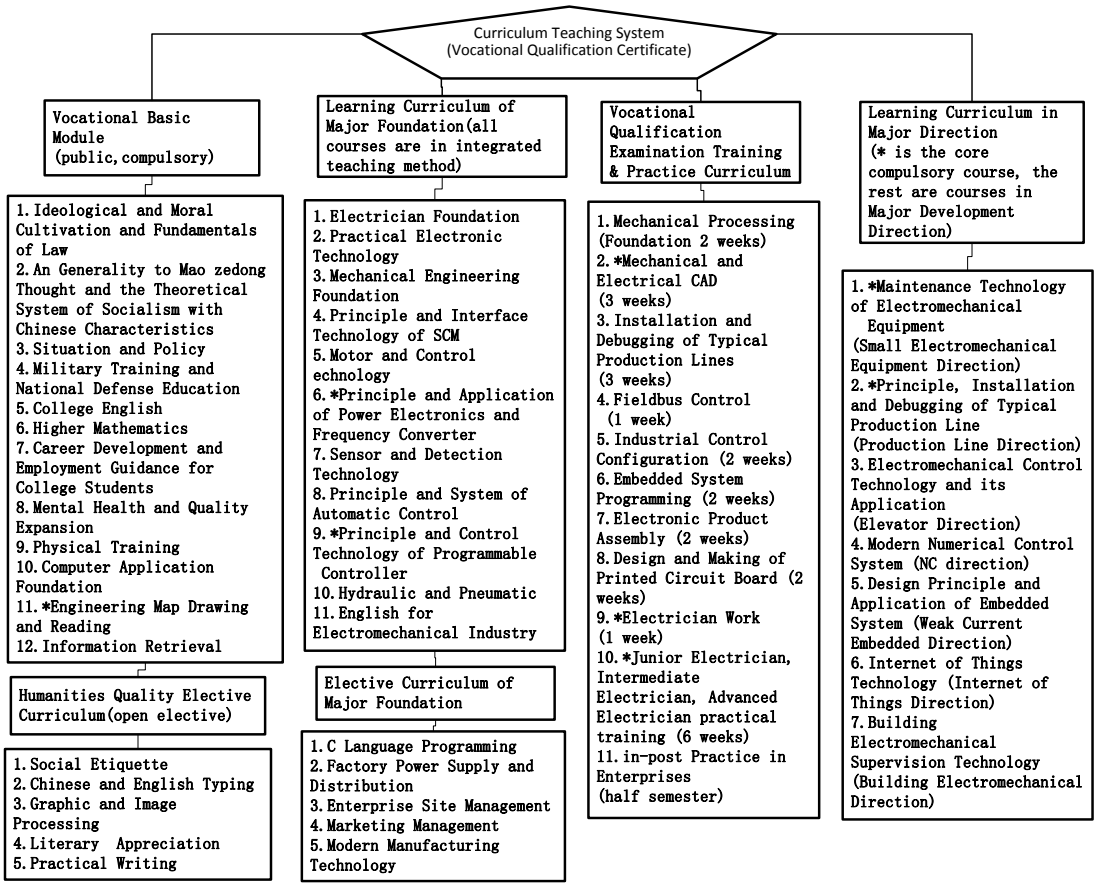

Figure. 1 Teaching System of Electromechanical Major Curriculum

According to the design of curriculum system structure, the teaching hours scale table of Electromechanical Major is calculated, as shown in table 2. It can be seen that the lecture hours of Theory Teaching account for 48%, while the Practical hours of Practice and Training account for 52%, reflecting the characteristics of Vocational Education.

Table 2 Teaching Hours Scale Table

Project	School Hours		Credit	
	Total Hours	Percentage	Total Credit	Percentage
Basic Learning Area	804	23%	37	25%
Major Public Learning Area	1098	33%	55	38%
Specialized Orientation Compulsory Course	1170	35%	39	27%
Major Extension Learning Area	240	7%	10	7%
Humanities Quality Learning Area	72	2%	4	3%
Total	3384	100%	145	100%
Of all school hours: Lecture hours	1618	48%		
Practical hours	1766	52%		
Practical Training hours: General training	596	34%		
Productive practice	1170	66%		

In curriculum content, the corresponding courses and practical teaching contents are set up according to the analysis of vocational ability of Vocational Post Group and analysis of Vocational Qualification Certificate. Take the vocational skills training syllabus of advanced electrician with

vocational qualification stipulated by the state as an example, the training content of advanced electrician is divided into two parts: SHOULD KNOW (knowledge) and SHOULD DO (skills), with a ratio of 3:7. Knowledge requirements include relevant knowledge, basic knowledge and professional knowledge. Skill requirements include Electrician's tools, materials and instrumentation, basic operating skills and Safe & Civilized production. To improve the technical quality and vocational skills of trainees through the training of obtaining Vocational Qualification Certificate. In the national syllabus, there is electrical control circuit with transformers, motors, CNC machine tools and so on as various carriers. According to the syllabus, we have drawn up table 3, which shows the schedule of advanced electrician training program.

Table 3 Teaching Plan Arrangement for Advanced Electricians

Chapter / content	School hours		
	Total	**Teaching**	**Training**
Chapter 1 Transformer	2	2	0
Chapter 2 Practical Electronic Technology	6	2	4
Chapter 3 Motor and Drag	8	2	6
Chapter 4 Automatic Control	2	2	0
Chapter 5 Fault Analysis and Troubleshooting of Mechanical Equipment and Electrical System	8	2	6
Chapter 6 Principle and Application of Programmable Controller	12	2	10
Chapter 7 Skills in Using Electronic Instruments	6	2	4
Chapter 8 Production Management and Machinery Basic Knowledge	2	2	
Chapter 9 Compile Overhaul Technology of Electrical Equipment in workshop and Matters Needing Attention in Designing Control Circuit	2	2	0
合 计	48	18	30

Of course this is only the training form arranged after students finish the Electromechanical Major curriculum. Without the support of basic courses, students will not be able to complete the training, nor will they achieve the goal of obtaining a certificate. Based on this, our curriculum system intersperses these contents into the teaching of Major basis courses, add an additional six weeks of targeted training, systematically complete the tasks of elementary, intermediate and advanced electricians. At the same time, the practice-week's training is also regarded as a compulsory credit for College diploma in this Major. In order to obtain employment, also to get a diploma smoothly, the students have to take advantage of class time and spare time to achieve this goal. The motivation of students' autonomous learning has been enhanced, the efficiency of learning has been improved, and the goal of Major teaching has been achieved.

Combine related and similar knowledge and skills. For example, the course "Principle and Application of Power Electronics and Frequency Converter" takes "knowledge + skill" parallel importance as the main line, organically integrates Power Electronics Technology and Frequency Converter Technology, and focuses on the use of Power Devices in Frequency Converter, reflecting the prominent position of Frequency Converter using in industrial production. Other curriculum have many basic courses which belong to the Major direction, and it is not recommended to integrate them. For example, the Principle and Interface Technology of SCM, it is the basic course in embedded direction; The principle and Application Technology of PLC is the basic course in direction of production line principle, installation and debugging; Sensor and Detection Technology Application is also currently an important branch of employment post and should not be integrated. This also reflects the innovation mode of the talent cultivation foundation - "both Major and Broad".

In the training practice of gaining Vocational Qualification Certificate, we should strengthen the skill training of practical operation in using instruments, tools, etc., which is the basic demand of vocational posts. At the same time, we emphasize the practical teaching link in the whole curriculum system. The core courses of the Major are taught in the form of TC, that is, small-class teaching in the technical center site. A teacher only teaches about 20 students, and the deep integration of "teaching, learning and doing" is strictly implemented to ensure the teaching quality of the curriculum. The practice teaching link of Electromechanical Integration Technology Major

also runs through the whole (3 years) teaching process, carries on the skill training to the students in stages, and combines the training for gaining skill certificate with the teaching. The corresponding relationship between specific courses and Vocational Skills Appraisal Certificate is shown in table 4.

Table 4 Correspondence Table between Curriculum and Vocational Skill Appraisal Certificate

Number	Basic Curriculum of the Major	Curriculum of Major Direction	National Vocational Qualification Certificate and Industry Certification
1	Fundamentals of Computer Application		Office Software Application intermediate (ATA)
2	Electrician Foundation Motor and Control Technology PLC Principle and Control Technology Principle and Application of Power Electronics and Frequency Converter	Principle, Installation and Debugging of Typical Production Line Maintenance Technology of Electromechanical Equipment Electromechanical Control Technology and its Application	1. Work License for Electrician (National Security Check Bureau) 2. Electrician (intermediate, advanced)(Hubei Provincial Department of Human Resources and Social Security) 3. Programmable Control System designer intermediate (Ministry of Human Resources and Social Security of Hubei Province)
3	Principle and Interface Technology of SCM Sensor and Detection Technology Practical Electronic Technology	Design Principle and Application of Embedded System	Printed Circuit Board (PCB) Maker (intermediate) (Hubei Provincial Department of Human Resources and Social Security)
4	Fundamentals of Mechanical Engineering Mechanical CAD	Modern Numerical Control System	National CAD Skill Level Certificate (issued by Chinese Society of Graphics)
5	College English English for Electromechanical Industry		The Test of College Students' English Application Ability (qualified) the Ministry of National Education

"Loose Enrollment, Strict Graduation" for students of Vocational Education. Improve Vocational Quality Education and Enhance the Consciousness of Demonstration Brand in Vocational Colleges

There are three entrances to recruit students for Electromechanical Major in our institute, namely National Colleges Entrance Examination, Separate Enrollment in Hubei Province and Hubei Technical Colleges Entrance Examination, total three enrollment modes. No matter ordinary high school students, secondary vocational school students or technical school students (including graduated or in-school students), the entrance to the source of students is relatively loose.

After 3 years of talent cultivation studying in higher vocational Electromechanical Major constructed with Vocational Qualification Certificate, students must complete at least 145 total credits in three years, and obtain the Intermediate Electrician Skill Appraisal Certificate (obtain advanced electrician if capable enough) before graduation. Among them there are 37 credits in basic field, 55 credits in Major public learning field, 39 credits for the compulsory courses in specialized direction, 10 credits in Major extension learning field and 4 credits in humanistic quality learning field. Additional 1 credit for volunteer work or youth volunteer service and 1 credit for social practice and social investigation.

In order to reflect the multi-objectives of education cultivation, students who achieve excellent performance in the core learning field (more than 90 points) or obtain advanced Major Skill Certificate can float up 2 credits, which can be included in the total credits of graduation. It can offset the credits of Major elective learning field which are still unqualified after re-examination or any elective course's credits of the whole institute.

The students' in-post practice can be arranged separately according to the teaching needs, and the total time of in-post practice shall not be less than one semester. Due to the change and adjustment of curriculum teaching caused by practical links such as in-post practice, relevant undertaking departments should flexibly organize and tutor students to meet the requirements of curriculum closure after they return to school.

Through demonstration and post-demonstration construction, the present teaching bases of practical training in and out of our institute can completely meet the requirements. Adopt "Loose Enrollment, Strict Graduation" for students of Vocational Education, improve the vocational quality education, simultaneously also promotes the consciousness of demonstration brand in our institute.

Conclusion

This paper discusses the talent cultivation mode of Electromechanical Integration Major constructed by Vocational Qualification Certificate in four aspects in our institute. Through practice, in line with the talent cultivation concept of "order-oriented, broad base on Major, Multiple-Major direction modules", on the one hand, to promote the improvement of students' comprehensive quality, with the improvement of skills, they obtain the corresponding Vocational Qualification Certificate, and gain employment weights, at the same time their abilities also promoted; On the other hand, it also promotes the improvement of teachers' teaching methods, attaches importance to the cultivation of students' Vocational Quality, and stimulates students' motivation and interest in learning.

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