Modular curriculum design under German vocational training standards

Min Wu, and *Ping* Liu*

Ningbo Polytechnic, Ningbo, Zhejiang, China

Abstract. with the international development of vocational education, cultivating international high-end technical and skilled talents who meet the requirements of modern industrial development and have international competitiveness has become an important responsibility of current vocational colleges. By introducing the German “duale Ausbildung ”education mode and learning from the IHK vocational qualification certification examination method, the two sets of teaching standards in the German“duale Ausbildung ”education, J Mechatronics framework teaching plan and Mechatronics vocational training rules, are integrated to establish a curriculum design that meets the requirements of the enterprise's professional post ability, and "double tutors" or "multi tutors" cooperate with modular teaching, Reform and innovate the way of curriculum assessment and evaluation, and cultivate high-quality and highly skilled talents.

1 Introduction

China's "one belt, one road" strategy and the development of the world's economic globalization and regional economic integration have provided new opportunities for the development of occupation colleges, but also put forward new requirements for the quality and skills of talents. With the international development of vocational education, it has become an important responsibility for vocational colleges to cultivate international high-end technical and skilled talents who meet the requirements of modern industrial development and have international competitiveness.

The national vocational education reform implementation plan of the State Council puts forward the reform plan of "learning from the "Duale Ausbildung" and other modes to promote the integration of industry and education and the 'dual' education of schools and enterprises", which points out the development direction for the integration of industry and education of Vocational Education in China [1]. Our college introduces the core concept of German ""Duale Ausbildung"" vocational education, and comprehensively introduces German AHK vocational certification system, teaching standards, management methods and assessment methods. Through the research on the transformation of "Duale Ausbildung" localized courses in line with China's national conditions, we strengthen the

* Corresponding author: 53760012@qq.com

cultivation and training of innovative and creative skills, and cultivate new technicians with international standards applicable to China and Germany.

2 Research on "Duale Ausbildung" talent training mode based on IHK vocational qualification certificate certification

Through the introduction of IHK electromechanical integration teacher professional qualification certificate certification project, according to the requirements of professional qualification certificate assessment and evaluation system, the development of suitable for the localization of the ""Duale Ausbildung"" talent training mode, promote the construction of "double teacher" teacher team, innovation of student assessment and evaluation.

2.1 Development of "Duale Ausbildung" localized curriculum system

In the dual vocational education system of Germany, the federal government has stipulated the legal framework of vocational education training through the Regulations on Vocational Education [2]. The courses related to each occupation are conducted in accordance with the vocational regulations and regulations of the profession which are uniformly issued by the Commonwealth and recognized by the state, namely, the Vocational Training Framework Teaching Plan for vocational schools and the Vocational Training Rules for training enterprises. "Vocational Training framework Teaching Plan" stipulates the objectives of vocational education and training, requiring action-oriented teaching, with young people in their respective vocational fields can independently plan, implement and test processing tasks and their results as the principle, to design and implement the curriculum. The framework plan of the Vocational Training Rules sets out the skills, knowledge and abilities to be achieved in the corresponding occupation. Its core is embodied in three aspects: in the aspect of teaching, it realizes the organic integration of action-oriented theoretical learning and practical training; In terms of training objectives, students are trained to solve problems independently in personal, work and social environments and situations. In terms of assessment, the third party guild is responsible for the completion examination system and the qualification certificate system, which respectively issue the completion certificate and the vocational qualification certificate [3].

According to the German "Duale Ausbildung" vocational training idea, new personnel training plan formulation, the reference to the vocational training framework of teaching plan and the vocational training rules stipulated in the knowledge, skill and quality system development course, German IHK/HWK embedded in the curriculum system, evaluation system to include 7 s management in teaching in the specification, Strengthen students' skills of independent thinking, independent operation and independent problem solving, and integrate social, economic, environmental protection and humanistic literacy into professional courses. By dividing the content of the learning field into several learning modules, each of which is independent and connected with each other, the curriculum design of each learning module is carried out, and the knowledge points and skill points of the course are carried out through several sub-teaching carriers. The selection of teaching carriers should be designed according to professional posts and work tasks. Finally, through the design and production of comprehensive carrier, the learning contents of 13 learning areas are connected, so as to realize the development of curriculum system.

2.1.1 Dual-system vocational training content

Electromechanical integration technology, for example, electromechanical integration technology of students during the period of school to complete the mechanical and electrical integration professional training content, and to get your HWK mechanical and electrical integration of professional qualification certificate, electromechanical integration architect "vocational training framework for teaching plan" in regulation 13 learning areas of the contents, the vocational training rules specified in the 21 training content, As shown in Table 1.

Table 1. Mechatronics professional training content.

Framework teaching plan areas of study	**Example column 2**
1. Functional correlation analysis of mechatronics system; 2. Machining and manufacturing of mechanical subsystems; 3. Install electronic operating tools under the premise of safety technology; 4. Study energy flow and information flow in electric, pneumatic and hydraulic components; 5. Communicate with data processing system; 6. Work process planning and organization; 7. Realization of electromechanical integration subsystem; 8. Design and manufacture of electromechanical integration system; 9. Study the information flow in complex mechatronics system; 10. Plan assembly and disassembly; 11. Debugging, fault finding and maintenance; 12. Preventive maintenance; 13. Deliver electromechanical integration system to customers.	1. Vocational education, Labour law and Labour law; 2. The structure and organization of training enterprises;3. Work safety and health protection; 4, environmental protection; 5. Digitization of work, data protection and information security; 6. Corporate communication and technical exchange; 7. Plan and control the work process and check and evaluate the work results; 8. Quality management; 9, inspection, marking and marking; 10, hand processing and machining, separation and forming; 11. Connection; 12. Installation of electrical components and components; 13. Measurement and inspection of electrical parameters; 14. Hardware and software installation and debugging; 15. Control system installation and inspection; 16. Programming of electromechanical integration system; 17. Assemble components and components into complete machines and systems; 18. Dismantling and assembling of machines, systems and equipment; Transportation and guarantee; 19. Functional testing and adjustment of electromechanical integration system; 20. Debugging and operation of electromechanical integration system; 21. Maintenance of electromechanical integration system.

2.1.2 Curriculum system development

IHK examination is divided into mid-term examination and completion examination of two parts, to electromechanical engineer as an example, mid-term examination to complete the first seven areas of learning content, examination field "electromechanical integration subsystem work" composition. Students should be able to :(1) Analyze technical data, determine technical parameters, plan workflow, and use materials and tools. (2) Assembly, wiring, wiring, setting and maintenance of equipment components and components, able to comply with safety rules, accident avoidance principles and environmental protection regulations. (3) to assess the safety of mechatronics subsystem, check mechanical and electrical protection measures. (4) Analyze subsystems and check functions, adjust and measure operating parameters, and realize their functions. (5) Delivered and explained the system, recorded the completion process of task entrusting, and completed the sorting of technical data (including the establishment of inspection reports). The final exam to complete the learning content of the eight areas of study, the examination area is mainly based on the installation, debugging and maintenance of electromechanical integration

system. Students should have the following abilities: 1) Ability to analyze problems. 2) Be able to select mechanical and electrical components, wires, software and tools required for installation and commissioning, taking into account the technical specifications. 3) Able to adjust assembly and installation plan in time. 4) Planning work steps and selecting standard software on the premise of considering work safety.

So we according to IHK appraisal to achieve the capacity requirements, according to the typical job tasks to choose the teaching carrier, student in the mid-term exam to electromechanical integration subsystem manufacture, installation, debugging, completed before graduation examination of mechatronics system design, manufacture, programming, installation, debugging, etc. According to the typical work tasks of mechatronics division, the learning field is divided into 11 learning modules and 6 training modules. Each task corresponds to several learning and training modules according to the vocational ability, and each learning module develops several teaching carriers according to the teaching content and vocational ability requirements.As shown in Table 2.

As shown in figure 1 for the medium-term Curriculum System Development ,Study area 2: Manufacturing of mechanical subsystems; Study Area 3: Installation of electronic operating tools in the context of safety technology; Study Area 4: Study of energy flow and information flow in Electric, Pneumatic and Hydraulic components; Study Area 7: Mechatronics subsystem the implementation of the "four learning areas (including learning areas 1, 5, 6, teaching content into the teaching process, no separate study divided into modules) steps to complete the task according to the enterprise actual production order carrier of electric liquid control power sliding table processing, installation, debugging, in order to achieve the interpretation of relevant knowledge and skills training. Here be especially emphasized that each study in the field of the design of the teaching resources, teaching process implementation, all to the vocational training rules for the top eight (1, vocational education, labor law and labor law, 2, training the structure and organization of the enterprise, 3, work safety and health protection, 4, 5 of environmental protection and work, data protection and information security of digital, 6. Corporate communication and technical exchange; 7. Planning and control of work process and inspection and evaluation of work results; 8. Similarly, the last 8 teaching fields also adopt the above methods to complete curriculum development and design.

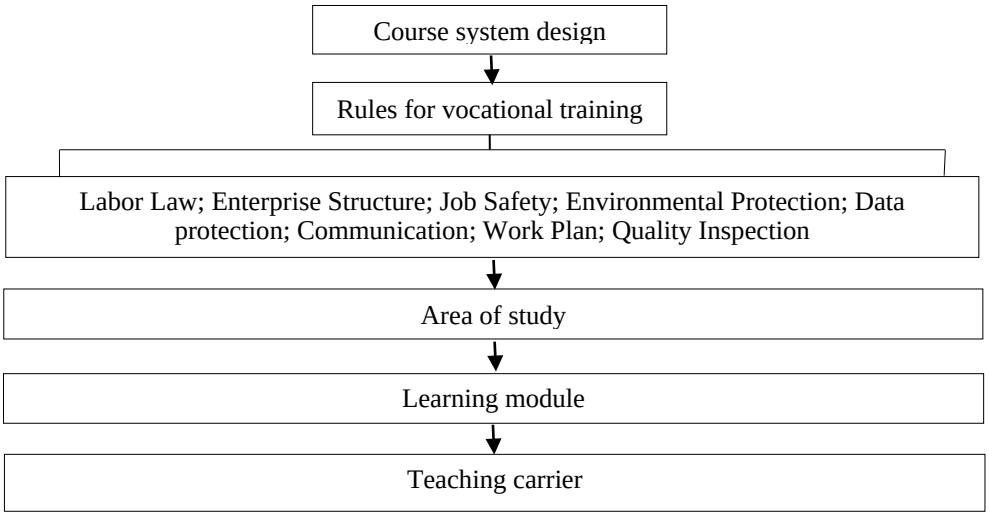

Fig. 1. Example of course system development.

Table 2. Mechatronics engineering course design

Target position	Work assignment	KLA/TRAINING module	Teaching carrier
Product design	1. Mechanical design; 2. Design and development of the appearance and internal mechanical structure of automation products; 3. Design and draw electronic and electrical schematic diagrams, wiring diagrams, electrical control cabinets and layout diagrams	1. Mechanical drawing and CAD; 2. Fundamentals of mechanical engineering; 3. Design and manufacture of mechatronic systems	Spatial positioning automatic screw machine
Parts processing	1. Operation of machine tools; 2. Selection and sharpening of tools; 3. Clamping of workpieces; 4. Parts measurement; 5. Daily maintenance of machining equipment.	1. Processing and manufacturing of mechanical subsystems; 2. Manual machining of parts; 3. Metal cutting.	Drill bit box;
Assembly and Commissioning	1. Assembly and debugging of mechanical parts; 2. Assembly and debugging of electrical parts; 3. Parts surveying and mapping; 4. Recognition of mechanical parts diagram, mechanism diagram and electrical diagram. 5.PLC programming and debugging	1. Electronic product production; 2. Installation and debugging of electrical system; 3. Installation and debugging of hydraulic pneumatic system; 4. Electrical and electronic technology; 5. Programming and debugging of PLC control system.	Bending device
Process preparation	1. Part process review; 2.Preliminary determination of technological process plan; 3.Selection of tools and measuring tools; 4. Selection of equipment; 5. Preparation of process cards; 6. Parts and mechanism design.	1. Fundamentals of mechanical engineering; 2. Design and manufacture of mechatronics systems.	capping device
Equipment maintenance and repair	1. Maintenance of conventional electromechanical equipment; 2. Fault detection and elimination of electromechanical equipment.	1. Design and manufacture of mechatronic systems; 2. IHK mechatronics engineer skills appraisal	Manual traffic lights
Sales and After Sales	1. Sales of mechanical and electrical products; 2. After-sales service of mechanical and electrical products.		Automatic labeling machines

2.1.2 Modular course design

In dual-system vocational training, teaching objectives and content are stipulated in the learning field, and skills, knowledge, ability and reference training time are stipulated in the training rules. Combining with the characteristics of vocational education in our country and our task according to the professional requirements, will learn to content and training rule of organic unifies in together, develop professional curriculum standard, will learn to knowledge module partition, mechanical knowledge module and electrical modules of study, theory study and practice of seamless, The knowledge content of each learning area is carried on by several carriers. After learning the first 7 fields, students can independently complete the manufacture, installation and commissioning of simple electromechanical equipment. After learning the last six fields, students should be able to independently complete the design, installation, debugging and maintenance of complex mechanical and electrical equipment, so as to break the traditional machine and electricity are not connected to each other, and realize the real mechatronics.

For example, according to area 4 of learning in the framework teaching plan: In electric, pneumatic and hydraulic components in the study of energy flow and information flow of the teaching goal and the content of teaching and training rules of article 15 of "installation and inspection of the control system" to integrate the teaching skills, knowledge and skills, to divide the teaching module electric drive, hydraulic transmission, pneumatic technology (including pure pneumatic + and electric pneumatic) three teaching modules, According to the requirements of teaching objectives and the skills, knowledge and ability to be taught, develop the overall design of corresponding modules, unit design, curriculum standards, teaching pages, teaching carriers and other curriculum resources. The three modules are independent and connected with each other. The basic working principle is explained through independent small projects, and the content is connected through comprehensive gas, electricity and hydraulic training projects.

2.2 Learn from IHK's assessment and evaluation methods and innovate the assessment and evaluation system

"Duale Ausbildung"vocational education has a set of strict and complete examination and evaluation system, examination content is diverse. The exams are mainly divided into three links: school completion exam, enterprise completion exam and skill certificate exam organized by industry association [5]. By referring to the German IHK certificate evaluation system, breaking the traditional centralized final examination and the traditional assessment method of unrelated courses, carrying out the assessment mode centering on the completion of comprehensive project ability assessment, combining the process assessment of modular courses with the phased comprehensive project assessment, focusing on the results-oriented. Give full play to the important role of graduation design works in assessment and evaluation. In the middle stage of talent training, the completion of projects with practical functions is regarded as mid-term assessment and evaluation, and in the late stage of talent training, the completion of comprehensive projects with complete and independent functions is regarded as final assessment and evaluation. When students complete a project, they need to sort out project drawings, processing process or process cards, processing entities, testing reports, report PPT and relevant WORD documents. After all the information is completed, teachers will give feedback to each student. The exam of each semester refers to the IHK examination mode and adopts the skill test mode. All the professional course exams include the theory comprehensive examination and the practical operation comprehensive examination. Theoretical comprehensive and practical operation comprehensive propositions refer to IHK examination questions, including multiple choice

questions and question-answering questions. The examination content is required to cover all important knowledge points of professional courses in the semester. Practical operation examination adopts comprehensive project carrier processing, production, installation, debugging and so on.

3 Conclusion

German "Duale Ausbildung" two sets of standards in education (" framework for teaching plan ", "vocational training rules"), set up to meet the requirements of professional post competence curriculum system, the formulation and implementation of the talent training scheme of the process and the formation of "communal class + professional basic course, learning field curriculum" of combining the curriculum system structure, introducing enterprise skillful craftsman, Receive German professional training synchronously with school teachers, and build a "double-qualified" course team; From simple single teacher teaching to "double tutor" or "multiple tutor" teaching, from simple theoretical classroom teaching to "task-guided" teaching, from simple emphasis on the training of students' hands-on ability to both technical and professional quality of development talents.

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