



Study on Modular Curriculums in Vocational Education and Training System

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Abstract. With the development policies and plans for vocational education appearing, modular curriculum in improving the vocational education and training system is more important to improve the education quality. The concept of module was introduced in the paper. The modular curriculum was explained by the analogy with the system which is composed of modules with different functions and characteristics. The characteristics of modular curriculum including functionality, interchangeability, flexibility and applicability were introduced and discussed. Taking automobile major as an example, the modules of the curriculums were studied and divided. The background and the career analysis of the students were investigated and researched on automobile engineering. Especially, the professional course modules were studied according to professional background and career analysis of the students. Curriculums in the professional modules were divided into four parts including Basic technology courses for specialty group, Vocational and technical skills courses, Professional comprehensive modular courses, and Innovative practical modular courses. Among the course modules, the professional comprehensive modular courses and the innovative practical modular courses are designed and divided into specific courses, and the specific courses were firstly designed with the type of micro lectures.

Keywords: Modular curriculum · Vocational education · Vocational training

1 Introductions

With the development of vocational education, especially with several important policies and plans from the government appearance, the vocational education enters a new developing stage in China. Vocational education stands side by side with general education for the first time in China. It is proposed in Implementation Plan of National Vocational Education Reform that vocational education should be placed in a more prominent position in educational reform innovation and economically social development. In the Implementation Plan, important development goals for vocational education are put forward, including that the vocational education and training system should be improved, the directions should be changed from pursuing the scale expansion to improving the quality of education, and so on [1].

At the Symposium of experts on education, culture, health and sports held on September 22nd in 2020, it was emphasized that the vocational education and training should be developed energetically, and lifelong learning system should be built [2]. With the lifelong learning being emphasized gradually, more and more social personnel have participated in vocational training. At the same time, our education objects have expanded from students to different kinds of people including students, company staff, migrant workers and other groups.

However, for different education objects, different curriculum forms and contents should be researched and designed to meet different work requirements to achieve good teaching and learning effects. No matter which type of students they are, the final learning goal and ability level they achieved are the same. Then challenges are brought for teachers in preparing lessons and teaching students. So how to organize the course materials to satisfy different requirements, is a new challenging work for teachers to reform the vocational education and training system.

2 Modular Curriculum

Due to the different kinds of students, different teaching methods and different teaching contents and form are required. Modular curriculum is an inevitable education reform mode on the curriculum for different kinds of students, facing the integration reform of vocational education and training system.

2.1 Module

Module is a typical general unit which can be combined into a system and has certain functions and interface structure. There are 4 characteristics for module including independence, abstractness, interchangeability, and flexibility [3]. The independence of the module refers to that not only the function of the module in a system is independent, but also the process of the designing, manufacturing and debugging module is independent in a system. The abstractness of the module refers to that it is not necessary to understand the internal structure and characteristics of the module fully. Even people who do not possess the knowledge about how to design the mode can design the whole system according to the function and interface of the module. The interchangeability of the module refers to that the module could be substituted by another one according to another parameter and target. The flexibility of the module refers to that the convenience for substitute some old modules with new ones in the system to update the characteristics and functions of the system.

Modularization is a way to deal with the decomposition of complex systems into better manageable modules [4]. The relationship between the module and the system is applied into the relationship between the curriculum unit and the curriculum constructions. Then the modular curriculum is produced.

2.2 Modular Curriculum

The module of a course is an independent unit designed in a course which could be flexibly substituted with another independent unit to construct a new course for another group of students with different skill background.

Modular curriculum refers to the curriculum which is composed of independent module units suitable to build any curriculum related to the professional background. Modular curriculum is the product from the development of the lifelong learning system which grows for improving the vocational education and training systems.

As shown in Fig. 1, the characteristics of modular curriculum include functionality, interchangeability, flexibility and applicability [3, 5, 6].

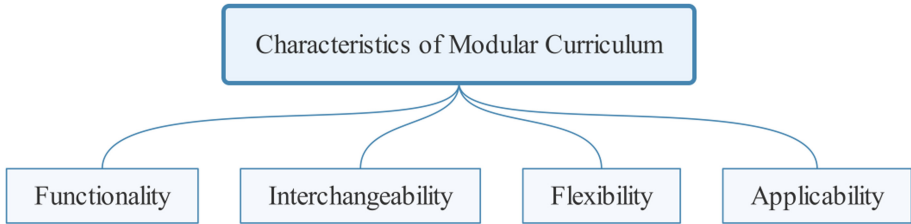


Fig. 1. Characteristics of modular curriculum

Functionality. Curriculum function is the role and utility of curriculum. John D. McNeil, an American curriculum scientist, summed up the recognized and typical functions of curriculum in his book. The first function is the common function or general education function, which aims to enable learners to participate in community public affairs, master the minimum ability necessary for health, welfare and protection, and become responsible people or citizens. The second function is the function of compensation or supplement, specially designed for individual defects or unique talents, is an individual course, which is opposite to ordinary (common) courses. The third function is the function of inquiry, which provides students with the opportunity to discover and develop their personal interests, so that learners can find out whether they have the ability and enthusiasm to engage in certain types of activities. The fourth function is the professional function, which requires learners to master the skills necessary for skilled workers and scholars, in order to meet the standards required by a certain industry, occupation or academic research [7].

The functionality of modular curriculum in vocational education and training system is reflected in that it could meet many different kinds of students' requirements more professionally besides common skill needs, knowledge defects compensation with a definite aim for a determined occupation worker and focused inquiry.

Interchangeability. Generally, interchangeability refers that for a machine, in a batch of parts (or components) with unified specifications, any one of them can be installed on the machine to meet the specified functional requirements without selection, repair or adjustment. For a modular curriculum, any module combined in the curriculum could be changed with another one to meet the specified functional requirements for another education project or training program. For a training system, a modular curriculum could be substituted by another one designed for the specified requirements of the education or training system.

Flexibility. By analogy with the flexibility of the module in a system, the modular curriculum possesses flexibility. The flexibility of the modular curriculum refers not only the contents of the course are flexible to be chosen, but also the association of courses are flexible to be designed. Due to the interchangeability of modular curriculum, the curriculum system composed of modules designed according to the specified requirements is flexible to adapt to every related system in one hand. On the other hand, learners could choose the suitable modular curriculum flexibly according to their own career development planning.

Applicability. Serviceability is the basic characteristic of vocational education. However, for vocational education and training system, applicability should be reflected in training system designing more specifically for a certain type of students and more applicably for a training system. The quality of applicability should be measured by the degree of customer satisfaction. For different type of student, the form of micro lesson, MOOC or other forms are selected and designed to achieve the best teaching effect.

Comparing with the common single and stable curriculum structures, modular curriculum could meet the students' interests in learning goal definitely and improve the enthusiasm in learning. Then the learning effect could be achieved and the skills of the students are developed more comprehensively.

3 Constructions of Modular Curriculum

The overall goal of modular curriculum construction is to optimize the contents of the curriculums by reconstructing the curriculum content system and refining the knowledge module and skill module in the course [8]. On the basis of optimizing the teaching contents, it is meaningful to construct a teaching mode that meets the needs of society and students so as to realize the effective teaching of modular curriculum.

Taking automobile majors as an example, the module analysis and curriculum design are very important works.

3.1 Career Analysis for Curriculum Constructions

For the major of automobile manufacturing and assembly technology in vocational education, the professional background and career analysis of the students were researched. Because the curriculums are designed for students who are working in the automobile related enterprises or who will work in the related companies, the career analysis is the necessary prerequisite work.

A statistical analysis on the common positions and job requirements of the graduates from the major of automobile manufacturing and assembly technology was made. According to the content and degree of social ability, operation ability and development ability required by typical jobs, and according to the theory of vocational education classification system, the typical job groups are divided into six levels [9]. For example, the contents of the 4th level job are summarized and shown in Table 1. And the typical tasks and ability requirements of the fourth level job are shown in Table 2.

Table 1. The contents of the 4th level job

Production operators	Equipment maintenance personnel	Quality inspectors
Assembly, welding and gluing of BIW assembly	Inspection and maintenance of production line	Inspection and repair on the appearance defects of stamping parts
Engine sub assembly and whole machine assembly	Robot operation and maintenance	Inspection and repair on BIW body defects
Static assembly and debugging of finished vehicle	Fundamentals of PLC operation	Quality control of assembly and welding process
General maintenance and emergency disposal of equipment		

Table 2. The typical tasks and ability requirements of the fourth level job

	Corresponding position	Typical tasks
1	Assembly, welding and gluing of BIW assembly	① Welding and gluing of side panel assembly; ② Front end assembly, main floor assembly and rear end assembly welded and glued; ③ Welding and gluing of body in white lower body assembly; ④ BIW assembly welding and gluing
2	Engine sub assembly and whole machine assembly	① Assembly of crank connecting structure; ② Assembly of valve train; ③ Assembly of cooling system; ④ Assembly of lubrication system; ⑤ Assembly of fuel supply system
3	Static assembly and debugging of finished vehicle	① Assembly of interior and exterior ornaments; ② Assembly of four doors; ③ Assembly of chassis; ④ Assembly of power train
4	General maintenance and emergency disposal of equipment	① Production line equipment inspection and daily maintenance; ② Process equipment operation and parameter adjustment; ③ Fixture inspection and maintenance; ④ Check and maintenance of transmission equipment; ⑤ Robot emergency stop reset operation and point-to-point programming

(continued)

Table 2. (continued)

	Corresponding position	Typical tasks
5	Inspection and maintenance of production line	① Inspection and maintenance of water supply system; ② Check and maintenance of power supply system; ③ Check and maintenance of compressed gas system; ④ Machining of simple mechanical parts
6	Robot operation and maintenance	① Robot debugging operation, parameter setting and tooling tool switching; ② Mechanical system fault diagnosis and maintenance of robot workstation; ③ Electrical system fault diagnosis and maintenance of robot workstation; ④ Control system fault diagnosis and maintenance of robot workstation
7	Fundamentals of PLC operation	① PLC network and communication; ② PLC control system; ③ PLC programming foundation; ④ PLC common instructions
8	Inspection and repair on the appearance defects of stamping parts	① Judge and release the visual defects of stamping appearance parts; ② Find and judge invisible defects of stamping appearance parts; ③ Use sheet metal repair tools and equipment to repair damaged and non-destructive parts
9	Inspection and repair on BIW body defects	① Assembly precision and debugging of four doors and two covers; ② Discovery, judgment and repair of appearance defects; ③ Torque adjustment; ④ Residual glue cleaning
10	Quality control of assembly and welding process	① Quality inspection of resistance spot welding; ② Connection quality inspection of physical connection points; ③ Appearance quality inspection; ④ Torque quality inspection; ⑤ Assembly accuracy inspection of four doors and two covers

3.2 Curriculum Design

Taking automobile majors as an example, since the major of automobile manufacturing and assembly technology was the core major in the national “double high” specialty group, the curriculums were designed and divided into several modules such as basic modules, professional modules, improvement modules and expansion modules, as shown in Fig. 2. The construction of curriculum system, especially in the modular curriculum development, adopts the way that one specialty leads other specialties to construct the

specialty compound and innovative practice curriculum module, which creates conditions for the automobile manufacturing and assembly technology specialty to adapt to the transformation and upgrading of automobile manufacturing industry, and meets the requirements of enterprises for the cultivation of the specialty compound ability and innovation ability of higher vocational graduates. Students can choose their own career development path to achieve individualized teaching and individualized training.

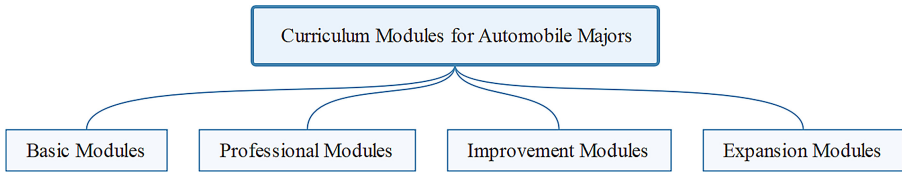


Fig. 2. The divided curriculum modules for automobile majors

In the automobile majors in Beijing Polytechnic, the curriculums in the professional modules were designed and divided into basic technology courses for specialty group, vocational and technical skills courses, modular courses for professional comprehensive students, and modular courses for innovative and practical students. Figure 3 shows the compositions of the curriculums in professional modules.

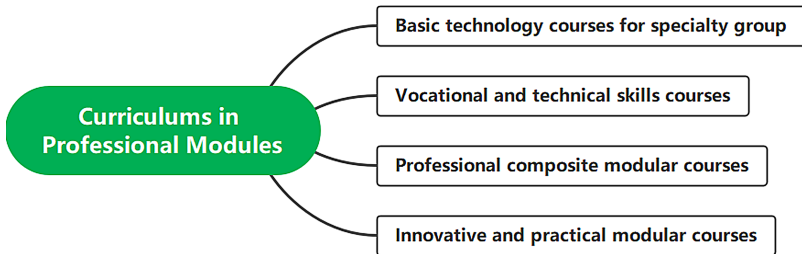


Fig. 3. Curriculums modules in professional modules

For example, in detail, the specific courses designed for professional comprehensive module in Beijing Polytechnic are shown in Fig. 4. The specific courses designed for innovative practical module are shown in Fig. 5. The courses designed for the professional comprehensive type students mainly includes Inspection and repair of BIW, Inspection and maintenance of electrical appliances in production line, Assembly and online diagnosis of industrial robot, Engine assembly and debugging, Vehicle assembly and debugging, Operation and maintenance of welding robot, Design and construction of intelligent manufacturing cell, Production line operation and monitoring. The courses designed for the innovative and practical type students mainly includes Intelligent assembly of automobile body, Robot operation and maintenance based on Integra 6 standard, Practice of automobile quality management system, Design and manufacture of students’ racing car, Composite manufacturing of auto parts, and Automobile off line detection and debugging [9].

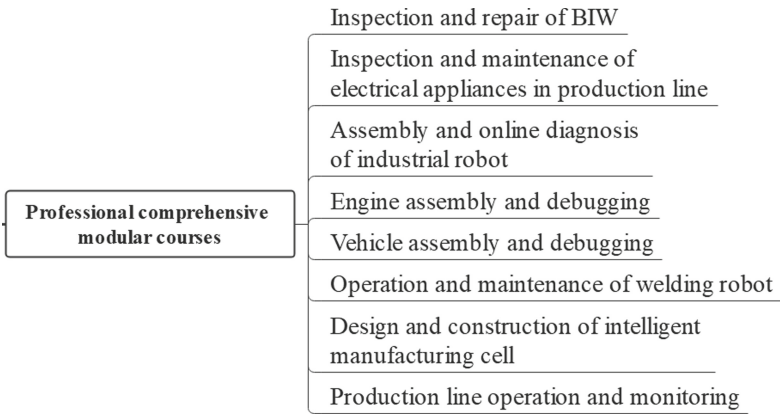


Fig. 4. Curriculums designed for professional comprehensive modules

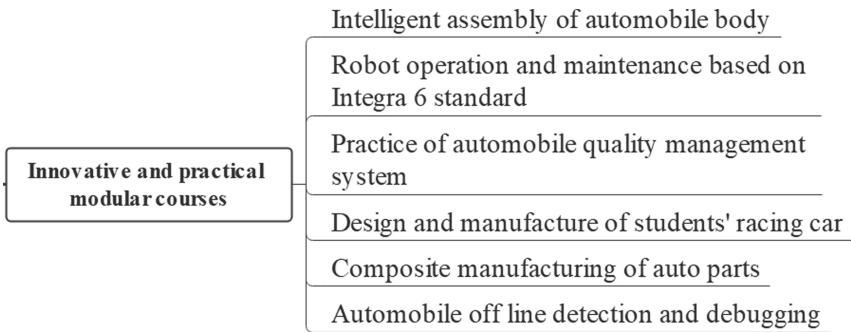


Fig. 5. Curriculums designed for innovative practical modules

Curriculums for students should be divided into several modules, and the modules should be designed in the form of more modules. Then a course should be designed into modules such as micro lectures, and every micro lecture could be designed several forms for different types of students [10, 11].

The most important work is that for every certain type of students, the specific contents of a certain course should be designed into different types to attract the attention of students and to make up the disadvantage of students. Then the teachers' team and the teaching methods should be the next important research objects.

4 Summary

The modular curriculum is more and more important in the developing of the vocational education and vocational training system with the lifelong learning and education development in China. In the paper, the modular curriculum was introduced, then the relationship between the modules and the curriculums were studied based on the career analysis and the contents of jobs related to the automobile majors. The curriculums in

the professional modules were designed and divided into specific modular courses. The specific courses should be designed according to the specific type of the students and considering the work contents of the students. Especially the designing of the micro-lectures is the important recommended.

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References

1. Implementation plan of national vocational education reform, pp. 1–3 (2019)
2. Xi, J.: Speech at the Symposium of experts on education, culture, health and sports, 22 September 2020
3. Lu, C.: Modularization theory of curriculum structure in Vocational Education. *Res. Contin. Educ.* **4**, 125–128 (2015)
4. Knoernschild, K.: Java application architecture: modularity patterns with examples using OSGi. *ACM SIGSOFT Softw. Eng. Notes* **38**(1), 1–55 (2013)
5. Kong, F.: Research of female secondary vocational education modular curriculum. *J. Adult Educ. Hebei Univ.* **17**(3), 65–67 (2015)
6. Zhang, X.: Research and exploration of modular teaching mode in Higher Vocational Education (in Chinese). *Sci. Technol. Vis.* 287–288 (2015)
7. McNeil, J.D.: Contemporary curriculum. In: *Thought and Action*, no. 10, p. 384. Jossey Bass An Imprint of Wiley (2005)
8. Lu, S.: Research on the modular curriculum construction on “international Chinese teaching ability” for undergraduate students of Chinese to speakers of other languages (in Chinese). *Theoret. Res. Pract. Innov. Entrepreneurship* **24**, 89–92 (2020)
9. Talent training program of automobile manufacturing and assembly technology, pp. 5–7. Beijing Polytechnic (2019)
10. Shu, W.: Composition of modern apprenticeship “modular” curriculum system in Vocational Education (in Chinese), vol. 9, pp. 101–105 (2018)
11. Wei, X.: The construction and practice of modular curriculum system for preschool education. *Int. J. Educ. Econ.* **3**(4) (2020)