

Vocational and Technical Education Practice Under the Guidance of Competency-Based Education

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Abstract—Vocational education is an important breakthrough in deepening education reform, only when vocational education is well developed can a large number of outstanding technical application talents be trained for the country and the high-quality development of the real economy can be promoted. Therefore, how to deepen the reform of higher vocational and technical education has become an important issue. The theory of Competency-Based Education pays attention to the all-round development and career prospects of students, and emphasizes the occupational pertinence of education, which is highly compatible with the characteristics and requirements of higher vocational and technical education. This paper introduces the concept of competency-based education concept, analyzes the characteristics of vocational and technical education, and summarizes the application of competency-based education concept to vocational and technical education practice methods.

Keywords—competency-based education, vocational and technical education, teaching reform practice

I. INTRODUCTION

Competency-Based Education (CBE) is an educational thought that emphasizes job ability which was formed in the United States in the 1960s and 1970s. CBE aims to attach importance to the ability to obtain post operation, and advocates ability-based. In the 1970s, CBE gradually matured and began to be used in vocational education and training. In the mid-to-late 1980s and early 1990s, major Commonwealth countries successively rebuild their national vocational education and training systems based on CBE. These practices had pushed CBE to a new level. The concept of competency-based education spreads to the world with the pace of globalization, and gradually shifts to emphasizing integrated literacy and lifelong learning, and regards literacy as the comprehensive overall performance of an individual in a specific situation, including knowledge, skills, procedures, methods,

attitudes, ethics, actions, etc., and it is a dynamic process of lifelong development [1].

In the early 1990s, the thought of Competency-Based Education was introduced to our country by Canada. Because of the obvious superiority of CBE, it has attracted widespread attention around the world, and has become the development direction of the teaching reform of vocational education in the world [2].

II. THE CONCEPT AND CONNOTATION OF THE COMPETENCY-BASED EDUCATION

Competency-Based Education refers to an educational theory that aims at developing learners' abilities. After the learners experience this kind of education, they can have the knowledge, skills and attitudes to engage in a certain activity or work [3].

Competency-Based Education's core concept is to determine the ability goals based on the needs of occupational positions; the school employs a group of representative experts in the industry to form a professional committee, according to the needs of the occupation, to determine the ability to be engaged in the industry, and to clarify the training goals; with these abilities as the goal, teachers set up courses and organize teaching content; and finally assess whether these ability requirements are met.

The core concepts of Competency-Based Education mainly include four aspects [4]:

A. *Emphasize the Pertinence of Teaching Objectives*

Taking ability as the basis of teaching and vocational ability as the basis of education, and establishing educational goals and evaluation standards accordingly.

B. *Emphasis on Student Self-Learning*

Students are the main body of the learning process, and they should take the initiative in learning. As the instructor and manager of students' learning process, teachers are responsible for refining teaching objectives, setting up curriculum systems, developing learning resources, and guiding students' learning according to their professional abilities. Students confirm their personal study plans

according to the requirements of the study guide, choose their own study methods to complete study tasks.

C. Emphasize the Comprehensiveness of Assessment Evaluation

Teachers evaluate the achievement of students' learning goals. The evaluation results should not only consider the achievement of "quantitative learning goals", but also pay attention to the achievement of "non-quantitative learning goals" reflected by students in the learning process. Such as willpower, innovation, collaboration, etc.

D. Emphasis on Flexibility in Teaching Form

The teaching place is not limited to the school, and can be jointly trained with the employer to learn in the actual production and work environment. Teaching methods are not limited to lectures and experiments, but also to practice while teaching. Teaching resources are not limited to publicly published textbooks, and customized materials can also be used, such as compilations of practical work experience, failure maintenance cases, etc.

III. FEATURES OF VOCATIONAL AND TECHNICAL EDUCATION

Generally speaking, "vocational and technical education" is the education of different levels of specialized knowledge and specialized skills for employed persons [5]. In other words, it is a kind of education that trains the labor force needed for social development based on general education, so that they can acquire certain specialized labor knowledge and labor skills, and achieve the purpose of employment. From various vocational and technical education phenomena, we can summarize the following basic characteristics, which are widely recognized:

- First, the training goal of vocational and technical education is to meet the needs of various sectors of the national economy for talents at different stages of social development. This includes the cultivation of junior, intermediate and advanced applied technology or management talents. As far as our country is concerned at this stage, the cultivation of technical talents is generally emphasized.
- Second, the school-running and management model of vocational and technical education is no longer a simple school model, and advocates the extensive participation of enterprises, industries, society and individuals.
- Finally, in the teaching process of vocational and technical education, basic knowledge is based on "Sufficient" as the standard, and in the process of skill training, emphasis is placed on the formation of "Competency". This "Competency" here refers to a comprehensive professional ability, which includes professional attitude, professional knowledge and professional skills, etc.

From the characteristics of the training objectives, school-running model and teaching process of vocational and technical education, it can be seen that the essential

characteristics of vocational and technical education should be reflected in:

- Macroscopically, it is aimed at the needs of talents for social and economic development.
- Microscopically, it is aimed at the requirements of professional positions on the quality of talents.
- In theory, it is aimed at the specialized theory and experience knowledge required by professional positions.
- In practice, it addresses the specialized skills, techniques, and other practical competencies required by occupational positions.

In a word, the essence of vocational and technical education can be summarized as: compared with general education, it is more "vocational-targeted" [6].

IV. EDUCATIONAL PRACTICE UNDER THE GUIDANCE OF CBE

The concept of Competency-Based Education is highly compatible with the characteristics and requirements of vocational and technical education [7]. Therefore, vocational and technical education can adopt CBE's curriculum design model to carry out teaching design [8].

The teaching mode of Competency-Based Education is shown in Fig. 1:

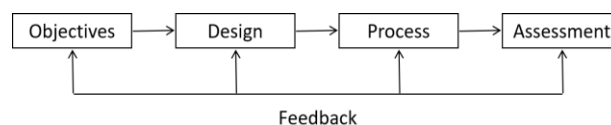


Figure 1. Teaching mode under the guidance of CBE.

First, design teaching objectives based on the ability that students can achieve after learning; then, design teaching activities and learning environment according to the teaching objectives; thirdly, carry out teaching activities with students as the main body and teachers as the auxiliary; finally, through the assessment and evaluation work, feedback to revise the entire teaching design.

A. In Terms of Teaching Objectives

In the formulation of ability-based teaching objectives, the standard is to clearly describe what abilities students should achieve after completing their studies. When designing teaching objectives for a certain major or course, the needs of students and employers should be fully considered. Through investigation and research, we can sort out the competency elements that vocational and technical personnel should have, so as to make education and teaching activities more "vocational-targeted". The competency here is not a one-sided "operational skill", but should include multiple dimensions such as "knowledge", "skill", "literacy", etc., to fully reflect the comprehensive ability of students.

Taking optical instrument users as an example, referring to Benjamin Bloom's taxonomy of educational objectives, the educational objectives can be described as:

1) *Knowledge dimension*: Understand the basic concepts of electrical engineering, understand the basic

principles of circuits, and understand the working principles and characteristics of common optoelectronic devices. Recognize the basic concepts of optics, understand the basic principles of optics, be able to apply optical principles to analyze optical problems, and be able to comprehensively use optical knowledge to solve practical problems.

2) *Skill dimension*: Able to use common electronic measuring instruments for measurement work. Proficiency in the operation of basic optical instruments, able to use optical instruments to complete actual measurement work.

3) *Literacy dimension*: Experience the precision and rigor of optics, and cultivate the rigorous and meticulous work style of optical instrument users. Cultivate innovative awareness and spirit, and cultivate teamwork ability.

B. In Terms of Curriculum System

On the basis of clarifying the teaching objectives, the curriculum system is constructed according to the overall teaching objectives, and the courses are divided into basic courses, core courses and practical courses. By clarifying the teaching objectives of each course, the purpose of ensuring the consistency, coherence, integrity and continuity of the course teaching objectives and the overall teaching objectives is achieved [9].

Taking optical instrument users as an example, the curriculum system can be set to:

1) *Basic courses*: Including basic electrical engineering, low-frequency electronic circuits, electronic measuring instruments and other courses.

The teaching objectives are:

- Knowledge Objective: Students can memorize the basic concepts and principles of electrical engineering and low-frequency electronic circuits, be familiar with the characteristics and application scope of commonly used electronic devices, and master basic data processing methods.
- Skill goal: Students can master the experimental skills of basic circuits and analog circuits, and master the use of common electronic measuring instruments; in practical work, they will choose appropriate electronic measuring instruments to complete the measurement work.
- Literacy goal: Students develop a style of study that loves science, seeks truth from facts, and develops a sense of innovation and an innovative spirit.

2) *Core courses*: Including engineering optics, fundamentals of optoelectronic technology, automatic control theory and other courses.

The teaching objectives are:

- Knowledge Objective: Students can memorize the basic concepts of optics, optoelectronic technology and automatic control theory; master the basic principles of optics, optoelectronic technology and automatic control; be able to analyze the actual optical path with optical

principles; understand the characteristics and applications of basic optoelectronic devices.

- Skill goal: Students can master basic optical experimental skills; master basic optoelectronic device experimental skills; assemble, operate, and debug simple automatic control systems.
- Literacy goal: Students develop the ability to analyze and solve problems, logical thinking ability, and develop a rigorous work style and scientific attitude.

3) *Practical courses*: Including the operation and use of optical instruments, maintenance of optical instruments, on-the-job practice and other courses.

The teaching objectives are:

- Knowledge Objective: Students can understand the working principle of commonly used optical instruments, master the basic data processing methods, and master the basic methods and procedures for the maintenance of commonly used optical instruments.
- Skill goal: Students can correctly use common optical instruments; in practical work, they can choose appropriate optical devices and optical instruments to complete the measurement work; in practical work, they can choose appropriate tools and reagents to complete the maintenance of optical instruments.
- Literacy goal: Students exercise the ability to solve practical problems, develop innovation ability and practical ability, develop teamwork ability and organizational coordination ability.

C. In Terms of Teaching Implementation

In the training process, CBE attaches great importance to the active participation of students. The teacher's job is to arrange teaching activities, stimulate learning interest, guide students to learn, and help students with learning difficulties [10]. The specific implementation process is shown in Fig. 2:

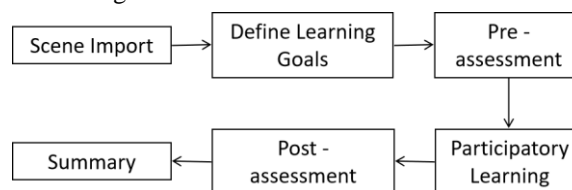


Figure 2. Teaching mode under the guidance of CBE.

In the implementation process, the online + offline mixed teaching method can be adopted.

1) *Scene Import*: At the beginning of the class, teachers can import pictures, videos, stories, questions, hot topics, etc. to attract students' attention, arouse their curiosity and interest in learning.

2) *Define Learning Goals*: Present students with specific and clear learning goals, which should include knowledge, skills and literacy. From the perspective of students, teachers should set clear, appropriate, achievable, and measurable learning goals, so that students can clearly understand what goals they want to

achieve in this lesson. That is, the learning objectives should describe specific requirements accurately with verbs, and the learning objectives should be related to the subject of the class. The learning objectives should be within the student's ability, the learning objectives should be measurable, and the quality of completion can be evaluated.

3) *Pre-assessment*: Due to differences in students' abilities, teachers can first judge students' level through "Pre-assessment" when arranging teaching progress, so as to arrange different study units. The Pre-assessment can be implemented through the online network resource platform. For example, through the "Questionnaire Star" platform to issue questionnaires to understand the professional background of students; through the "Rain Classroom" platform to set course-related basic questions, to grasp the education level of students.

4) *Participatory Learning*: In order to encourage students' initiative, teachers need to increase the interactivity of the classroom. In the course of teaching, teachers can ask a series of designed questions to guide students to learn relevant knowledge points on their own in MOOCs or other online resource platforms, and adopt methods such as group discussion, questioning and reflection to help students form their own understanding of relevant knowledge.

5) *Post-assessment*: CBE values immediate feedback. For students with advanced learning progress, after passing the post-test, teachers can arrange exercises for the next unit, or design more difficult problems for students to solve. For students who cannot pass the test, teachers need to provide special tutoring and give extra time to practice until these students can reach their learning goals. This process can be implemented through "Rain Classroom", which divides the test questions into basic questions and extended questions, allowing students to answer them in a targeted manner.

6) *Summary*: Competency-based training adopts a standard-referenced evaluation method, and the data analysis function of the "Rain Classroom" online platform can be used to understand the students' mastery of the course content. According to the students' proficiency in the learning unit, the teacher judges whether the students have achieved the set teaching objectives and whether they have the abilities required by the industry after learning. When it is found that students have learning difficulties, teachers must further diagnose the reasons for learning difficulties or failures, and adjust teaching objectives or learning methods as appropriate.

D. In Terms of Teaching Feedback

When teachers develop competency-based education courses, unexpected situations may occur due to differences in subjective cognition or interference from objective factors, such as deviations between teaching goals and professional requirements, teaching goals are not recognized by students, students are not interested, and courses are too difficult, the time arrangement is not

enough, the teaching progress is too slow, the passing rate of the assessment results is too low, etc. Teachers must discuss the actual situation and seek solutions, adjust the curriculum system and teaching implementation process, make the curriculum system more mature, and make the teaching effect more in line with the professional needs of students.

V. TEACHING PRACTICE EFFECT

Since 2020, the teaching team has applied the teaching design ideas of vocational and technical education based on the Competency-Based Education concept to teaching practice, and achieved obvious teaching promotion effect.

Through questionnaires, we counted students' satisfaction with the course, classroom participation, etc. It is found that in 2020 and 2021 after the implementation of the teaching design based on the Competency-Based Education concept, compared with 2019, students' satisfaction with the course has improved, and classroom participation has been significantly improved. The survey results of course satisfaction, participation (the lowest satisfaction/participation is 1, the highest is 5) is shown in Fig. 3:

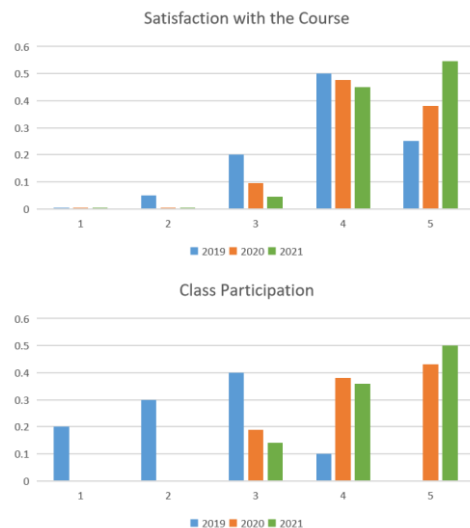


Figure 3. Survey results of course satisfaction, participation.

Taking the engineering optics course as an example, we compared the percentage of students' test scores in 2019 with those in 2020 and 2021, and found that the proportion of students who achieved a score of 80 or more has increased significantly, and the proportion of students who failed has decreased. The comparison of test scores is shown in Fig. 4:

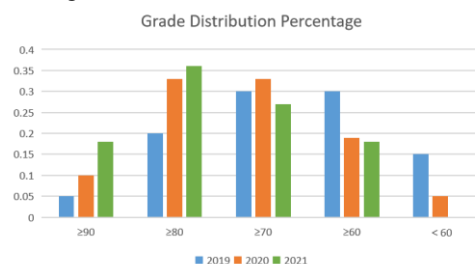


Figure 4. Comparison of test scores.

VI. CONCLUSION

To sum up, Competency-Based Education refers to an educational theory aiming at developing learners' abilities, and its philosophy is highly compatible with the characteristics and requirements of vocational and technical education. The teaching design ideas of vocational and technical education based on the concept of CBE include: First, by analyzing the needs of occupational positions, teachers design more targeted teaching objectives, and then design a corresponding teaching system; Secondly, in the process of teaching implementation, by paying attention to individual differences of students, more targeted teaching is carried out; Finally, through teaching feedback, the teaching objectives and curriculum system can be dynamically adjusted. This design idea is in line with the characteristics of vocational and technical education, and has important reference significance for improving the teaching effect of vocational and technical education and deepening the teaching reform.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Jing-ran Li, Jian-qiang Liu, Chang-de Hu, Zi-yang Li, Lan-ying Zhang, and Po Wang participated in the study; Jing-ran Li and Jian-qiang Liu analyzed the data; Jing-ran Li wrote the paper; all authors had approved the final version.

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