Practical Teaching Reform of Engineering Management Specialty in China Institute Based on the OBE-CDIO

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Abstract. Practical teaching is the key link in undergraduate education for engineering management specialty, which directly affects students' engineering practice and innovation abilities. In view of the current problems existing in practical teaching of engineering management in applied undergraduate colleges in China, a practical teaching system of engineering management specialty based on the OBE-CDIO concept is put forward, and the practical teaching links and specific contents are clarified. On this basis, a more scientific evaluation index system for practical teaching of engineering management is constructed. The research results can provide a new idea for improving the engineering practice and innovation ability of engineering management students.

Keywords: Engineering management specialty; OBE-CDIO; Practice teaching reform

1 Introduction

The Engineering Management specialty is a highly practical discipline with the goal of cultivating applied talents .On the basis of theoretical teaching, this specialty focuses more on cultivating students' engineering practical and innovative abilities. At present, the foreign universities generally pay attention to the cultivation of students' engineering practice and innovation abilities[1]. In terms of engineering management majors, they have a relatively mature practical teaching system. For example, German universities require students to participate in the implementation of practical engineering projects as workers, cultivate their professional awareness, and this is a prerequisite for graduation.

Since 1998, with the expansion of university enrollment and the vigorous development of the real estate industry, the undergraduate education of engineering management has been developing rapidly in China. By September 2023, there are 464 universities in China (excluding Hong Kong, Macao and Taiwan) offering undergraduate majors in engineering management[2]. But it is worth noting that while the scale of higher education is rapidly expanding, the quality of student training is worrying. At present,

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more and more employers are dissatisfied with the practical and innovative abilities of engineering management graduates, pointing out that the training of students in colleges and universities is out of touch with the actual demand.

Xie Yanping, Sun Yimin, Dai Xiaoyan and many other scholars have actively discussed the practical teaching reform of engineering management specialty in China[3-5], many colleges and universities have also set up corresponding practical links in the engineering management specialty and actively attempts. However, there are still the following issues that need to be addressed urgently in the practical teaching of engineering management major in applied undergraduate colleges in China:

(1) Lack of emphasis on output orientation and lagging practical teaching system

At present, the practice teaching of engineering management major in most application-oriented undergraduate colleges and universities adopts traditional subject education rather than output-oriented education. The guiding ideology still stays at the level of verification theory and cognitive practice (production), and the practical teaching system is not systematic, resulting in poor adaptability, poor engineering consciousness and poor practical ability of students.

(2) Insufficient investment in practical teaching funds, and the effect of off-campus practical teaching is not obvious

At present, due to the characteristics of the specialty itself and the impact of other factors such as funds, it is very difficult for students to find a suitable internship unit outside the school and have a dedicated person responsible for guiding the internship. The staff of the practice unit are generally not very active in guiding students, the time for practical teaching is relatively short, and the off-campus practice teaching bases lack stability and continuity, which leads to the continuous decline of practice teaching quality.

(3) Students are generally weak in innovation and practice abilities

At present, due to the limitation of hardware conditions and other factors, the practice and training in most colleges and universities generally only focus on a certain knowledge point, and students can not get systematic professional knowledge practice and exercise. Moreover, there are some problems in the evaluation of practical teaching quality, such as emphasizing knowledge, undervaluing output, and having large differences in evaluation systems, which lead to students' weak engineering practice and innovation abilities.

Therefore, reforming the existing practical teaching system and mode of engineering management major is an important issue faced by current higher education reform. The educational concepts of OBE (output based education) and CDIO (conceptualizing designing implementing operating) are the latest achievements of international engineering education reform in recent years. Among them, the OBE is a learning output oriented approach, which reversely organization, implementation and evaluation of teaching[6]. The CDIO, on the other hand, takes the life cycle from product design to operation as the carrier, allowing students to learn and master professional knowledge as much as possible in a proactive, practical and teamwork way, in the process of solving engineering problems and and in the most realistic engineering practice environment[7].

At present, the OBE and CDIO education concepts have been widely applied in higher education reform both at home and abroad, with 105 universities have carried out the CDIO education model pilot in China.

Based on this, the concept of OBE-CDIO are introduced into the practical teaching reform of engineering management specialty in this study, and the practical teaching system of engineering management specialty based on the OBE-CDIO is constructed, to enhance the professional technical ability, engineering practical ability, and innovation ability of students in this specialty.

2 Reconstruction of Curriculum System for Engineering Management Specialty Based on OBE-CDIO Concept

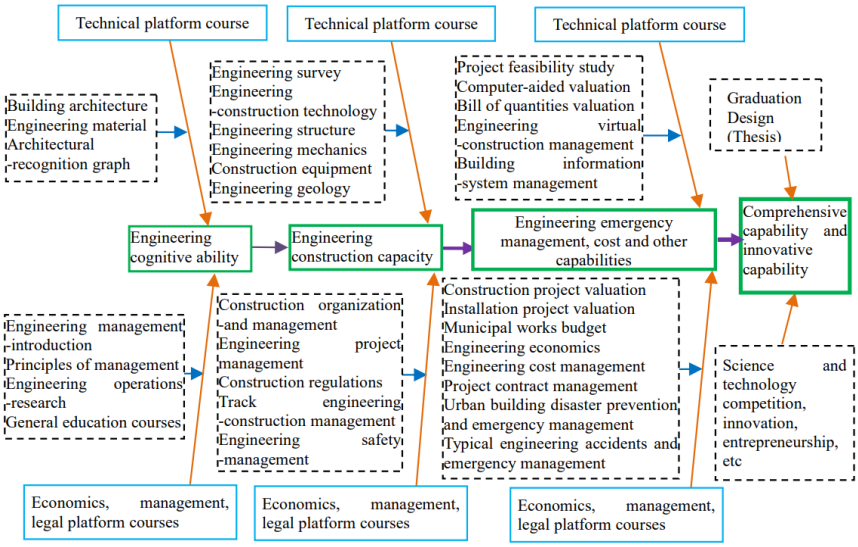

Fig. 1. Curriculum system framework of engineering management speciality based on the OBE-CDIO

The research has shown that practical teaching must be supported by curriculum system. According to the requirements of the 2016 Ministry of Housing and Urban Rural Development for the evaluation (certification) of higher education engineering management specialty[8], as well as the 2018 National Standards for the teaching quality of management science and engineering majors[9], students in this specialty should learn and master basic theories and knowledge in five aspects, including engineering technology, management, economic and financial management, legal regulations, contract management, and information technology. Engineering management graduates should have the basic abilities of engineering planning, design management, investment (cost) control, schedule control, quality control, safety management, contract management,

information management, organization and coordination in the field of civil engineering or other engineering, and have the comprehensive professional abilities to discover, analyze, research and solve practical problems in engineering management. Combining with the current curriculum system shortcomings of the engineering management specialty, in this paper, the practical teaching objectives and ability requirements of engineering management specialty are firstly determined through the OBE concept, and then the integrated curriculum design idea of CDIO concept is referenced. The architecture of the undergraduate curriculum system for engineering management specialty based on the OBE-CDIO concept is ultimately presented in this study, as shown in Figure 1.

In Figure 1, The green bold wire frame indicates that Level 1 items are the main line， The blue thin wire frame indicates that Level 2 items are supported, the dashed box indicates that level 3 items (core courses) are the foundation. The setting of the system fully considers the requirements of the industry and society for the skills of engineering management talents, introduces the latest cutting-edge theories such as virtual construction, urban building disaster prevention and emergency management, and project management informatization. And in the course system design, the experiments, internships, course designs, graduation designs and technology competitions involved in general education basic courses, subject basic courses, and professional frontier courses are closely combined with relevant courses, and the systematic knowledge system is emphasized. At the same time, considering the fact that most colleges and universities have significantly reduced the total credits of engineering management speciality to about 160 credits in order to implement the requirements of the Ministry of Education for streamlining class hours, while courses such as ideological and political education have only increased without decreasing, setting up teaching directions such as cost and engineering emergency management is suggested in the course system. Among them, the cost direction can focus on cultivating students' engineering cost management ability, while the engineering emergency management direction can focus on cultivating students' engineering accident and disaster emergency management ability.

3 Construction of Practical Teaching System for Engineering Management Speciality Based on the OBE-CDIO

Based on the curriculum system in Figure 1, the practical teaching system framework of engineering management speciality under OBE-CDIO concept is constructed in this study, as shown in Figure 2.

This practical teaching system covers all practical section of engineering management speciality from four aspects: strengthening students' basic skills, professional skills, comprehensive skills, and innovative skills. In the process of implementation and operation, students are required to complete experiments and course design (practical training) in class, to complete scientific research training, scientific and technological innovation, and academic competitions outside class, and to complete cognition internship, construction internship, graduation design (thesis) and other practical section through school-enterprise cooperation.

At the same time, in the operation of the practical teaching system, the main role and active participation of students are emphasized, and the link between various practical sections is payed attention to, gradually improving students' cognitive ability, hands-on ability, engineering practice ability, and innovation ability.

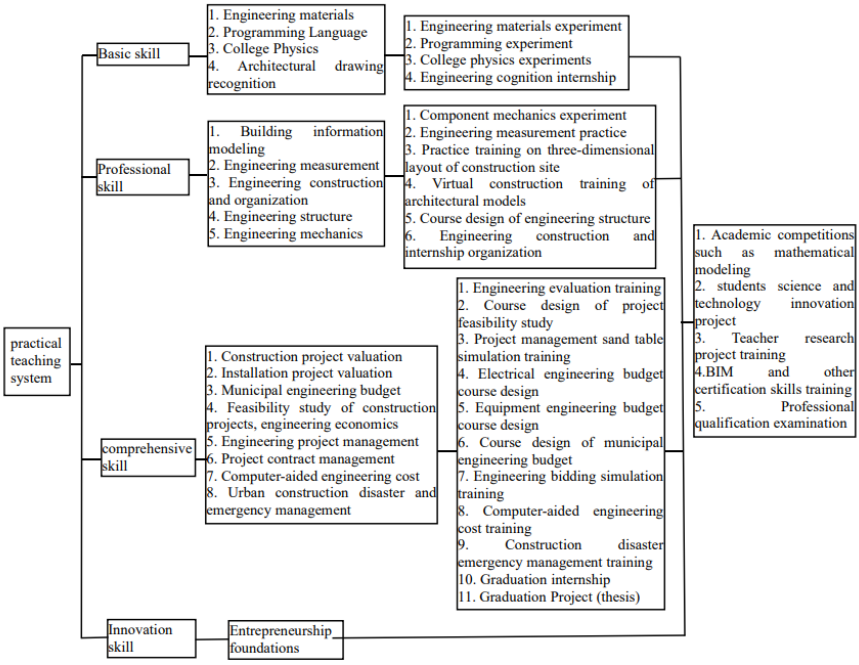

Fig. 2. the practical teaching system framework of engineering management speciality under OBE-CDIO

4 Evaluation System for Practical Teaching of Engineering Management Speciality

According to the survey of engineering management graduates in recent years, nearly half of them believe that there is a significant difference between the practical environment on campus and the working environment, and that a longer adaptation period is required after work. About a quarter of graduates believe that the hardware equipment used in college practice courses lags behind and has a big gap with actual work. Therefore, combined with the teaching requirements of engineering management speciality, this study suggests that the evaluation index system of practical teaching in engineering management speciality should include the index of practical environment, and comprehensively evaluate the effectiveness of practical teaching through three aspects: the investment of practical teaching funds, the construction of key laboratories, and construction of internal and external practical bases.

In view of the current shortage of practical skills among engineering management graduates, combined with the current industry demand for engineering management professionals, the practical skills indicators are introduced into the evaluation index system in this study, to comprehensively reflect students' practical skills from both professional skills and comprehensive skills. At the same time, considering that the effect test of practical teaching should be different from the deficiency of over-reliance on performance evaluation of theoretical teaching, this study introduces social evaluation and skill certification indicators. To further enhance the practical teaching evaluation scientific of engineering management speciality through third-party graduate social evaluation and skill certification.

Based on the above analysis and references[10-11], the evaluation index system for practical teaching quality evaluation of engineering management speciality in application-oriented undergraduate colleges constructed in this study is shown in Figure 3, with 6 primary indicators and 16 secondary indicators.

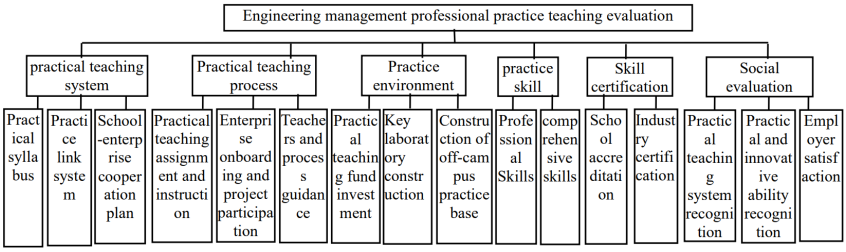

Fig. 3. Evaluation index system for practical teaching of engineering management speciality

5 Conclusion

In view of the shortcomings of the current practice teaching and evaluation system of engineering management speciality in China, the practice teaching system of engineering management speciality based on the OBE-CDIO concept put forward, and a more scientific practice teaching evaluation index system of engineering management speciality constructed. The research results can provide a new way for the practical teaching reform of engineering management speciality under the new situation, and improve the engineering practical ability and innovation ability of students in application-oriented undergraduate colleges.

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