Reform and practice of construction engineering under background of engineering education accreditation

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Abstract: To promote the graduation requirements of civil engineering education accreditation, combining with the speciality of civil engineering curriculum and course characteristics in application-oriented universities, this paper reviews the teaching and reform status of construction engineering course in China, and analyses the teaching goal, teaching contents, examination and assessment system of this course. Based on engineering education accreditation, the reformed course design system is built, which adopts the principle of regression of engineering practice in order to train engineering practical ability for technical implementation personnel.

1. Introduction

Engineering education occupies an important position in China's higher education, which is an important guarantee for promoting industrial transformation and upgrading, and implementing the national major development strategy. Engineering education accreditation is an internationally accepted quality assurance system of engineering education, and is also the prerequisite for international mutual recognition of engineer qualification. On June 2, 2016, China became the 18th member of the "Washington Agreement" on engineering education officially, marking that China's engineering education has been truly integrated into the world's engineering education system, and the quality of education has begun to achieve the substantial equivalent of other member states. At the same time, it brings more opportunities and greater challenges for China's higher engineering education to deepen the reform of engineering education. Engineering education accreditation take the students as the center, whose main task is to shift from "what can teachers teach" to "what students should achieve", that is, engineering education received in college should be regarded as a preparation for future related career, the reasonable training objectives should be determined based on social needs and the connotation of discipline development, the graduation requirements supporting the training objectives should be defined, the teaching activities should be designed and implemented with the students, and the teaching of engineering technical knowledge should be transformed into the training of the ability required by the career. By the end of 2020, over 100 institutions in China had passed engineering education accreditation, exploring the teaching reform under the perspective of engineering education accreditation is of great practical significance for promoting the transformation and development of application-oriented universities.

The application-oriented undergraduate course is a kind of full-time undergraduate education, which is guided by the application of scientific knowledge and technological achievements and aiming to cultivate high-level technical and skilled personnel for the society [1]. In terms of education types, applied undergraduate courses mainly provide professional theoretical knowledge at the middle level, exercise students' professional and technical skills, and help students obtain bachelor's degree certificates or vocational qualifications at the same level. In terms of training level, the main aspiration of application-oriented undergraduate courses is skilled talents at the "engineer" level. Hence, the accreditation is better than specialized vocational education in basic theory teaching and better than ordinary undergraduate education in practical training teaching. Therefore, highlight "application" and

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to carry out teaching innovation under the background of engineering education accreditation from the aspects of curriculum conception and design, curriculum organization and implementation are the key work to promote the quality of undergraduate vocational education to a great extent.

Table.1. Major Section of construction engineering.

Number	Knowledge unit	Module division
1	Earthwork	Construction technology
2	Pile foundation	
3	Concrete construction	
4	Pre-stressed concrete	
5	Masonry structure	
6	Steel structure	
7	Scaffolding construction	
8	Hoisting works	
9	Waterproof engineering	
10	Decoration engineering	
11	Construction streamline method	Construction management
12	Network planning technique	
13	Construction organization plan	

Engineering construction is a compulsory course of civil engineering, which possess strong practicality, comprehensiveness, application, timeliness and multidisciplinary intersecting. Engineering construction organizes students to deepen their understanding of professional theoretical knowledge and master the combination of theory and practice by means of study, experiment and practice in a planned way, and plays an important role in the curriculum of civil engineering. In recent years, more than 80% of the graduates majoring in civil engineering from local universities have been engaged in on-site construction and management. Therefore, the importance of engineering construction has become increasingly prominent. Major section of construction engineering is listed in Table 1.

2. Problems and deficiencies in traditional teaching of construction engineering

Personnel training in application-oriented universities is still in a "middle ground" at present, namely the students' theoretical knowledge is far less than that in scientific-research-type universities, while do not have distinctly advantages in terms of the operation ability and proficiency compared to higher vocational colleges [2]. At present, following problems mainly exist in the teaching of construction engineering.

2.1 Neglection of engineering education

For a long time, China's engineering education has been focusing on science education. Engineering education is ignored because of being regarded as subordinate to science. Hence technical, practical and comprehensive content keep being weakened while academic and theoretical content remain increasing, which led to the disjunction of graduates and talent requirement. in consequence, students still lack direct and specific understanding of key knowledge such as main construction technology and technical parameters of machinery and equipment, which is extremely unfavorable to the internalization of knowledge and the subsequent development of career.

2.2 Limitation of Laboratory site and intership resources

Due to the highly practical content of the construction engineering course, and the fact that the volume of the building is usually huge and the construction machinery is expensive, most construction

equipment cannot enter the campus at all. Lead to extreme shortage of intuitive understanding of construction knowledge. Therefore, even the curriculum studies are finished, only the basic calculation, like load on formwork, casting speed and lateral soil pressure, can be done, students still do not have the ability to make construction plans. At the same time, lack of substantive participation in the construction process emerges because of the long period and the difficulty of coordinating the construction schedule and teaching progress.

2.3 Lack of training of computer aided design skills

Due to the discipline-centered training mode, colleges and universities often focus on cultivating students'" hand calculation "ability and weaken the computer aided design skills. Even if it involves a part, it is only CAD skilled operation exercise, which lead to students' difficulty in construction object, poor communication and coordination skills, and loss of competitive advantage in the industry.

3. CDIO mode-based course system of construction engineering

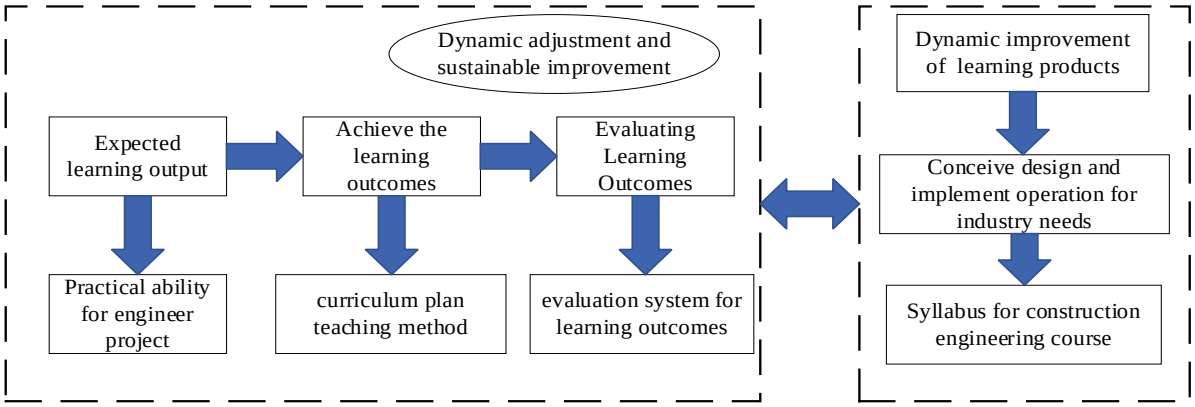

Figure 1. Logical framework for construction talent training based on CDIO model.

CDIO is a new type of engineering education model developed in 2001 by the Massachusetts Institute of Technology in conjunction with three top engineering universities in Sweden, representing the life cycle of industrial products from conceive, design, and implement to operate. The concept is to make the full use of the university's full range of disciplines and rich learning resources, stay as close as possible to engineering practice, let student study with the pursuit of solving engineering problems, so that the ability of theoretical knowledge, personal quality and cooperation get comprehensive training and improvement. Clearly, the concept of CDIO coincides with the core of engineering education accreditation and the demand of curriculum reform in applied undergraduate universities. For further promotion of dynamic coupling of CDIO education model and construction engineering teaching, the construction talent training logical framework based on CDIO model is shown as Figure1.

In order to optimize the quality of practical teaching and overcome the problems caused by the long period of engineering project, the difficulty of coordination between construction link and teaching progress, and the difficulty of ensuring the safety of students, the construction engineering practical training platform is established. The composition of the platform is shown in Figure 2.

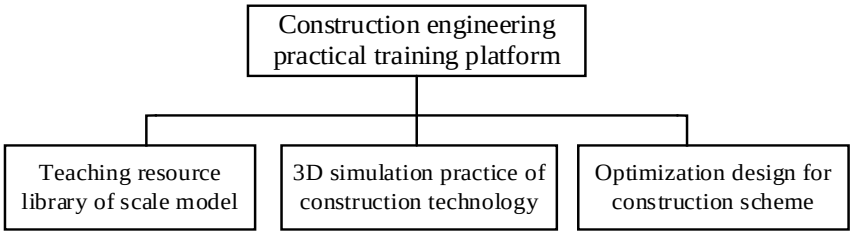

Figure 2. Composition of construction engineering practical training platform.

4. Application of BIM in construction engineering teaching

Building information model (BIM) is a technology that creates and uses digital models to design, build and manage projects [3]. At present, the concept of BIM in China has evolved from a three-dimensional architectural design tool to an engineering method, that is, in addition to emphasizing the function of three-dimensional parametric design, it also stresses the whole building life cycle management. Based on the core knowledge of civil engineering, the cross-cutting nodes between BIM technology and core knowledge areas of construction engineering are listed in Table 2.

Table.2. Cross-cutting nodes between BIM and core knowledge areas of construction engineering

Knowledge areas	BIM domain		
	Planning and design	Construction management	Operation and maintenance
Principles and methods of mechanics	Fundamentals for mechanics	Fundamentals for mechanics	————————
Professional and technical basis	Three-dimensional modeling	Model reconstruction and maintenance	Record and query of operational information
Project management	BIM bidding plan, Schedule and construction	Construction cost management	————————
Basic principles and methods of structure	Structural analysis	Professional deepen enterprise and collision check	————————
Principle and method for construction	Concept design	Construction organization plan	Record and query of information
Computer aided design	BIM 3D, animation rendering	BIM 4D, BIM 5D	BIM model maintenance

Figure 3. Structure simulation of concrete T beam bridge

The realization of visualizing multimedia resources in the construction process is an important work of CDIO based construction engineering teaching, including structural modeling and virtual construction process [4]. Construction, simulation and phase division of building structures, like foundation, masonry structure, reinforced concrete structure, can be simulated with the help of software Revit. Navisworks Manage software has powerful collaboration function, the model can be docked with the Revit model, and the 4D simulation of the model can be realized with the help of Timelier tools to show the construction process, then by using the rendering function of Presenter tools, the scene effect is realized close to the actual situation. At the same time, with the help of Animator tools to achieve scene layout, animation effect, the dynamic simulation of the whole construction process of the building structure and the construction of the sub-project is realized accordingly, see Figure 3, 4. Revit software and Navisworks manage software can achieve the construction of video resources of key construction technologies in the course and meet the needs of students' learning characteristics.

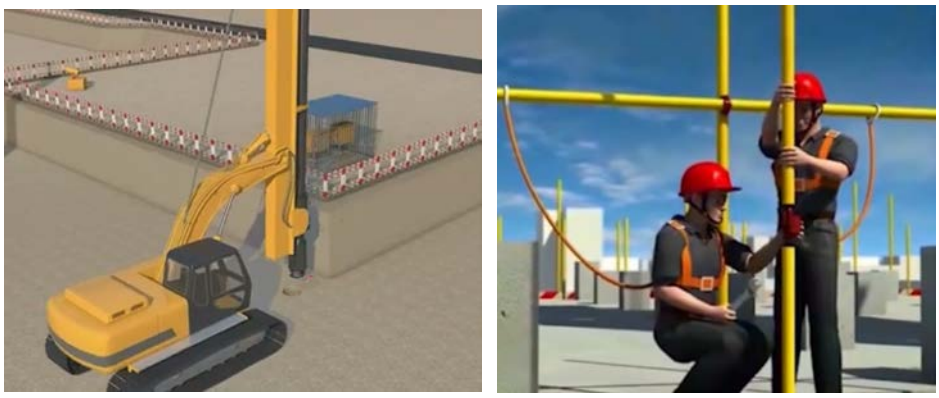

Figure 4. Simulation and animation of construction process.

5. Conclusion

Under the background of teaching reforming and engineering education accreditation, this paper carries out the reform plan analysis for construction engineering curriculum. According to students' learning needs and learning habits, the problems existing in construction course teaching are analyzed. On this basis, guided by CDIO model theory and BIM technology, modularization of course content is divided and teaching activities based on information technology are designed. This reform methodology a highly integrated with BIM technology, and is a new mode of construction engineering teaching which can meet the needs of learners and realize the improvement of learners' engineering practice ability and innovation ability, which provides a concrete and feasible way to realize the "return to engineering practice" of application-oriented undergraduate education.

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