Research on Teaching Reform of Engineering Cost Major with Deep Integration of BIM

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ABSTRACT
This paper introduces the current situation of the application of BIM technology in teaching reform, analyzes the problems faced by BIM in the course of engineering cost major in higher vocational colleges. On this basis, the BIM-based engineering cost curriculum system reform is analyzed and researched. The specific suggestions for the reform of the curriculum system of engineering costing professions with in-depth integration of BIM are put forward from the aspects of the overall planning of the curriculum system of BIM into courses, the design of new BIM courses, the implantation of BIM contents in traditional professional courses and the opening of comprehensive courses based on BIM.

Keywords: *BIM technology, engineering cost, teaching reform.*

1. INTRODUCTION

BIM technology is developed by Autodesk on the basis of computer-aided design technology. It is the visual expression and digital bearing of the functional characteristics, professional information and physical characteristics of construction projects [1]. After more than ten years of development, BIM technology has been widely recognized by the industry around the world and is one of the most influential emerging technologies in the construction field so far. The core of BIM technology is to establish a virtual three-dimensional model of construction engineering and use digital technology to provide a complete and actual construction engineering information database for this model. Based on this 3D model containing construction engineering information, it provides a platform for the exchange and sharing of engineering information for the stakeholders of the construction project. BIM technology can be widely used in various stages of building planning, design, construction, operation, etc., and can provide technical and tool support for each stage of work. Advanced construction companies in Europe and the United States have been able to use BIM technology to realize the integration of building information from the beginning of building design, to construction, operation and the end of the entire life cycle of the building. The whole life cycle information is integrated into a 3D model information database, and all companies in design, construction and facility operation can work together based on BIM, which can effectively improve resource saving, work efficiency, cost saving, and achieve sustainable development. With the widespread application of BIM technology, construction companies are increasingly favoring professionals with BIM skills. However, the current capacity and scale of BIM talent training are far from meeting the needs of the development of the construction industry.

The teaching reform of engineering cost major based on BIM has been carried out in many universities. However, most of the reforms are still in the preliminary exploration stage. Wu [2] analyzed the courses offered for construction engineering majors in higher vocational colleges, and on this basis, put forward the idea of introducing BIM technology into the teaching of higher vocational construction engineering. Ding [3] applied BIM to the professional production practice of civil engineering. Zhang [4-5] studied the BIM education in American colleges and universities, and analyzed the BIM teaching reform of construction engineering management majors. On this basis, the planning and suggestions of BIM-based education reform are put forward. Huang [6], Liu [7] studied the construction of the curriculum system of civil engineering based on BIM. In addition, many scholars [8-11] have studied the

specific problems of BIM enrollment, and put forward specific suggestions and reform measures.

This paper makes a preliminary discussion on the reform of the engineering cost major based on BIM, and puts forward specific suggestions for the reform of the engineering cost professional curriculum system that is deeply integrated into BIM.

2. PROBLEMS FACED IN THE TEACHING REFORM OF ENGINEERING COST MAJOR WITH DEEP INTEGRATION OF BIM

Since BIM technology has good 3D expressiveness in architecture, the application of BIM technology in the teaching of engineering cost professional courses can greatly improve the teaching effect. On the one hand, with the help of BIM 3D information modeling visualization, simulation and other characteristics, it can help students to quickly establish spatial relationships. Moreover, relying on the synchronous generation of plane, section and elevation by BIM technology, one-to-one correspondence between 2D drawings and 3D objects can be realized, which makes the original monotonous two-dimensional drawings concrete and vivid, and the boring imagination becomes an interesting experience, the students' interest in learning can also be better stimulated. On the other hand, teachers can use the virtual roaming function of BIM software to overcome the drawbacks of on-site teaching, so that students can experience an immersive sense of reality going deep into the construction site, which can help students understand the shape, composition, and structure of the building.

The impact of BIM on the engineering cost major is revolutionary, which makes the market demand for talents who master BIM application ability gradually expand. At the same time, the increasing demand is forcing the construction majors at all levels to carry out educational reform work. However, how to integrate BIM into talent training and traditional teaching system still faces many problems.

(1) The hardware conditions are limited. BIM technology involves a lot of advanced software and has higher requirements for computer hardware configuration. The computer configuration of the existing computer rooms of most advanced vocational colleges cannot meet the requirements of BIM software, which hinders the teaching application of BIM technology.

(2) Insufficient teaching ability. At present, most teachers in domestic advanced vocational colleges are still in the learning and exploration stage of BIM technology itself. Most teachers only know the basic operation of BIM and lack a deep understanding of BIM itself. This situation can easily make students mistakenly think that BIM is just an ordinary construction software, but cannot understand the essence and powerful capabilities of BIM, and cannot apply BIM to future jobs.

(3) Conflict with the traditional curriculum system. With the increasing influence of BIM on the engineering cost major, the integration of BIM into the curriculum system is not only in line with the development trend of the construction industry, but also in line with the government's long-term planning for the construction industry. However, the implementation of BIM enrollment cannot be determined through a simple administrative meeting or academic exchange. On the one hand, BIM itself includes a huge knowledge system. For different majors, what content needs to be included in the curriculum system has not yet reached an agreement within the major itself. On the other hand, if BIM is implemented, it will have an impact on the original stable curriculum and content system, whether it is in the entire professional curriculum system or in the content system of a certain professional course. As an existing professional, the talent training program for engineering cost major has been revised and improved for many years, and various courses have been fully tested in practice. It is difficult to compress the existing hours and provide the course content for BIM. Therefore, in order to deeply integrate BIM to form an organic knowledge system, it is necessary to adjust the original traditional curriculum system, which not only needs to increase the BIM basic course in the course system, but also needs to decompose the complex BIM knowledge system into all professional courses of all grades of engineering cost major. Obviously, this kind of adjustment is not achieved overnight, and the entire education industry needs to conduct a full investigation of the talent capacity needs in accordance with the training rules of engineering cost major and the market. On this basis, overall analysis and top-level design should be carried out. However, at present, most colleges and universities still lack systematic thinking on how to deeply integrate BIM into professional courses.

(4) It is difficult to adjust the teaching content of the original professional courses. BIM is not only a kind of ability requirement for talents, but also an advanced teaching method reform. The integration of BIM and professional emphasis is on the ability to apply BIM. Therefore, in addition to the need to increase the explanation of the basic content of BIM, it is also necessary to decompose the complex BIM knowledge system and integrate it into the curriculum system of each grade of the engineering cost major to form an organic knowledge system, which is undoubtedly very difficult.

3. SUGGESTIONS ON THE REFORM OF ENGINEERING COST MAJOR CURRICULUM SYSTEM DEEPLY INTEGRATED INTO BIM

3.1. Teaching Staff Construction

Teachers are the main body of "teaching" in teaching activities, and they are the imparters of knowledge and skills. For teachers, while actively bringing in, they should be encouraged to go out and broaden the overall BIM skills of the teaching staff. On the one hand, according to the requirements of the teaching reform, when recruiting teachers, the BIM skills of the applicants should be used as an important reference index, and professional teaching based on BIM can be carried out immediately after entering the job. On the other hand, teachers are encouraged to regularly participate in relevant training to improve their BIM skills.

3.2. Teaching Conditions Construction

The teaching reform of deep integration of BIM must be equipped with a sufficient number of computers and corresponding BIM software, which can provide real projects for virtual design, construction, management and cost estimation, etc., and can provide students with a good virtual engineering simulation link , so that students can really feel the problems that may be encountered in the process of actual project cost estimation, and realize the convenience of BIM-based solutions.

3.3. Planning of the Curriculum System

3.3.1. Overall plan

When planning the curriculum system of BIM-based engineering cost major, the existing curriculum system should be fully referred to and considered. The existing curriculum has been tested in practice over a long period of time and has itself proved its soundness in terms of human capacity development. The reform of the curriculum with deep integration of BIM is not a total rejection of the existing curriculum, but on the contrary, it is a necessary adjustment and adaptation of the existing curriculum to modern advanced technology. Therefore, it is possible to plan the BIM course system and the sequence of lectures in conjunction with the existing curriculum and teaching schedule. In the actual reform process, the students' professional knowledge, BIM knowledge and other relevant software knowledge need to be reasonably balanced. Knowledge of BIM skills should maintain a continuity of knowledge that is reflected throughout the stages of professional learning. Throughout the learning process, the development of basic BIM-based professional competencies should be carried out from easy to difficult and from point to point. The general plan of the curriculum system of engineering cost major with deep integration of BIM is shown in Figure. 1.

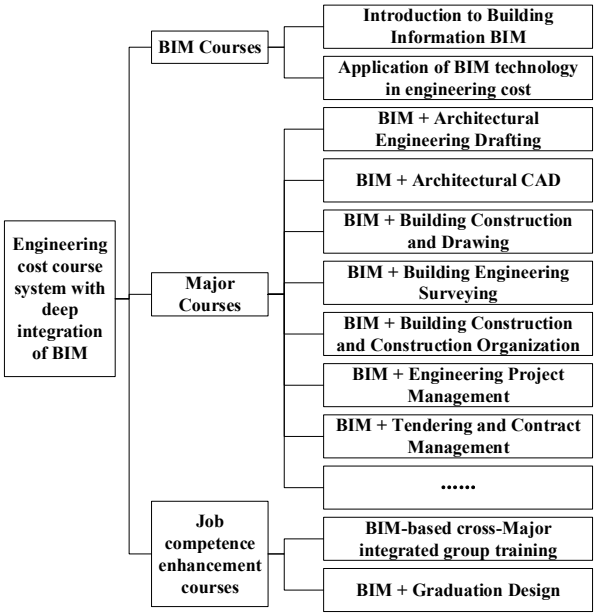

Figure 1 The general plan of the curriculum system of engineering cost major with deep integration of BIM

3.3.2. BIM content implantation in traditional professional courses

The integration of BIM content into the traditional professional curriculum ensures that BIM knowledge is coherent throughout the professional learning process. At the same time, the three-dimensional visualization and dynamic simulation features of BIM have led to changes in the way professional courses are taught and the means of delivery. As a result of the use of BIM, some of the key points and difficulties in the traditional professional courses will change, so some optimization of the content of the traditional professional courses will be required. More diversity in the way teaching is organized can also be considered. In addition to traditional classroom teaching, computer-based operations or expert lectures can be added as appropriate to deepen and reinforce the learning effect. The design of BIM content implantation in traditional professional courses is shown in Table.1.

3.3.3. BIM new course design

For the integration of BIM courses, it is recommended to adopt a hybrid approach, that is, on the one hand, special courses are set up to systematically learn BIM, and on the other hand, the corresponding BIM content is implanted in traditional professional courses. For the newly opened BIM courses, the method of the University of Nebraska-Lincoln can be referred to, and the courses are divided into two categories: primary BIM courses and advanced BIM course, which is shown in Table.2. The primary BIM courses are mainly aimed at

lower grade students, and can be considered to be set in the third semester, mainly to teach the basic knowledge and operation of BIM. The advanced BIM courses are mainly for graduating students, and can be set in the fifth or sixth semester, mainly to teach the advanced skills of BIM technology and the expansion in the professional field.

Table 1. The design of BIM content implantation in traditional professional courses

Course Name	Course Nature	BIM Learning Content	Teaching organization
Architectural Engineering Drawing	Examination Course	3D	Classroom teaching and hands-on operation
Architectural CAD	Test Course	3D	Classroom teaching and hands-on operation
Architectural Structure and Recognition	Examination Course	3D	Classroom teaching and hands-on operation
Construction Engineering Surveying	Test Course	3D	Classroom teaching and hands-on operation
Concrete and Masonry Structures	Examination Course	3D	Classroom teaching and hands-on operation
Engineering economics	Examination Course	3D	Classroom teaching
Building Construction and Construction Organizations	Examination Course	3D, 4D	Classroom teaching, hands-on operation and expert Lectures
Engineering project management	Examination Course	3D, 4D, 5D	Classroom teaching, hands-on operation and expert Lectures
Construction project quota and budget	Examination Course	3D, 4D	Classroom teaching and hands-on operation
Reinforced Concrete Structure Flat Construction Drawing Reading	Examination Course	3D	Classroom teaching and hands-on operation
Bidding and contract management	Examination Course	3D, 4D, 5D	Classroom teaching
Estimated budget of architectural decoration project	Examination Course	3D, 4D	Classroom teaching and hands-on operation
Construction Engineering Control	Examination Course	3D, 4D, 5D	Classroom teaching and hands-on operation
Practical software for construction engineering	Test Course	3D, 4D, 5D	Classroom teaching and hands-on operation
Bill of Quantities and Valuation Practices	Test Course	3D, 4D	Classroom teaching and hands-on operation

Table 2. Primary and advanced BIM course at the university of Nebraska-Lincoln

Course Category	Course Content
primary BIM courses	drawing reading, construction documentation, BIM concepts, target parametric techniques, multi-discipline facility operation analysis, collaboration, detailed design, constructability, mechanical, electrical and plumbing models, basis for quantity calculation
advanced BIM courses	4D simulation, classification system, location-based schedule, model-based construction engineering, 4D/5D simulation, progress monitoring, cost management, crane operation simulation, sustainable construction, simulation of various energy facilities required by the project, noise simulation

3.3.4. The establishment of comprehensive courses

In addition to the regular BIM basic courses and engineering cost professional courses, it is suggested to add a group training course for comprehensive ability enhancement based on BIM. The course is based on actual projects, targeting the needs of enterprise positions and the comprehensive application of the knowledge learned in this major. At the same time, the projects in the course can be completed together with other construction engineering majors to enhance students' awareness of independent data collection, strengthen communication and coordination, teamwork and other comprehensive abilities, and lay a solid foundation for future practice.

3.4. BIM elements are included in the scope of graduation design topics

Graduation design is the key practice teaching and assessment link of advanced vocational education. In the graduation design of engineering cost major oriented by BIM application ability, rich BIM elements should be fully introduced. These BIM elements not only include Revit software secondary development, structural design optimization, engineering quantity calculation, acquisition of national standard bill of quantities, and collision checking, but also include the partial application of BIM technology in the complete graduation design, such as BIM engineering quantity calculation in construction organization design, schedule arrangement, construction site layout, animation simulation of four-dimensional construction process, etc. The introduction of these elements can cultivate students' BIM application skills and enrich the content of the graduation project.

4. CONCLUSION

BIM technology is developing very rapidly under the vigorous promotion of the government and the industry, and has become an important means to transform the traditional operation and management methods of the construction industry. For the whole process of cost consulting is the inevitable trend of development, therefore, BIM will undoubtedly be a strong technical platform. The higher education of engineering cost major aims to match the position and improve the application ability of students, and the all-round teaching reform is inevitable. However, it should also be clearly recognized that the comprehensive teaching reform will be a relatively long-term process. In the actual reform, the actual situation of the institution itself can be fully considered. It can start from the reform of a certain professional course, and gradually improve the talent training plan from point to point.

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