



Investigation into the Pedagogical Design of BIM Technology Application to Foster the Craftsman Spirit

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Abstract. General Secretary Xi Jinping to implement the spirit of the important speech for promoting the artisan spirit. Explore the integration of teaching content into the ideological and political elements of the curriculum. Promote all-round coordinated education of all employees. This paper takes the "Introduction" course of BIM technology application course as a teaching design case study. From the emergence of super projects in China, which reflects the power of Chinese science and technology, and marks that China has entered the era of digital BIM, to the introduction of the concept, development and characteristics of BIM, to the display of BIM model results. This paper studies the teaching design ideas and methods organically integrated in the introduction course of BIM technology application.

Keywords: Craftsmanship spirit; Curriculum ideology and politics; BIM technology; Introduction; Instructional design

1 Introduction

Since the 18th National Congress of the Communist Party of China, General Secretary Xi Jinping has made profound expositions on the spirit of labor models, the of labor, and the spirit of craftsmanship, which are rich in content and profound in thought.

In November 2020, at the National Conference on the Recognition of Model Workers and Advanced Workers, General Secretary Xi Jinping clearly stated that the long-term practice, we have cultivated and formed the spirit of model workers who love their jobs, strive for excellence, work hard, are brave in innovation, are to fame and wealth, and are willing to contribute^[1].

In May 2021, General Secretary Xi Jinping clearly stated at the 10th National Congress of the China Association for Science and Technology that more attention should be paid to the cultivation of young talents, efforts should be made to foster a group of top-notch scientific and technological talents with world influence, a number of innovation teams should be stably supported, and more high-quality technical and skilled talents, skilled craftsmen and master artisans should be cultivated.^[2]

In April 2022, General Secretary Xi Jinping stated in his congratulatory letter to the First Innovation Exchange Conference for Master Craftsmen in Big Countries that the

working class and the vast number of working people in China should vigorously promote the spirit of model workers, the spirit of labor, and the spirit of craftsmanship, adapt to the needs of today's scientific and technological revolution and industrial revolution, study and practice hard, conduct in-depth research, be bold in innovation and dare to be the first, continuously improve their technical and skill levels, and contribute their wisdom and strength to promoting high-quality development, implementing the strategy of making China a manufacturing power, and comprehensively building a modern socialist country.^[3]

In recent years, in order to thoroughly implement the spirit of General Secretary Xi's important speeches, our school has been actively organizing various "Ideological and Political Education in Courses" activities, arranging teaching competitions on ideological and political education in courses for faculty and staff, requiring full-time teachers to constantly innovate, improve teaching methods, integrate teaching resources, actively carry out "Ideological and Political Education in Courses" during teaching, incorporate ideological and political elements into the teaching content, and promote coordinated education by all staff in all aspects.

The application of BIM technology is a professional compulsory course for engineering majors such as engineering cost, engineering management, and civil engineering. Students mainly study the application of BIM technology in projects, with a focus on learning to use modeling software to create BIM simulation models. The introduction is the first lecture of this course. It plays a guiding role in the entire teaching process and has a special status and great significance. It is of great importance in guiding students to enhance their learning interest and stimulate their subjective initiative. Many ideological and political elements can be integrated into the introduction. This can not only increase students' learning interest but also enhance their professional identity, cultivate their patriotism and the craftsmanship spirit of striving for excellence, thus achieving the goal of ideological and political education.^[4]

2 The Ideological and Political Teaching Design of the Introduction Course

The introduction lesson is the beginning of the BIM Technology Application course and is the part where ideological and political elements can be most easily integrated. It mainly elaborates on questions such as "What is the digital BIM era?", "What is BIM?", "How does BIM develop?", and "What are the characteristics of BIM?". During the teaching process of the introduction lesson of BIM Technology Application, in light of the actual situation of students, ideological and political elements are integrated into the discussion and study of the above questions.^[5]

2.1 The Digital BIM Era

The strength of the country is a great blessing to its people. The emergence of remarkable mega - projects one after another reflects the powerful scientific and technological level of China.^[6]

The Hong Kong - Zhuhai - Macao Bridge is a cross - sea bridge in China, with a total length of 55 kilometers. It is hailed as the "Mount Everest" of the bridge - building world, holding the world's top record. [7] FAST, the Chinese "Sky Eye" (a spherical radio telescope), is the world's largest single - aperture spherical radio telescope. [8] The "Blue Whale 2" in China is the world's most advanced ultra - deep - water dual - drill - tower semi - submersible drilling platform. [9] The "Fuxing Hao" high - speed train in China has a standard operating speed of 350 kilometers per hour, making China the country with the highest commercial operation speed of high - speed rail in the world. [10] The "Jiaolong" is an operational deep - sea manned submersible independently developed by China. Its maximum diving depth reaches 7,062 meters, indicating that China's ability in seabed manned scientific research and resource exploration has reached the international leading level. The "Mozi" satellite is the world's first space quantum science experimental satellite independently developed by China. It has enabled China to seize the commanding heights of quantum technology innovation globally and has become a benchmark for international counterparts. The achievements of China's science and technology - the mega - projects are shown in Figure 1.

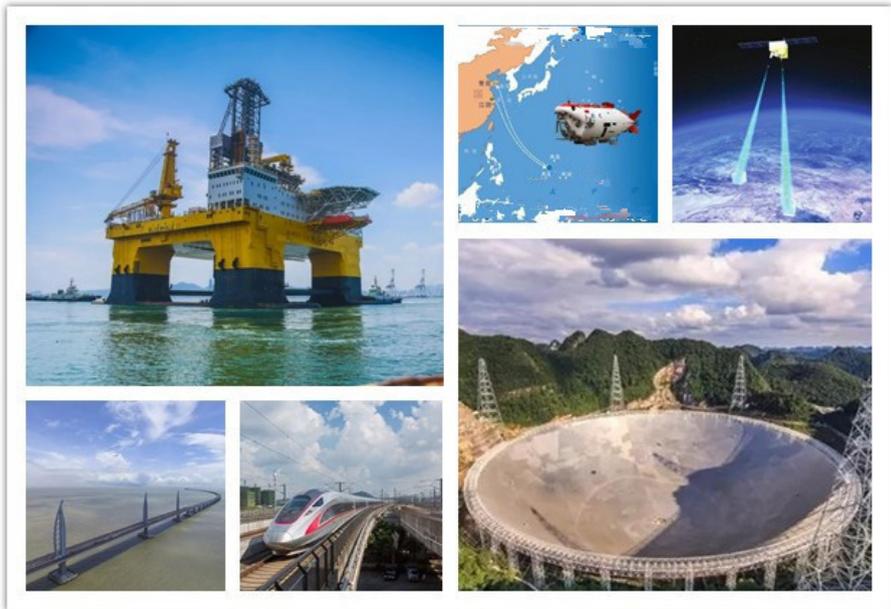


Fig. 1. Achievements of Chinese Science and Technology - Mega Projects

With the continuous advancement of Chinese science and technology, the BIM technology has been introduced into China. The introduction of BIM standards, the application of BIM technology throughout the entire life cycle of projects, and the emergence of giant construction projects all comprehensively mark that China has entered the digital BIM era.

In China, the application of BIM technology has gone through two stages. The first stage was mainly focused on design applications. Centering around the preliminary

design of projects by design institutes, various professional disciplines carried out collaborative design. The second stage was mainly focused on construction applications, exploring applications based on BIM models to solve practical problems encountered during the construction process.

With the development of BIM technology, the BIM application environment has been continuously improved, BIM products have gradually matured, and the application value has gradually emerged. BIM applications are now entering the third stage. This stage still mainly focuses on construction applications, shifting from construction site management to the operational management of construction enterprises. It penetrates into all aspects of project management, including technical management, production management, and business management. It also includes the widespread application of projects and the comprehensive integrated application at the management level.

2.2 The Concept of BIM

In 1975, Professor Chuck Eastman from the Georgia Institute of Technology, known as the "Father of BIM", created the concept of BIM. In his research topic "Building Description System", he proposed "a computer - based description of - a building" to facilitate the visualization and quantitative analysis of construction projects and improve the efficiency of construction. In 2002, Autodesk acquired Revit Technology, a 3D modeling software company, and for the first time used the initials of BIM (Building Information Modeling) together, which has become the well - known "BIM" today.

BIM is the abbreviation of Building Information Modeling in English. The relatively unified translation in China is "Building Information Model". Building Information Modeling takes various relevant information and data of a construction project as the basis of the model to build a building model, and simulates the real information of the building through digital information. BIM includes three aspects of content, as shown in Table 1.

Table 1. Contents of BIM

English content	Chinese pinyin
Building Information Model	Jianzhu Xinxi Moxing
Building Information Modeling	Jianzhu Xinxi Moxing Yingyong
Building Information Management	Jianzhu Xinxi Guanli

2.3 The Development of BIM

The earliest engineering designs were manually drawn by engineers on A0 or A1 paper, and construction drawings were produced in paper format. The general - purpose drawing software AUTOCAD developed in the United States was improved based on the characteristics of the architecture major. Engineers used CAD software to achieve two - dimensional architectural drawing. With the continuous improvement of com-

puter technology, the performance of computer hardware has been rapidly enhanced. People have gained a deeper understanding of the computerization of architectural design, providing technical, material, and ideological support for the development of a new generation of CAD software. Eventually, a higher - level breakthrough was achieved, giving birth to the second - generation CAD software - 3D building model software.

Due to the introduction of BIM technology, software companies such as Glodon, BIMSVIL, Luban, and Pinying have emerged in China. The BIM modeling software they developed came into existence, and the application of BIM technology in major projects has set off a "BIM craze". Major universities have offered BIM - related courses to teach the application methods of BIM modeling software. The development of BIM is shown in Figure 2.

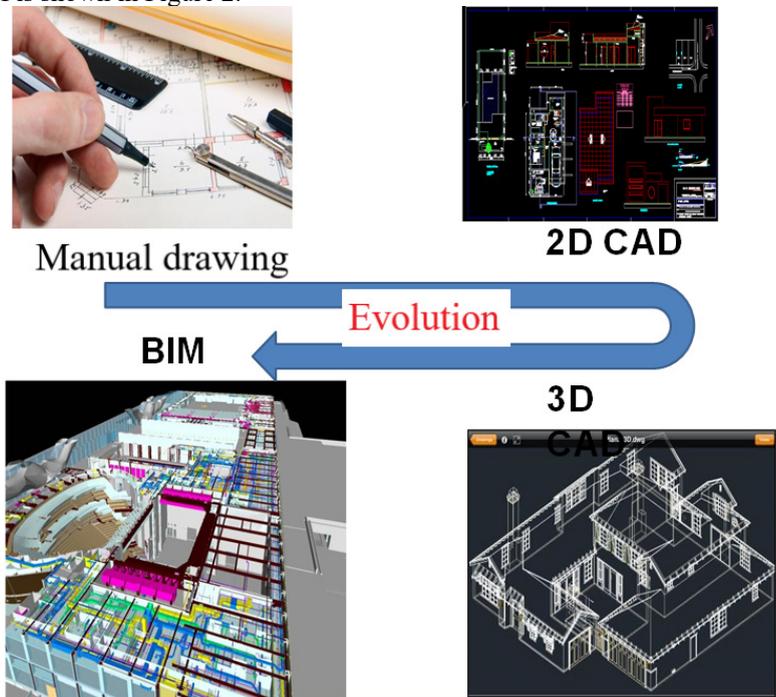


Fig. 2. The Development of BIM

2.4 Characteristics of BIM

The Building Information Model (BIM) is established based on various relevant information and data of construction projects, simulating the real information of buildings through digital information. It has several characteristics such as visualization, coordination, simulation, optimization, and drawing production. The knowledge points of BIM characteristics are shown in Table 2.

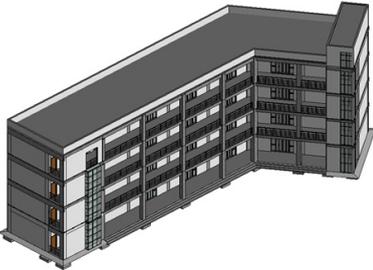
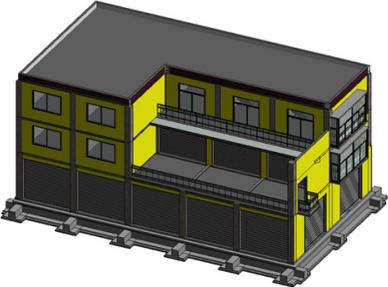
Table 2. Characteristics of BIM

Characteristics of BIM	Knowledge point
Visualization	The 3D solid model is visible, as are the construction processes such as project design, construction, and operation and maintenance.
Coordination	Conduct comprehensive coordination among various specialties to reduce unreasonable changes or problem - related changes.
Simulability	3D graphic simulation, simulation of energy efficiency, sunshine, heat conduction, simulation of construction process, simulation of cost control
Optimality	Various optimization tools are used to optimize the project, especially for buildings with a high degree of complexity.
Drawability	Architectural design drawings, comprehensive pipeline diagrams, collision inspection reports, and proposed improvement plans

2.5 Presentation of BIM Model Results

The BIM Technology Application course has been offered for several semesters. In each semester, different types of engineering drawings are selected as the research objects. Students have learned the core of BIM technology - the application of BIM modeling software, and created vivid and lifelike BIM models. The presentation of BIM model results is shown in Table 3.

Table 3. BIM Model Achievements

Comprehensive Teaching Building Project	Commercial - residential Building Project
	
Central Garden Community Project	Staff Dormitory Building Project
	

Teaching Building Project of Xinwu Primary School	Townhouse project
	

3 Conclusion

The above content is the teaching design of the "Introduction" lesson in the BIM Technology Application course. Through the study of this introductory lesson, students have fully understood the rapid development of science and technology in China. China has fully entered the digital BIM era. They have grasped the concept, development and characteristics of BIM. This has increased students' interest in learning, stimulated their subjective initiative, and they have earnestly studied every operation method of the BIM modeling software. During the teaching process, it was found that students possess the craftsmanship spirit of a major country. After the course, by applying the BIM technology they have mastered, they have painstakingly created various BIM simulation models, obtaining a strong sense of achievement and satisfaction.

BIM technology serves as the digital infrastructure for digital buildings, digital enterprises, digital cities, and Digital China. It will inevitably drive the improvement of industrial technology levels, facilitate the upgrade of the full life cycle of projects, promote the transformation of business models, and drive the innovation of management models, thus better leading the transformation, upgrading, and sustainable and healthy development of the construction industry. As BIM applications in China enter the third stage and fully embrace the digital BIM era, digital buildings can boost the transformation and upgrading of the construction industry, enabling the successful application of BIM technology in every construction project.

BIM technology is also a crucial technology as the construction industry advances into the information age. It is an important means for professionals in construction cost, project management, and civil engineering to embody the "craftsman spirit," reflecting the basic technical requirements for "craftsmen" in the information age. The BIM Technology Application course aims to cultivate engineers with the qualities, spirit, and sentiment of master craftsmen from major countries, contributing to the development of BIM technology.

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