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Research on the Teaching Reform of "Engineering Mechanics" Course Based on BIM Technology

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Abstract: With the rapid development of science and technology, BIM technology has been widely used in the civil engineering industry and has become an important tool to promote the progress of the industry. However, colleges and universities still face many challenges in the teaching of engineering mechanics, such as the disconnect between theory and practice, and the lack of students' practical innovation ability. Therefore, this paper proposes to integrate BIM technology into the teaching reform of Engineering Mechanics and establish a BIM virtual teaching and research room to realize the sharing and optimization of teaching resources, to improve teachers' teaching level and students' practical ability [1]. Specifically, this paper first analyzes the teaching problems of "Engineering Mechanics" based on BIM virtual teaching and research room and puts forward corresponding teaching reform strategies, aiming to promote the continuous improvement and innovation of Engineering Mechanics instruction.

Keywords: BIM technology; Engineering Mechanics; Course teaching; Teaching reform

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1. Introduction

BIM technology, with its powerful spatial performance and visual rendering capabilities, has brought revolutionary changes to the field of civil engineering. Integrating BIM technology into the teaching reform of the Engineering Mechanics course can make students better adapt to the needs of future industry development. BIM virtual teaching and research room, as a new form of teaching organization enabled by BIM technology, breaks the restrictions of traditional teaching and research rooms thus can dynamically organize professional teachers and enterprise engineers from different regions and schools to jointly carry out collaborative teaching research and reform practice. Through this platform, teachers can share teaching resources, exchange teaching experiences, and discuss teaching methods to improve their teaching level. Students can also have access to more engineering cases and practice opportunities to improve their practical ability and innovation [2]. Therefore, based on the construction and application of BIM virtual teaching and research room, it is of certain

practical significance to discuss the problems and paths of teaching reform of Engineering Mechanics course.

2. Teaching problems of Engineering Mechanics course based on BIM virtual teaching and research room

2.1. Insufficient popularization and application of BIM technology

First of all, technical cognitive impairment. Although the application of BIM technology in the construction industry has become more and more mature, its popularity is still insufficient in the field of education, especially in the teaching of Engineering Mechanics in higher education. This is mainly due to the limitations of teachers' cognition of BIM technology. Some teachers may have insufficient understanding of the potential of BIM technology due to factors such as age, professional background or technical acceptance, and lack of enthusiasm for active learning and application. Secondly, the lack of technical training and support system. The mastering of BIM technology requires systematic study and practice, but at present, many universities have insufficient investment in BIM technology training, and lack systematic training plans and continuous technical support systems. As a result, even if teachers are willing to learn BIM, they still face problems such as lack of learning resources and unclear learning paths, and it is difficult to effectively master and apply BIM in teaching. In addition, the hardware and software facilities do not match. The application of BIM technology relies on high-performance computer hardware and professional software support. However, some universities have difficulty meeting the hardware requirements of BIM teaching due to financial constraints or uneven resource distribution. As a result, even if some teachers have mastered BIM technology, it is difficult to give full play to its role in actual teaching.

2.2. Imperfect integration and sharing mechanism of teaching resources

First of all, the resources are scattered and fragmented. In the construction process of the BIM virtual teaching and research room, due to the lack of unified standards and platforms, teaching resources are often scattered, and it is difficult to form a systematic knowledge system. At the same time, the teaching resources developed by different teachers according to their understanding and experience have the problems of duplicate content and uneven quality, which is not conducive to the efficient learning of students and the communication and cooperation between teachers. Secondly, the issue of intellectual property rights and profit distribution. The integration and sharing of teaching resources also face the challenge of intellectual property protection and benefit distribution [3]. The creation of teaching resources such as BIM model and case base often requires a lot of time and energy, but the existing intellectual property system is not clear about the protection of teaching resources, coupled with the lack of reasonable benefit distribution mechanism, which affects the enthusiasm of teachers to share resources. In addition, the capacity of platform construction and maintenance is insufficient. Effective resource integration and sharing requires an information platform with complete functions and easy operation as support [4]. However, many universities lack professional technical support in the construction of BIM virtual teaching and research room platforms, resulting in a single function of the platform and poor user experience, which is difficult to meet the teaching needs. At the same time, the maintenance and update of the platform is also a big problem, which requires continuous capital and technical investment.

2.3. The teaching content of the course is out of line with the actual demand

First, theory and practice are not closely integrated. Engineering Mechanics is a discipline that closely

combines theory and practice, but traditional teaching tends to emphasize the teaching of theoretical knowledge and neglect the cultivation of practical operation ability. Although BIM technology provides the possibility of transforming theoretical knowledge into practical operation, in actual teaching, it is often difficult for students to apply the knowledge to solve practical problems because of unreasonable course content design and lack of practice links. Secondly, the integration of cutting-edge technology in the industry is insufficient. With the continuous progress of construction technology, BIM technology is constantly updated and iterated, but the teaching content often lags behind the development of the industry and fails to introduce the latest BIM technology and industry standards promptly. This makes it difficult for students to adapt to changes in the industry after graduation, affecting their employment competitiveness. In addition, interdisciplinary integration is low. Engineering Mechanics is closely related to many disciplines such as civil engineering, architecture, and computer science, but in actual teaching, interdisciplinary knowledge integration is often lacking, resulting in a narrow range of students' knowledge and difficulty in forming a comprehensive professional vision and comprehensive ability [5].

2.4. The teaching mode and teaching method lag

First of all, the shackles of traditional teaching mode. For a long time, the traditional teaching mode based on lecturing has occupied a dominant position in the teaching of Engineering Mechanics. Although this mode is conducive to the teaching of systematic knowledge, it ignores the main learning position of students and makes it difficult to stimulate their learning interest and initiative. Although the construction of BIM virtual teaching and research room provides a new model of online and offline mixed teaching, in practice, many teachers are still accustomed to the traditional teaching methods and fail to make full use of the advantages of BIM technology. Secondly, the lack of innovative teaching methods [6]. The introduction of BIM technology provides abundant teaching resources and means for the teaching of Engineering Mechanics, such as 3D model display, virtual simulation experiment, etc. However, the application of these innovative teaching methods is still insufficient in the current teaching. Teachers often lack effective exploration and practice of new methods, which leads to limited improvement of teaching effect. In addition, the evaluation system is unitary [7]. The traditional teaching evaluation system mainly focuses on test scores and neglects comprehensive evaluation of students' ability, innovative thinking, and teamwork. In the environment of BIM virtual teaching and research rooms, a more diversified and process-based evaluation system should be built to comprehensively reflect students' learning outcomes and comprehensive abilities.

3. The teaching reform strategy of Engineering Mechanics based on BIM virtual teaching and research room

3.1. Construct BIM virtual teaching and research room and optimize the allocation of teaching resources

Building BIM virtual teaching and research room platform is the basis for realizing the teaching reform of the Engineering Mechanics course. First of all, it is necessary to build a functional virtual teaching and research room platform, which should have the following functions: First, teaching resources sharing. Through the platform, teachers can upload and share BIM-related teaching resources, such as teaching cases, model libraries, teaching videos, etc., and students can access and learn anytime and anywhere. Second, online communication and collaboration. The platform should provide online communication tools, such as chat rooms, forums,

etc., to facilitate real-time communication and collaboration between teachers and students to solve problems encountered in the learning process. Third, virtual experiment environment. Using BIM technology to build a virtual experiment environment, students can carry out mechanical experiments in the virtual environment, observe and analyze the experimental results, and improve practical ability. Fourth, personalized learning path. The platform should provide personalized learning paths and suggestions according to students' learning progress and ability level to help students better grasp engineering mechanics knowledge. It should be noted that in the process of building the BIM virtual teaching and research room platform, firstly, it is necessary to ensure the stability and security of the platform. The platform should have high stability and security and be able to resist risks such as network attacks and data leaks. Secondly, the ease of use and user experience of the platform should be emphasized. The platform interface should be simple and clear, easy to operate, and convenient for students and teachers to use. In addition, the maintenance and update of the platform should be strengthened. Maintaining and updating the platform regularly should ensure that its functions are perfect and keep pace with the times.

3.2. Strengthen curriculum integration and improve curriculum teaching quality

Under the application of BIM virtual teaching and research room, teachers should make full use of the characteristics of visualization, simulation, coordination and optimization of BIM technology, further strengthen the in-depth integration and optimization of Engineering Mechanics course content, delete redundant and outdated content, and add content closely related to practical application, to improve teaching quality. First of all, in the theoretical explanation, teachers can build 3D models with the help of BIM technology and display abstract mechanics concepts such as stress, strain, and bending moment with intuitive 3D graphics to help students better understand and master these concepts. At the same time, through the simulation characteristics of BIM, teachers can simulate a variety of mechanical experiments, such as beam bending experiment, column compression experiment, etc., so that students can carry out experimental operations in a virtual environment, observe and analyze the experimental results, to deepen the understanding of mechanics principles [8]. Secondly, in the selection of teaching content, teachers should pay attention to practicability and cutting-edge. For example, the latest engineering cases can be introduced, such as the structural design of high-rise buildings, mechanical analysis of large Bridges, etc., and these cases can be combined with the course content of Engineering Mechanics so that students can understand the application of mechanical knowledge in practical engineering. At the same time, teachers can also combine the latest scientific research results and technological progress, such as the application of new materials, structural optimization design, etc., to update the teaching content and improve the practicability and cutting-edge nature of the course. In addition, to stimulate students' interest and enthusiasm in learning, teachers can also add interactive links and interesting elements [9]. For example, some interactive games or challenging tasks based on BIM technology can be designed so that students can learn and master mechanics knowledge in the games. At the same time, teachers can also organize students to have group discussions or team collaboration, model construction and analysis through the BIM platform, and cultivate students' teamwork ability and innovative thinking [10].

3.3. Implement project-based learning to cultivate students' practical ability

Project-based learning is a student-centered teaching method that cultivates students' practical ability and innovation ability by solving problems in real projects. In the BIM virtual teaching and research room, project-

based learning can be implemented so that students can learn and master engineering mechanics knowledge in the process of completing projects. In the concrete implementation, first of all, teachers should combine the content and objectives of the Engineering Mechanics course to determine the theme and objectives of the project [11]. The theme and objective of the project should be compatible with the students' actual levels and abilities and be feasible and practical. For example, a specific building structure can be selected as a research object to analyze its mechanical properties and optimize design methods. Secondly, teachers can divide students into several groups, and each group is responsible for a specific project task. In this process, the teacher should let the members of the group divide the labor and make clear the responsibilities and tasks of each student. At the same time, teachers should strengthen the process of management and guidance, and find and solve the problems and difficulties encountered by students. Moreover, teachers can encourage students to use BIM technology for project design and analysis, including the establishment of three-dimensional models, mechanical analysis, and optimization of design schemes. After the students complete the project, the teacher should also organize the students to display and report the results. By evaluating students' project results and performance, teachers should understand students' learning situations and existing problems and provide targeted feedback and suggestions to help students constantly improve and improve [12].

3.4. To carry out blended teaching and improve the efficiency of curriculum teaching

Blended teaching is a teaching mode that combines online teaching and offline teaching. In the teaching of Engineering Mechanics, teachers can make full use of the convenience of online resources and the interactive advantage of offline teaching to improve the teaching effect. Based on the BIM virtual teaching and research room, teachers can make use of its technical advantages to realize the organic combination of online independent learning and offline interactive communication [13]. First of all, in the online self-learning process, students can self-study through the BIM virtual teaching and research room platform, including watching teaching videos, reading teaching materials, and completing online tests. Teachers can provide personalized learning paths and suggestions according to students' learning progress and ability level. In offline interaction and communication, teachers can regularly organize offline communication activities, such as classroom discussions, experiment operations, project reports, etc., so that students can have face-to-face communication and interaction. Through offline activities, teachers can have a deep understanding of students' learning situations and existing problems to provide targeted guidance and improvement. In the process of carrying out blended teaching, it is necessary to pay attention to the following points: First, online resources should cover all knowledge points and skills of Engineering Mechanics, including teaching videos, teaching cases, online tests, etc., to ensure the richness and diversity of online resources. Secondly, offline activities should be highly interactive and participatory to stimulate students' learning interest and enthusiasm. Third, coordination and coherence between online self-learning and offline interaction should be ensured to avoid disconnection and duplication [14].

4. Conclusion

With the rapid development of information technology, BIM technology is increasingly widely used in the field of education, which brings new opportunities and challenges to the teaching of engineering mechanics. As a new teaching mode, BIM virtual teaching and research rooms provide students with a more abundant,

intuitive, and interactive learning experience by integrating information technology and teaching resources [15]. Engineering Mechanics, as one of the important courses for architectural engineering majors, applies BIM virtual teaching and research room in its teaching. Teachers can explore teaching reform paths from the perspectives of building BIM virtual teaching and research rooms, strengthening curriculum integration, implementing project-based learning, and carrying out blended teaching, effectively improving teaching quality and efficiency and promoting curriculum teaching reform.

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