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Project Construction Organization and Management Exploring Teaching Reform in Smart Classrooms

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Abstract: *To meet the modern requirements of education, the author conducted a Smart Classroom reform study on Project Construction Organization and Management teaching using online educational resources and modern information technology. This article discusses a series of changes in resources, subjects, and ideas brought about by the reform of smart classroom education, and summarizes the implementation effects of the reform in cultivating new engineering talents through high-quality education and teaching.*

Keywords: *Project Construction Organization and Management; Smart Classroom; Teaching Reform; Education innovation*

1. Introduction

In May 2020, the Ministry of Education issued the "Guidelines for the Construction of Future Technology Colleges (Trial)", which is a further implementation of the New Engineering Research and Practice proposed in 2017. In order to explore the substantive compound cross-disciplinary cooperation laws of professional disciplines, cultivate future technological innovation leaders, and further enhance the promotion of scientific and technological power to social development. With the rapid development of IoT and artificial intelligence technology, smart buildings will become a trend. Future buildings must have a certain degree of automation, such as intelligent lighting, intelligent temperature control, facial recognition access control, etc. Zhonglian Heavy Industry's smart construction site, China's Panzhihua Dalian Expressway construction, Shandong Expressway's "Six Types of Mountain High" construction, and unmanned construction are all emerging in the engineering field.

Adjusting economic and energy structures can not only improve the level of economic development but also reduce pollution emissions. The harmonious development between humans and nature is a necessary path for domestic development. Ultra-low energy consumption buildings are the basis and necessary conditions for achieving carbon neutrality. The current teaching system of architectural design in universities barely covers the basic green building standards[1].

2. The Current Status of Classroom Teaching

2.1 The current state of teaching core courses in engineering majors at Abroad

There are various teaching models for core courses in engineering majors in foreign countries. One such model is Competency-based Education and Training (CBET), which is mainly promoted in the UK and Australia. The aim of this model is to enhance students' engineering and technical abilities, as well as their life skills, with a focus on outcomes and holistic development[2]. Another teaching model for core courses in engineering majors in foreign countries is the Competency-based Education and Training (CBET), which originated from the United States[3].

With the development of technology, new engineering talent training models have emerged in foreign higher engineering education driven by industrial transformation. Among them, the CDIO (Conceive, Design, Implement, Operate) engineering education model and OBE (Outcome-based Education) model are representative. The CDIO model aims to cultivate engineering talents with engineering qualities and engineering application abilities required by the industry through the four stages of conceiving, designing, implementing, and operating. The OBE philosophy takes student learning outcomes as the educational goal, promotes the transformation of the educational model, and advocates a shift from content-oriented

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to student-oriented[4].

2.2 Analysis of Curriculum Reform for Project Construction Organization and Management at Home

Passive learning is prevalent. Students rely on the final exam review week in order to graduate smoothly. Classroom participation and enthusiasm are low, while knowledge acquisition is poor, making it difficult to form a sound knowledge system.

Teaching content is outdated. The difficulty of writing university textbooks is high, and reviewing them takes a lot of time. In modern society where things are changing rapidly, it is difficult for textbook content to keep up with social development.

Insufficient use of Internet knowledge. New technologies are emerging, and knowledge systems are constantly being updated. The rise of MOOCs and flipped classrooms provides better resources for cultivating new engineering talents. The linkage between classroom teaching and Internet knowledge not only expands students' knowledge access but also greatly improves their comprehensive quality [5].

Meeting industry needs and market demand for cultivating technical and research talents requires universities to keep pace with the teaching content. Relevant surveys show that by 2025, there will be a shortage of 5 million talents in China who can design, construct, and manage digital engineering projects. Solving the problem of digital engineering talent cultivation is an urgent task in teaching[6].

Tian Qiong, from Hunan University of Science and Technology, pointed out that the Teaching Reform curriculum should introduce advanced international engineering education concepts, implement "new", "practical" and "integrative" teaching methods to meet the needs of the development of new engineering disciplines and cultivate high-quality applied talents[7]. Zhao Guoguang from the School of Architecture and Engineering at Qingdao Huanghai University proposed relying on BIM technology for curriculum reform, achieving the combination of theory and practice to achieve expected teaching results[8].

3. The concept and reform of Smart Classroom

3.1 The concept of Smart Classroom reform

Smart Classroom is an upgraded transformation of the flipped classroom under the concept of intelligent education[9]. It expands the classroom to an online environment and extends it beyond class hours. This will enable students to participate in independent learning and research through teacher led classroom guidance. This method aims to improve students' independent learning ability, integrate classroom teaching with social development, utilize internet resources, and cultivate engineering talents who meet social needs[10].

3.2 The reform of smart classroom innovation

The focus of Smart Classroom teaching is to integrate Internet resources, mobilize students' independent learning ability, enhance classroom vitality, transform teaching into curiosity, and make students the main body of the classroom.

3.2.1 Comprehensive utilization of Internet platform resources

Flipped classroom micro-lessons, which provide teaching resources in the form of short videos, often result in incomplete knowledge systems, lack of focus on key points, and insufficient opportunities for teaching interaction. The reform of Smart Classroom leverages internet-enabled interaction to achieve teacher-student collaboration. Teachers can use the teaching platform to assign homework and guide students' learning direction. Students can overcome learning obstacles through online interactions, thereby improving learning efficiency, thus achieving a linkage between in-class and out-of-class learning.

3.2.2 Shift in the subject of the classroom

Smart Classroom has shifted the role of learning from the traditional teacher-led approach to a more student-initiated approach. In traditional teaching methods, student participation is often low and limited to rote memorization. Driven by a test-oriented mindset, students focus on their scores rather than actively engaging in class. The classroom becomes a one-man show for the teacher, with students not knowing what the lesson is about. After the reform, midterm and final grades are valued equally to

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encourage active participation and achieving academic goals. Students are encouraged to participate in class to accomplish their educational objectives. As a result of these changes, student enthusiasm and engagement in learning have increased.

3.2.3 The transformation of teaching ideology

The reform of the smart classroom shifts the teaching ideology from the teacher's consideration of whether the classroom content is substantial to the student's consideration of whether the classroom performance is excellent. It liberates teachers from the heavy burden of the classroom, transforms teaching into guidance, and allows the classroom to become a stage for students. Smart teaching will trigger a qualitative change in students' thirst for knowledge. In the trend of globalization, classroom teaching cannot stop at the transmission of outdated textbooks. New technologies and industries urge the transformation of talent training. Pure engineering knowledge cannot meet the competitive ability of engineering talents in the market. The teaching ideology is about to be reborn.

3.2.4 The transformation of teacher teaching

Teachers are no longer simply delivering lectures on traditional textbooks and coordinating with final exams. Instead, education and teaching are shifting towards modernization and informatization, guiding students to better absorb and apply professional knowledge. It integrates the cultivation of talents in new engineering disciplines from six dimensions [as shown in the figure 1], aiming to enhance the comprehensive abilities of engineering professionals.

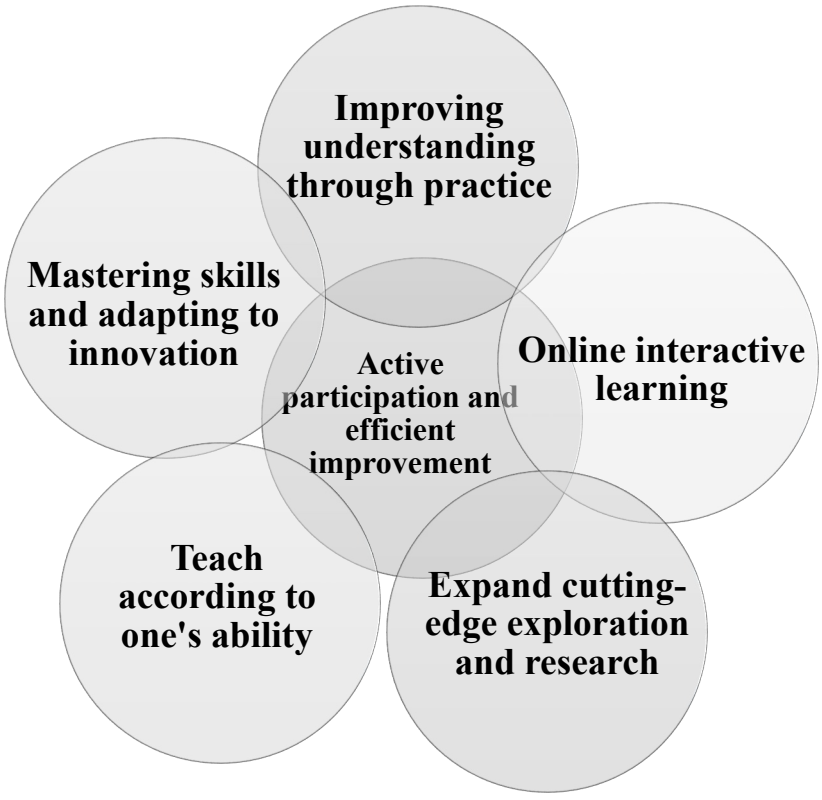

Figure 1 New engineering disciplines from six dimensions

4. The application and advantages of Smart Classroom reform in project construction organization and management

4.1 Innovative Teaching Methods

In situations where traditional laboratory equipment and material costs are expensive, using the Smart Classroom platform to simulate experimental environments has a strong sense of reality and participation, while also greatly reducing related expenditure. For example, in the direction of engineering construction,

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for high-risk technical equipment operations such as deep foundation pit excavation and tunnel construction, virtual reality technology can be used to better demonstrate the construction of various structures to students.

4.2 Increased Interaction and Communication

Through online classroom communication, question-and-answer sessions, and group cooperation inquiries, teachers can encourage interaction and communication between teachers and students, promote critical thinking skills and professionalism among students, and effectively activate students' educational and healthy ecosystem.

4.3 Data Monitoring and Evaluation

The Smart Classroom platform supports data monitoring and evaluation of students' learning conditions, collecting statistics on students' learning records, including knowledge point score rates, test-taking time, and the volume of work, which help teachers to understand students' learning situations and adjust teaching strategies in a timely manner to enhance teaching quality. For core knowledge in the profession, teachers can adjust classroom content and difficulty in a timely manner based on students' learning situations.

4.4 Project Construction Organization and Management Exploring Teaching Reform in Smart Classrooms Relative Advantages of Reform

Smart classrooms connect excellent educational resources from different regions, schools, and even countries, achieving the sharing of educational resources worldwide and fully utilizing the advantages of human educational resources. It cultivates students' internet literacy and promotes the continuous development of modern education. In smart classroom teaching, learning can be compared to a game, allowing students to acquire knowledge in the game and enhancing their interest and potential in such an interactive environment. the Comparison between Smart Classroom and Traditional Classroom is as shown in the figure 2.

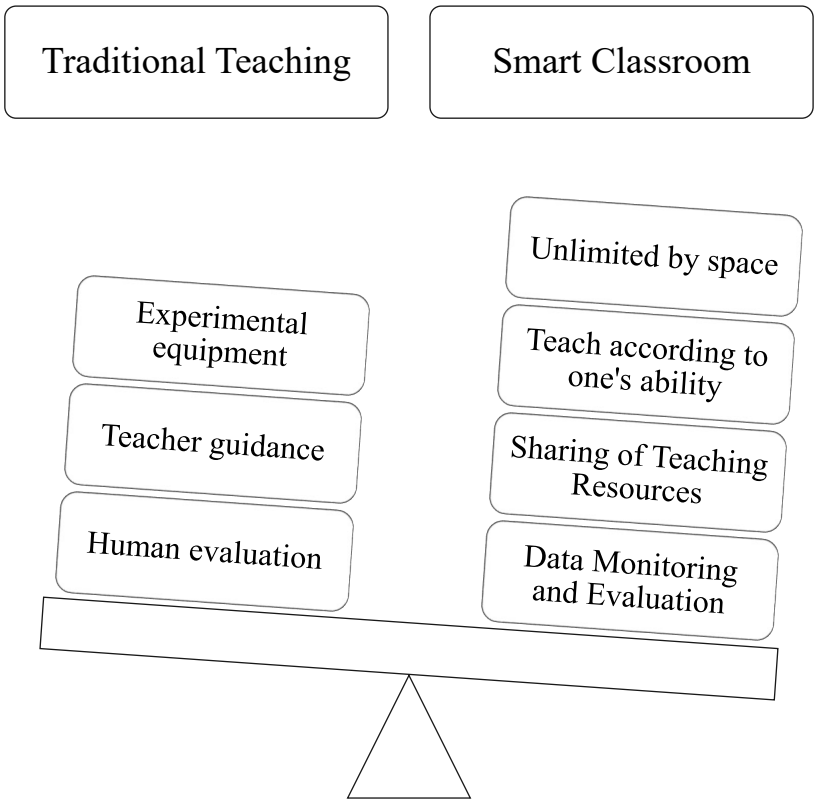

Figure 2 Comparison between Smart Classroom and Traditional Classroom

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5. Project Construction Organization and Management Exploring Teaching Reform in Smart Classrooms Case Study

5.1 Reform Measures

1) Adjustment of teaching content. Through a thorough analysis, decomposition and supplementation of the knowledge points and cases involved in the Project Construction Organization and Management course, the theoretical knowledge of the course is integrated into practical projects, stimulating students' enthusiasm and motivation for learning.

2) Introduction of online teaching platforms. By introducing online teaching platforms and prioritizing digital and mobile advantages, the Yangtze River Rain Classroom is used to establish better two-way communication between teachers and students, truly achieving networked teaching.

3) Enhanced practical operations. Some practical courses are added to the teaching plan, such as using BIM technology to implement 2D layouts in 3D, establishing two-person groups, and specifying standard requirements. It is reasonable to further consolidate and deepen one's knowledge through practice.

4) Expand teaching methods. By using different forms of homework and strengthening classroom tests, students' learning status and ability growth can be improved, and teachers' explanations can be enriched to balance student interaction. This method greatly shortens the traditional time arrangement and learning cycle related to the course, and improves learning efficiency. Figure 3 shows students sharing their thematic learning experiences.

Figure 3 Students sharing their thematic learning experiences

5.2 Teaching Data Analysis

Based on the overall evaluation of students' teaching of this course, final exam scores and other indicators, the new teaching model can indeed have higher utility in promoting student growth compared to traditional models.

5.2.1 Evaluation Standards for the "Whole Process" of Education and Teaching

1) Online communication in "Rain Classroom" (10%): This part of the grades will be evaluated based on students' self-study records and online Q&A records on the course teaching platform.

2) Seminar-style homework (20%): Seminar-style homework is posted on the course teaching platform from the beginning of the course, including mandatory and elective options. Students are required to study and summarize relevant literature in the form of themes and submit PowerPoint presentations on the teaching platform. Several students with representative works are selected for classroom display and exchange. Homework grades are evaluated based on the innovation and logic of the content, the clarity and standardization of editing and arrangement, and the effectiveness of the PowerPoint production, and students selected for classroom display and exchange are awarded additional bonus points.

3) Course internship (20%): The teacher will comprehensively evaluate the performance of off-

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campus course internships based on the students' internship summary reports, diary, and attendance records.

4) Final exam (50%): A traditional closed-book exam is used, but the exam content focuses more of the knowledge points, with comprehensive engineering case analysis questions accounting for no less than 70%.

The summary of evaluation criteria is shown in Figure 4.

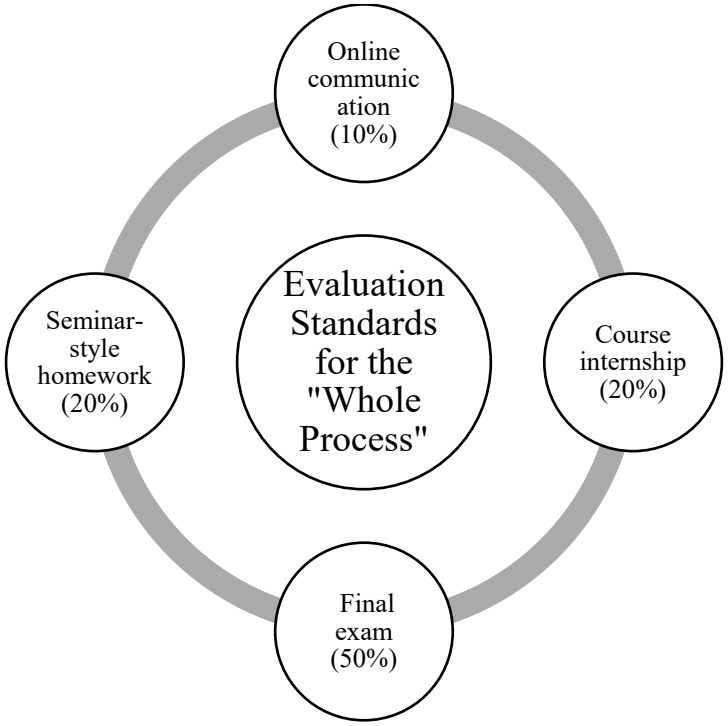

Figure 4 Evaluation criteria for the entire process

5.2.2 Summary of Teaching Effectiveness:

Analyzing four years of teaching data, it can be found that students' enthusiasm, initiative, and independent analytical skills have improved significantly. The Smart Classroom teaching model has been widely recognized and accepted by students. At the same time, students' learning purposes have also significantly improved, and practical abilities have been enhanced, mainly manifested in the quality of students' seminar-style homework and reports and course internships. Students' comprehensive scores have been significantly improved.

6. Summary and Prospect

6.1 Effect summary of Project Construction Organization and Management Exploring Teaching Reform in Smart Classrooms

Smart Classroom teaching greatly enhances students' exposure to modern technology and weakens the negative impact of textbook updates on education and teaching with lower resource costs, thus enhancing the progress of cultivating modern engineering talents.

Adhering to the basic principle that talent is the first in the field of Project Construction Organization and Management to participate in the reform, and having a high-quality teaching staff to better promote the smooth implementation of the Smart Classroom reform. Smart Classroom reform is a complex project that requires time to gradually realize, and it is not possible to achieve a perfect state in a short period of time. In the implementation process, we should strengthen evaluation and adjustment, pay attention to feedback and suggestions from teachers and students, and timely optimize and adjust the mode, thereby promoting the deep development of the reform and creating more good results.

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6.2 Prospect of cultivating excellent engineering education

With the rapid development of information technology and big data, excellent engineering education in the future needs to have strong information technology and data analysis capabilities and collaborate in fields such as data science and mathematical modeling. Future education should increase the comprehensive training of digital technology, introduce efficient teaching resources through multiple channels to promote curriculum reform, and guide students to have a comprehensive understanding and proficient application of new technologies such as big data, the Internet, 5G IoT technology, etc.

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