Scientific Research Publishing

Open Journal of Social Sciences, 2025, 13(1), 390-399
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Construction of Virtual Simulation Practice Base Based on Cross-Cutting Teaching: A Case Study of the Engineering Management Major at Jiangxi Normal University

Zhangsheng Liu, Shuiwu Zhu

College of City Construction, Jiangxi Normal University, Nanchang, China
Email: xiaoliu8033@126.com

How to cite this paper: Liu, Z. S., & Zhu, S. W. (2025). Construction of Virtual Simulation Practice Base Based on Cross-Cutting Teaching: A Case Study of the Engineering Management Major at Jiangxi Normal University. *Open Journal of Social Sciences, 13,* 390-399.
https://doi.org/10.4236/jss.2025.131024

Received: November 4, 2024
Accepted: January 24, 2025
Published: January 27, 2025

Abstract

The rapid development of virtual simulation experimental teaching in education has raised higher requirements for the construction of practice bases, especially in the context of the integration of industry and education in the new era. Taking the Engineering Management program at Jiangxi Normal University as an example, this paper addresses issues in engineering management practice teaching, such as the lack of a close connection between theory and practice and the fragmentation of teaching content. Based on cross-cutting teaching case, this paper explores the feasibility of constructing an intelligent construction virtual simulation practice base to develop highly skilled professionals suited to the evolving needs of the construction industry. Results demonstrate that this approach reinforces development efforts across three dimensions: talent development, disciplinary teaching and research, and collaboration between academia and industry. Through measures in optimizing talent development, building the practice base, and innovating teaching methods, the content and structure of the practice base were enriched, resulting in notable improvements in teaching effectiveness and receiving broad recognition from both internal and external stakeholders. These research findings provide innovative insights into the reform of intelligent construction practice teaching and valuable guidance for advancing new engineering discipline development.

Keywords

Virtual Simulation, Cross-Cutting Teaching, Practice Base Construction, Industry-Teaching Integration

1. Introduction

Since the concept of "virtual experiment" (Tian & Meng, 2017) was introduced, virtual simulation experiment teaching has gained popularity among foreign universities due to its unique advantages in simulating real scenarios, overcoming time and space constraints, avoiding operational risks, and improving teaching outcomes (Hou et al., 2022). The Ministry of Education of China issued the Notice for the Construction of National Virtual Simulation Experimental Teaching Centre and the Notice for the Construction of Demonstration Virtual Simulation Experimental Teaching Project from 2017 to 2020 in 2013 and 2017 respectively. Influenced by the policy, major universities in China have combined their own advantages and professional characteristics to carry out the construction of virtual simulation experimental teaching canters (platforms), which has greatly promoted the application and development of virtual simulation experimental teaching in the field of education in China (See **Figure 1** for details).

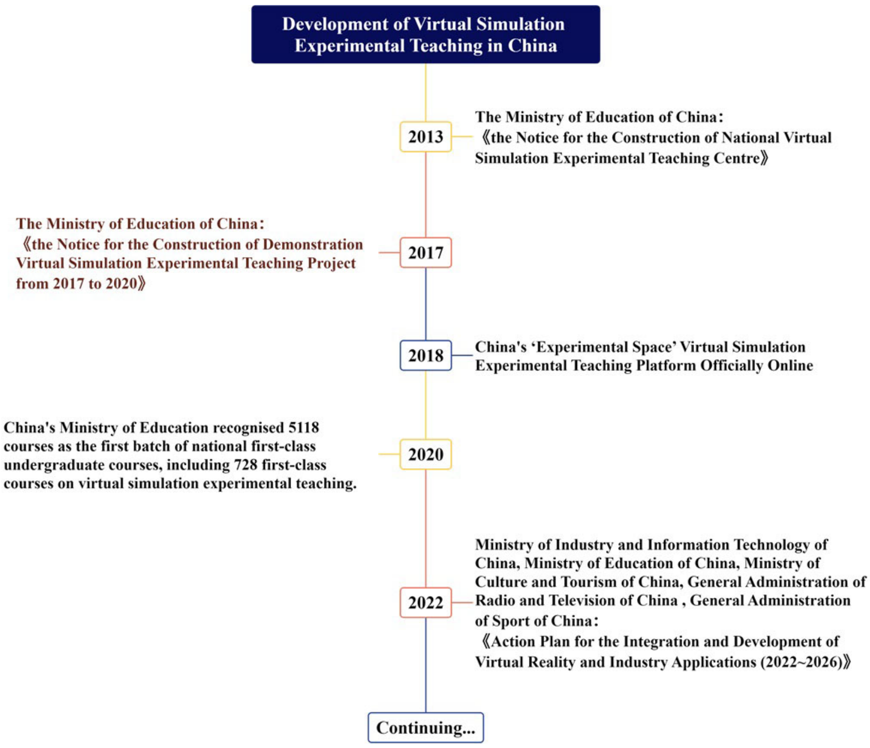

Figure 1. Development of virtual simulation experimental teaching in China.

In this regard, Chinese scholars have carried out a lot of exploration and achieved fruitful results. Existing research indicates that virtual simulation experimental teaching in China has evolved from focusing on process-oriented industrial simulations to gradually supporting the development paths (Zhang & Li, 2024) of emerging disciplines (Lv et al., 2019; Lun & Li, 2016), including new engineering (Wang et al., 2019; Wu et al., 2021), new medicine (Lian et al., 2023), new liberal arts (Jia & Li, 2022; Xue et al., 2022), and new agriculture. Initially, engineering disciplines were predominantly represented, but now engineering remains dominant while encompassing a wide range of fields, such as literature (Wang et al., 2021), Marxist theory (Xu, 2023; Zhang & Li, 2016), and the arts (Wang & Li, 2019). The methods of interaction have expanded from early mouse and keyboard interfaces to voice, VR, and AR interactions, and further to room-scale virtual simulation environments (Chen & Zhang, 2023). In terms of institutional engagement, local universities have shown greater involvement in national virtual simulation experimental teaching curriculum development, while high-ranking universities have not demonstrated a clear advantage in this area (Liu et al., 2024).

The Engineering Management program at Jiangxi Normal University originates from the Civil Engineering program of the former National Chung Cheng University. In 2022, it was ranked as a five-star program in Jiangxi Province and recognized as a distinctive program during the "14th Five-Year Plan" period. In the "2023 Shanghai Ranking of Chinese University Programs," it ranked 45th among 461 institutions offering this field, receiving an A rating. Since its establishment, the program has achieved notable educational outcomes, producing a substantial number of professionals for enterprises, public institutions, and government departments. Many graduates now serve as key personnel in their respective organizations. However, given the practical aspects of engineering management, including construction, implementation, and project oversight, the real-world environment presents significant risks. Practitioners are required to have strong and well-rounded competencies, such as risk management, teamwork, and project management capabilities. Due to limitations in time and space, existing engineering management education is largely theoretical, with fragmented content and some abstract concepts that are challenging to grasp, and offers minimal opportunities for hands-on practice. These constraints have significantly limited students' understanding of end-to-end project management in engineering contexts.

In recent years, fueled by rapid development of modern information technology such as 5G communication, big data, and artificial intelligence, virtual simulation experimental teaching has entered the "2.0" era. The Ministry of Education, in collaboration with multiple departments, jointly issued the "Action Plan for the Integration and Development of Virtual Reality and Industry Applications (2022-2026)", which further clarifies the direction for virtual simulation experimental teaching. Therefore, this paper takes the engineering management major of Jiangxi Normal University as an example, and explores the construction program of virtual simulation practice base based on the case of cross-cutting teaching, which is not only in line with the reality of the engineering management major of the university, but also in line with the development trend of the integration of industry and education in the future.

2. Main Issues Addressed and Work Objectives

2.1. Main Issues Addressed

By deepening the integration of industry and education, promoting the organic convergence of the education chain, talent chain and industry chain, and advancing the construction of intelligent construction virtual simulation practice bases based on cross-cutting teaching cases, it helps to consolidate students' professional knowledge, enhance their comprehensive ability, and cultivate high-quality talents adapted to the needs of the industrial development of the construction industry.

2.2. Work Objectives

(1) Forming project teams and optimizing practical teaching programs

In terms of the project team, firstly, a team will be established consisting of professors, associate professors, and lecturers with expertise in civil engineering, economics, and management, led by an experienced professor for overall planning and top-level design. Secondly, the educational philosophy of "prioritizing undergraduate education" will be further implemented through broad-based admissions to meet students' diverse developmental needs. Specifically, this approach aims to highlight the "four emphases": first, emphasis on developing well-rounded, highly skilled, and capable interdisciplinary talent; second, prioritizing diverse training standards and flexible training models; third, focusing on the reform strategy of "strengthening foundational knowledge, broadening professional scope, adapting education to individual needs, and implementing differentiated training paths"; and fourth, emphasizing a cooperative model of education that links resources inside and outside the university, integrating digital and industrial transformation into the program to optimize the talent cultivation system.

(2) Building practice platforms to optimize digital talent training

On the one hand, through university-enterprise cooperation and by leveraging digital technology, advanced internet technologies are employed to centrally store and manage knowledge content in a cloud-based backend. This setup uses the campus network and the Internet to establish a shared practical teaching resources platform to achieve resource sharing and effectively improve the efficiency of professional teaching and practical training. On the other hand, relying on the intelligent construction virtual simulation practice base based on cross-cutting teaching cases, professional knowledge is incorporated into virtual project operation and management practice teaching, and students' practical ability is cultivated through virtual process monitoring. At the same time, with the regular monitoring of practical teaching quality, standardized, consistent, and information-driven quality management in practical teaching is ensured. This process allows for the ongoing identification and improvement of challenges within the intelligent construction virtual simulation practice base developed through cross-cutting teaching.

3. Ideas and Main Initiatives for Reforming Practice

3.1. Ideas for Reforming Practice

This project focuses on the goal of cultivating intelligent construction talents, and comprehensively improves the effect of industry-academia collaborative education by continuously improving the project construction content and optimizing the implementation path.

3.2. Key Initiatives

This section delineates two pivotal initiatives: the enrichment of construction content and enhanced construction efforts (See Figure 2 for details). The former encompasses the optimization of training programs, reinforcement of base construction practices, and innovation in practical teaching methodologies. Concurrently, the enhanced construction efforts focus on three critical dimensions: strengthening team construction to elevate practical teaching quality, deepening discipline development for advancing teaching research, and fostering team development to ensure program quality assurance. These interconnected initiatives form a robust framework for educational advancement, establishing the foundation for subsequent detailed analysis and implementation strategies.

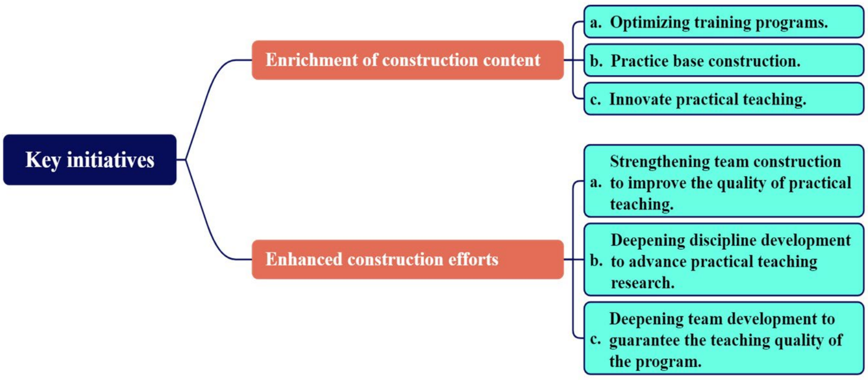

Figure 2. Key initiatives and their segmentation.

(1) Enrichment of construction content

a) Optimizing training programs. We will continue implementing the fundamentals-based education approach and address the diverse developmental needs of students through broad-category admissions. Specifically, this approach aims to reflect the "five emphases": first, emphasizing the foundational objective of developing well-rounded, high-quality, and capable interdisciplinary talent; second, promoting diverse training standards and flexible training methods; third, focusing on the reform strategy of "consolidating foundational knowledge, broadening disciplinary fields, adapting teaching to individual needs, and implementing differentiated pathways"; fourth, emphasizing the coordinated operation of internal and external resources to establish a multidimensional, specialized, open, and integrated talent cultivation system; and fifth, stressing the organic integration of classroom instruction and practical training in talent development.

b) Practice base construction. We will develop practical training bases focused on intelligent construction, incorporating modules in intelligent design, intelligent production, smart construction, and new-generation information technology.

Each of these modules will be enhanced with BIM series teaching software.

c) Innovate practical teaching. By conducting internal discussions within the teaching and research department and inviting guidance from experts on the Ministry of Education's Education Instruction Committee and the Ministry of Housing and Construction's Professional Evaluation Committee, we will continuously enrich the "three-stage and four-integration" practical teaching model. This includes deepening the school-university and school-enterprise cooperative models in talent development and further enhancing the intelligent construction virtual simulation practice base, grounded in an integrated case-based teaching approach.

(2) Enhanced construction efforts

a) Strengthening team construction to improve the quality of practical teaching. On one hand, it has actively introduced talents in recent years, doctoral recruits from Huazhong University of Science and Technology, Tongji University and Zhejiang University. Additionally, it has made use of the university's doctoral degree resources to increase the number of doctoral degree students.

b) Deepening discipline development to advance practical teaching research. Research is focused on the construction of intelligent construction virtual simulation practice base based on cross-cutting teaching cases, strengthening the construction of academic team and condense the characteristics. Through academic collaboration, we aim to cultivate new academic backbone of teaching research and strive to achieve greater breakthroughs in the establishment of teaching reform projects.

c) Deepening team development to guarantee the teaching quality of the program. On the one hand, we will continue to strengthen the construction of the existing teaching team and form their own characteristics and highlights; on the other hand, through the selection and recruitment of off-campus tutors and university-enterprise co-operation, we aim to achieve the coordinated development of scientific research and teaching and to promote the practical teaching by scientific research.

4. Features and Innovations

4.1. Strengthening Digital Technology Training and Achieving Deeper Integration between Industry and Academia

Currently, at the construction level, Building Information Modelling (BIM) uses Internet technology to computerize the Internet of Things (IoT) for building construction, thus enabling building design teams to collaborate on online design directly through the Internet on the BIM platform. However, for post-operation, BIM does not allow for the management of already formed buildings. Therefore, through developing a practice base centered on integrated case studies around modules such as intelligent design, intelligent production, intelligent construction, and next-generation information technology, students can acquire relevant digital skills. This approach helps train students in smart project operation and management and strengthens their comprehensive skill set.

4.2. Enhancing Digital Operation Capability and Opening up the Boundaries of Industry-Academia Integration

By introducing digital technology to simulate project construction and management, we can establish a new hybrid teaching model that integrates online and offline methods. By using the platform to simulate building material and process data, students can master data analysis methods and techniques, adding depth and breadth to the teaching process. This approach also helps to broaden the scope of industry-academia integration.

5. Effectiveness of Practice, Promotion and Application, and Internal and External Evaluation

This section examines three fundamental dimensions: practical effects, promotion and application strategies, and evaluation systems spanning both internal and external contexts (See Figure 3 for details). The practical effects manifest through the integration of practice platforms, enhancement of teaching-research synergy, and the orchestration of student competitions. In terms of promotion and application, the framework encompasses the formation of construction programs, revision of practical syllabi, and declaration of national-level projects. Furthermore, the evaluation mechanism incorporates both in-school and out-of-school metrics, characterized by positive student feedback, peer evaluation excellence, and significant achievement benchmarks. This tripartite evaluation structure provides a systematic foundation for assessing the efficacy of educational initiatives and their broader impact on pedagogical advancement.

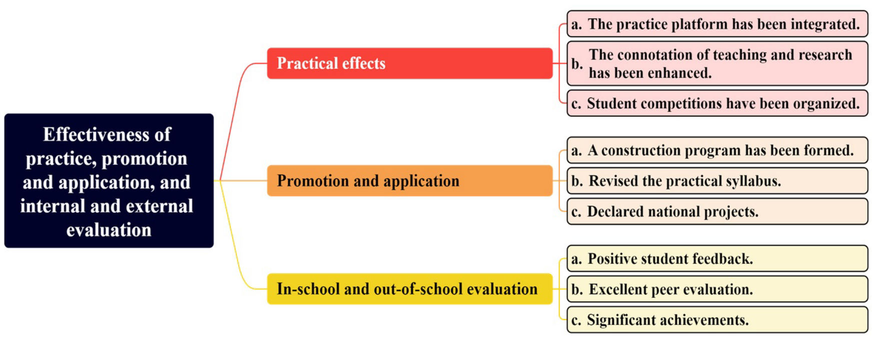

Figure 3. Effectiveness of practice, promotion and application, and internal and external evaluation.

5.1. Practical Effects

(1) The practice platform has been integrated

According to the construction program, intelligent construction supporting software for modules such as intelligent design, intelligent production, intelligent construction and new generation of information technology foundation are supplemented, and the construction of an intelligent construction virtual simulation practice base based on the penetrating teaching case is initially formed.

(2) The connotation of teaching and research has been enhanced

Eight scientific research projects on teaching reform were approved, and seven papers on teaching reform were published.

(3) Student competitions have been organized

Senior students were encouraged to participate in relevant competitions, earning 17 national awards over the past three years, further demonstrating the educational impact of the smart construction virtual simulation practice base established through integrated case-based teaching.

5.2. Promotion and Application

(1) A construction program has been formed

Around the basic teaching system (i.e., the school's basic resource teaching system, the simulation reality teaching system and the university-enterprise practice teaching system), a program was formed for the construction of a virtual simulation practice base for intelligent construction based on the cross-cutting teaching case.

(2) Revised the practical syllabus

The practical syllabus was revised by sorting out the problems in practical teaching and taking into account the characteristics of the engineering management profession.

(3) Declared national projects

In the past three years, six industry-academia collaborative education projects have been approved by the Ministry of Education, and two are being declared.

5.3. In-School and Out-of-School Evaluation

(1) Positive student feedback

Student evaluations are conducted annually on practical teaching, and the latest evaluation found that 95 percent of students highly approved of the practical teaching of the program, an increase of 1.2 percentage points over the previous period.

(2) Excellent peer evaluation

In the past three years, seven courses achieved provincial first-class course recognition, and eight provincial teaching reform projects were approved.

(3) Significant achievements

Over the past three years, the program has received five provincial awards, three first-place school-level teaching achievement awards, and students have earned four national awards, including "Internet+" and Challenge Cup, along with 17 other national awards and over 300 provincial awards.

6. Conclusion

Virtual simulation experimental teaching, due to its advantages in simulating real-world scenarios, transcending spatial and temporal constraints, and minimizing operational risks, has seen widespread application in higher education. Taking the Engineering Management program at Jiangxi Normal University as an example, this paper addresses issues in intelligent construction practice teaching, such as the insufficient integration of theory and practice and fragmented teaching content. A solution is proposed to build a virtual simulation practice base centered on integrated case-based teaching. By optimizing the practical teaching plan, constructing an intelligent construction virtual simulation platform, and innovating the practice teaching model, the project has achieved a deeper integration of industry and education. Results demonstrate that this solution effectively strengthens students' comprehensive practical skills, with 17 national awards and over 300 provincial and higher-level awards earned in the past three years, and 95% of students reporting satisfaction with the practical teaching outcomes. These findings offer valuable guidance for the reform of intelligent construction practice teaching within the context of new engineering disciplines.

Acknowledgements

This work was supported by the Teaching Reform Research Project of Higher Education Institutions in Jiangxi Province (Project No. JXJG-22-2-46). This work is also supported by the Key Project of Teaching Reform in Degree and Graduate Education in Jiangxi Province (Project No. JXYJG-2022-042).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Chen, Y. N., & Zhang, Y. S. (2023). Progress, Hotspots, and Trends of VR Experimental Foreign Language Teaching Research in the Past Three Decades—Based on a Visual Analysis of WOS Journal Articles. *Foreign Language e-Learning, 3,* 100-108.

Hou, H., Zhu, S. H., Zhang, Q. Y. et al. (2022). An Overview of the Development of Virtual Simulation Experiment in Universities. *Journal of Electrical and Electronic Teaching, 44,* 143-147.

Jia, W. T., & Li, Y. J. (2022). Innovative Path of Virtual Simulation Experimental Teaching of New Liberal Arts in Colleges and Universities. *China Higher Education, No. 3,* 55-57.

Lian, X. L., Liu, Y., Pang, L. L. et al. (2023). Application of Virtual Simulation Experiment in Embryology under the Background of New Medicine. *Chinese Journal of Histochemistry and Cytochemistry, 32,* 532-535.

Liu, C. F., Wang, R., & Li, Q. (2024). Analysis of the History and Current Situation of Virtual Simulation Teaching Research Based on Bibliometrics. *Laboratory Research and Exploration, 43,* 99-104.

Lun, S. X., & Li, C. J. (2016). Construction of Virtual Simulation Practical Teaching Platform for New Energy Power Distributed Generation. *Experimental Technology and Management, 33,* 111-114.

Lv, Q. G., Mou, R. L., Xu, W. J. et al. (2019). Construction and Application of Virtual Simulation Laboratory for Iron and Steel Production. *Laboratory Research and Exploration, 38,* 83-87.

Tian, X., & Meng, J. (2017). The Current Situation and Prospect of China Virtual Experiment Research Based on CiteSpace. *Laboratory Research and Exploration, 36,* 97-101.

Wang, J. H., & Li, B. J. (2019). Construction of Virtual Simulation Practice Teaching Platform System of "Art-Technology Combination and Virtual and Real Integration". *Experimental Technology and Management, 36,* 201-204.

Wang, J. J., Wang, L. L., & Yin, P. P. (2021). Design and Practice of Foreign Language Virtual Simulation Experiment Instruction Project—Take the Japanese Intercultural Communication Virtual Simulation Project as an Example. *Foreign Language e-Learning, 3,* 57-62.

Wang, R. J., Zhang, X., Zhang, M. J. et al. (2019). Construction and Exploration of Internet Security Virtual Simulation Practice Teaching for New Engineering. *Experimental Technology and Management, 36,* 124-128.

Wu, G. Y., Lin, M. H., & Li, H. Z. (2021). Research on the Virtual Simulation Practice Education in New-Engineering. *Digital Printing, 4,* 106-110.

Xu, Y. (2023). Research on the Introduction of Virtual Simulation Practice Teaching into Ideological and Political Theory Course in Universities—A Case Study of Anyang Normal College. *Education Theory and Practice, 43,* 42-45.

Xue, T., Li, X. Y., & Huang, Q. (2022). Virtual Simulation Experimental Teaching of Tourism Management: Reform and Innovation of "Two-Tier Teaching" Mode under the Construction of New Liberal Arts. *Journal of Tourism, 37,* 9-10.

Zhang, H. Q., & Li, Z. K. (2024). Research Status Review of Virtual Simulation Experiment Teaching in the Past Decade in Chinese Universities. *Laboratory Research and Exploration, 43,* 77-82.

Zhang, Y. X., & Li, L. Y. (2016). Connotation of Virtual Simulation Practice Teaching of Ideological and Political Theory Course and Its Construction. *School Party Building and Ideological Education, 11,* 59-61.