



Exploration of lean teaching mode of engineering project management courses under a new engineering background

Zhenquan Zhou^{1,2,a}, Yinli Du^{1,b}, Hongjiao Yu^{3,c}, Deprizon Syamsunur^{2,4,d*}

¹School of Architecture and Engineering, Tianfu College of SWUFE, Mianyang, 621050, China

²Department of Civil Engineering, Faculty of Engineering, Technology and Built Environment, UCSI University, Kuala Lumpur, 56000, Malaysia

³Faculty of Social Sciences & Liberal Arts, UCSI University, Kuala Lumpur, 56000, Malaysia

⁴Postgraduate Studies, Department of Civil Engineering, Universitas Bina Darma Palembang, Kota Palembang 30111, South Sumatera, Indonesia

^a1002164129@ucsiuniversity.edu.my

^b17380048026@163.com

^c1002267246@ucsiuniversity.edu.my

^{d*}deprizon@ucsiuniversity.edu.my

Abstract. The Fourth Industrial Revolution has significantly affected the higher education in recent years. The disparity in proficiency between project development schemes and the feasibility of graduating students is a prevalent challenge for construction management education. While the students enrolling in the higher education program have developed a theoretical foundation in project management, they still cannot apply the theory to practice. This research intends to integrate lean management methods with the course group's teaching reform and implementation consulting by including industry experts throughout the process based on the concept of new engineering disciplines. The researched courses are implemented through digital teaching technology supported by the university learning management system and various resources. The collaborative learning and teaching strategy enriches the participants' learning experience. The data from the questionnaire survey of the teaching class indicates that assessing task-oriented project teams and using suitable digital teaching resources can significantly enhance learning outcomes and facilitate the development of students' ability to apply theoretical knowledge to practical management tools. Including new professional course chapters, such as those covering the obstacles to implementing modular building methods and relevant project management subjects, enhances the student learning experience and contributes to the advancement of construction management discipline courses. This research is crucial for advancing the digitalization process of higher education and training programs for applied skills to address society's demands effectively. Further study should aim to increase the sample size of instructional items and use the multi-criterion analysis method to enhance the accuracy of research findings.

Keywords: Teaching digitalization, lean learning management, new engineering disciplines, project management related course, educational reform.

1 Introduction

Many people agree that the advent of smart factories in the fourth industrial revolution can likely impact the sustainable growth of several industries, including but not limited to the higher education sector [1]. China, a nation of significant global impact and a vast population, has always prioritized higher education as a crucial component of its talent development initiatives [2]. In the current administration of higher education courses, digital teaching methods can greatly enhance students' employability by cultivating application-oriented talents with strong professional knowledge and the capacity to adapt to the specific skill requirements of various job positions. A significant body of academic research indicates that in recent years, many professionals in higher education have been actively involved in digitalizing teaching within their respective fields [3]. One main direction of higher education study is developing the new engineering teaching model and management reform as part of the optimization process for application-oriented people training programmes [4]. When combined with collaborative development between lecturers and students, the Athenian teaching theory is an effective approach to constructing a teaching model [5]. Engineering project management courses incorporate the disciplines of project management and construction economics as their fundamental subjects [6]. Indeed, to cultivate skilled individuals, the professional curriculum must be designed with a strong emphasis on aligning the knowledge system of curriculum optimization with the requirements of the labour market [7].

Engineering project management courses mainly focus on construction management discipline and encompass several subjects such as project management simulation training and construction economics and management. This article primarily focuses on the case study of using innovative teaching methods in the courses mentioned above. Figure 1 illustrates the two core courses in this research project managed by Tianfu College of Southwestern University of Finance and Economics (SWUFE), including the project management simulation training and construction economics and management courses. Thus, the teaching method and management employed in the targeted course establish a solid foundation for the modified teaching of these two courses, ensuring high-quality instruction. Besides, this educational reform project adds the newest research findings (regarding prefabricated buildings and project management topics) to the course teaching period. Students in the management science and engineering category will likely take and demonstrate proficiency in engineering project management courses, forming their essential core skills and abilities [8, 9, 10]. These courses serve as the essential base for the discipline to gain a competitive edge.

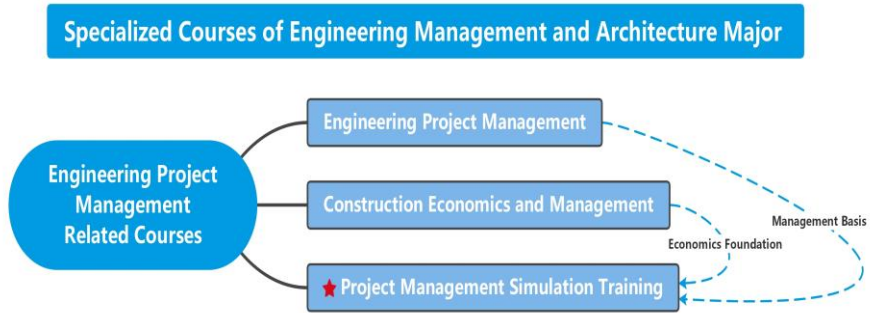


Fig. 1. The internal relationship of the teaching system of engineering project management main courses.

2 Research Process and Implementation Methods

The two researched courses are designed to enhance students' capacity to assess the viability of real projects using innovative teaching methods. To ensure students' timely comprehension of the construction management-related courses, lecturers should effectively utilize the teaching quality management system. It includes promptly publishing pertinent theoretical teaching plans, electronic courseware, micro-lesson videos, and other reference materials on the platform. For instance, the lecturer utilizes the system platform to pre-upload teaching courseware and micro-class videos for the first week of the case course. The teaching courseware serves as mandatory reading material before class, while the micro-class videos or other reading materials are designated as optional after class. Following the conclusion of the course, course lecturers can gain an initial understanding of students' learning progress on the assigned reading materials (indicating the students' attitude towards the course) and the reading data of selected materials (indicating the level of engagement in the class). Incorporating teaching software and application programmes involves utilizing electronic courseware, a teaching management platform, integrating and uploading micro-course materials, and utilizing Computer-Aided Design (CAD) software for learning and practical application during the course.

Regarding the utilization of multimedia resources, students are encouraged to enrol in the excellent national courses of Massive Open Online Courses (MOOCs) after class. It can be done through assessments and earning extra points. These courses can then be used as video resources to review and reinforce what was taught in class. One of the major targets is to mitigate the issue of uneven comprehension among students in traditional classroom settings. Therefore, the course employs recorded segments highlighting key knowledge points. Students can access and study these course videos online via the teaching management system after class. Simultaneously, weekly online Question and Answer (Q&A) sessions may be customized to suit the skills and interests of students, allowing for personalized feedback and growth for students with varying learning capacities or professional interests. The case course primarily uses PowerPoint

(PPT) electronic courseware to produce and utilize e-learning materials during classroom instruction. The courseware content has been enhanced through multiple rounds of discussion by the course group. It comprehensively includes simulation videos, field investigation pictures, academic literature citations, and teacher-student interactive questions. These elements promote collaborative learning between lecturers and students, enabling students to deepen their understanding of knowledge. Based on these improvements, the positive and enriching learning interaction experience allows the whole teaching class to sustain high motivation and engagement.

3 Research Results

By utilizing digital teaching methods, the execution and management of the courses have been optimized, resulting in improved evaluations from students and peers this semester. According to the scoring system, students are awarded the highest points (five points) for learning satisfaction. Similarly, the instructor received positive feedback in the reciprocal assessment that the peer evaluation score improved from 96.7 last year to 98.9 (100 total) this semester. The comprehensive data demonstrate that the teaching approach and progress described above have significantly enhanced students' engagement and classroom experience. This is particularly evident in the immediate or scheduled feedback provided through the collaborative, interactive tools of online meetings and teaching management systems, weekly in-class question-and-answer sessions and regular flipped classroom seminars. The teaching class's final average score and learning test impact have significantly increased compared to the prior pupils. The teaching quality management system can automatically assess students' performance and provide teaching supervisors with prompt feedback on each course assignment. It significantly enhances the effectiveness in instructing management and evaluating learning, utilizing data analysis tools to scrutinize students' performance to adapt teaching methodologies promptly. A total of 40 valid questionnaires have been completed in the feedback statistics of the innovative teaching process of the construction economics and management course. The questionnaires were filled out anonymously online to ensure the authenticity and objectivity of the collected data. Based on the comprehensive data, 92.5% of the students surveyed expressed enthusiasm for this course's collaboration with industry experts to engage in learning assessment and innovative teaching. Additionally, all respondents indicated they had a complete or partial understanding of the course's objectives regarding knowledge, skills, and quality that students are expected to achieve. Approximately 80% of the students surveyed acknowledge the significant impact of teaching on applying their practical project management skills. Additionally, 97.5% of the surveyed students express high satisfaction with the frequency of teacher-student interaction in case courses, which somewhat enhances the effectiveness of student-centred classroom activities. Overwhelmingly, the majority of participants expressed satisfaction with the utilization of course materials (100%), the fairness of homework assignments (95%), and the instructional techniques employed using digital resources (97.5%). Most respondents, specifically 95%, indicated that studying case courses enhances one or more of their talents. For instance, 90% of the polled students

reported that the course has significantly strengthened their capacity to collaborate in project teams. Meanwhile, 70% of advocates felt that the instruction had improved their ability to put theory to practice and study independently in terms of the learning experience of the teaching class in the Construction Economics and Management course. Based on the students surveyed, 92.5% believe that learning this course is enjoyable and fulfilling, while 7.5% have a neutral opinion. None of the students provided a negative rating. Hence, the statistical analysis findings from the above survey indicate that implementing innovative strategies in teaching in this research project positively impacts most students' learning outcomes and experiences.

Regarding the project management simulation training course, Figure 2 reveals the highly satisfied students' feedback by collating the viewpoints from the 58 effective-response questionnaires. The interviewed students can feel the improvements in enhancing the fairness and impartiality of the assessment process for the lean management and control course. To ensure a more objective assessment, industry professionals are enlisted as external reviewers to oversee the development and evaluation of assessment assignments. By collating the total 58 questionnaire responses, 39 and 19 students provided highly satisfactory feedback for the quality of teaching aspect, respectively. All of them are satisfied with the teaching arrangement, classroom atmosphere and learning gain. They agree that the proposed course modification improves the fairness and objectivity of the course evaluation mode. Students perceive that the course teaching reform has significantly improved compared to the prior teaching approach, particularly due to the alteration and enhancement of the conventional teaching method. In the conventional paradigm, students mostly adopt a passive position of listening and practising, while the teacher's main responsibility is evaluation. However, students may have limited opportunities to gain a comprehensive viewpoint, and the content could be more complex. Incorporating the modified approach into the ongoing educational reform allows students to gain exposure to various viewpoints about methods, demonstrations, and assessments. Furthermore, the inclusion of both external expert teams and internal expert teams can enhance the overall fairness of the evaluation process. These teams also serve as supervisors for student judges during the defence examination, ensuring a more equitable and impartial assessment of the course and student performance. Most students also provide positive feedback on the effectiveness of digital technology using a clear study objective setting. They also highly recommended the continuous introduction to the chapter on modular building promotion and project management because this chapter can effectively improve students' understanding of applying engineering management theory and tools to the practical adoption of sustainable construction approaches.

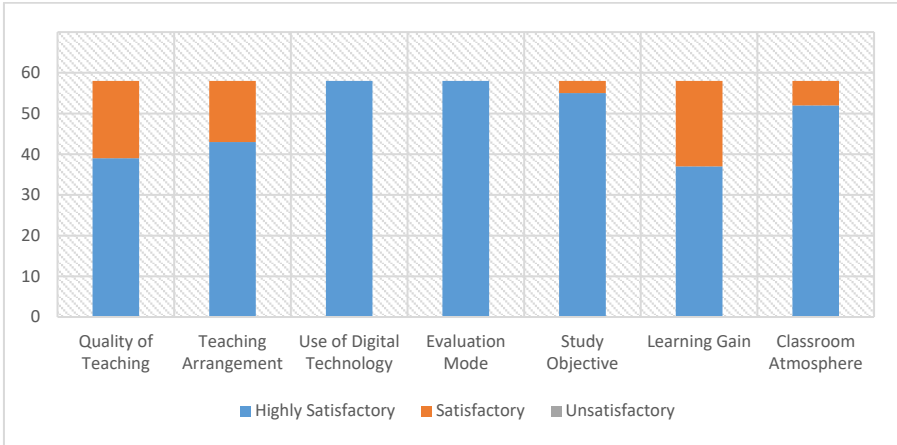


Fig. 2. The feedback of the interviewed students for the project management simulation training course.

4 Discussions

In this educational reform project, the case courses adopt the lean teaching paradigm, which focuses on simulating real tasks to encourage students' creativity and excitement in the classroom. By assigning project work, students may engage more extensively in educational activities and enhance their comprehension and utilization of knowledge. By implementing several instructional reforms in project management simulation training and construction economics and management courses, the teaching group has established a basis for establishing future favourable subject groups. Integrating theoretical courses in the researched courses with hands-on project management simulation training makes it possible to effectively monitor curriculum knowledge, skills, and quality targets. This innovation point aims to provide a cohesive disciplinary structure that allows students to grow comprehensively, adapt to the evolving field of new engineering, and foster versatile individuals with multidisciplinary expertise. Besides, the education reform project focuses on integrating industry and learning and assesses and provides feedback on the course process through industry consultants. This situation ensures that the teaching content, development methods, and assessment criteria align with the demands of the industry market. Industry mentors provide grading comments to guarantee that students gain authentic industry experience and obtain accurate assessments from project team members actively involved in the work. This improvement helps develop professionals who are well-equipped to fulfil the market's demands. This example project intends to offer a model for establishing topic groups in the context of new engineering to facilitate teaching reform in other disciplines. Sharing project experience and innovative ideas can inspire other disciplines with similar backgrounds and reform requirements. It also promotes further education reform in these disciplines and contributes to the development of teaching management and discipline construction in application-oriented universities in Sichuan Province to some extent. On the other

hand, the collected data in this research are still limited, so it is more reasonable to enlarge the sample size of interviewees and student participants. In further research, more semester teaching data should be collected, and adopting a multi-criterion analysis method for analyzing the research data can validate the current research results and improve the accuracy of research findings.

5 Conclusions

This paper implements teaching innovation in engineering project management courses, incorporating the research foundation of discipline construction and lean management strategy in the context of new engineering. It also considers the specific learning situation of school construction management students. This innovation contributes to training applied talents in universities in Sichuan province by providing them with new practical experience. This project aims to optimize and change the teaching management of the fundamental courses in engineering project management delivered by Tianfu College of SWUFE. Students' learning outcomes and experiential satisfaction may be significantly enhanced by strategically assigning teaching staff and implementing targeted and suitable task-based instruction and evaluation. Specifically, the feedback statistics of the example courses indicate that the teaching innovation measures are highly favourable and beneficial for most students. The newly added course chapter, which discusses the modular approach and its related project management topics, also improves the student learning experience and gains in construction management discipline courses. This project case can be valuable for optimizing and reforming other comparable courses. Additionally, this situation can contribute significantly to the sustainable growth of the school's engineering management major subject group. Simultaneously, this case has provided a solid foundation for the theoretical framework of practical talent development in higher education institutions, aiming to produce a greater number of well-prepared graduates who meet the demands of the labour market in our nation. Further research can enlarge the sample size and use more precise analysis methods to validate the accuracy of current findings.

Funding

This university teaching reform project was funded by Tianfu College of SWUFE (Project Grant Number TFCJGYB202317).

References

1. Gleason, Nancy W. Higher education in the era of the fourth industrial revolution. Springer Nature, 2018.
2. Wang, Jia, and Jian-Min Sun. "Talent development in China: Current practices and challenges ahead." *Advances in Developing Human Resources* 20.4 (2018): 389-409.

3. Wu, Shuguang, Zhenning Yuan, and Na Zhou. "Research on the Construction of Digital Higher Education of China from the Perspective of Symbiotic Education." (2023).
4. Shen, Jinlu, Tuoyu Li, and Mingchuan Wu. "The new engineering education in China." *Procedia Computer Science* 172 (2020): 886-895.
5. Song, Xianlin. "Critical thinking and pedagogical implications for higher education." *East Asia* 33.1 (2016): 25-40.
6. Lutsenko, Galyna. "Case study of a problem-based learning course of project management for senior engineering students." *European Journal of Engineering Education* 43.6 (2018): 895-910.
7. Wang, Li. "The gap between university studies and labour market in journalism: opening educational community example in China." *Heliyon* 8.12 (2022).
8. Zhou, Zhenquan, et al. "Exploring the feasibility of using modular technology for construction projects in island areas." *Journal of Infrastructure, Policy and Development* 8.4 (2024): 3424.
9. Zhou, Zhenquan, et al. "The development of the smart factory during the Industry 4.0 period under the study of system thinking." *Proceedings of the 2023 International Conference on Artificial Intelligence, Systems and Network Security*. 2023.
10. Zhou, Zhenquan, et al. "Identification of Impeding Factors in Utilizing Prefabrication during Lifecycle of Construction Projects: An Extensive Literature Review." *Buildings* 14.6 (2024): 1764.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

