ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

Construction and Practice of an Integrated Teaching System for the "Civil Engineering Materials" Course Based on Sino-Foreign Cooperative Education

Liang Zhao[1, a], Chong Wang[2, b], Zhide Hu[3, c], Mingjia Xu[1, d] and Yuxin Yang[1, e]

[1]School of Civil and Architectural Engineering, Yangtze Normal University, Chongqing 408100, China

[2]College of Materials Science and Engineering, Chongqing University, Chongqing 400030, China

[3]Army Logistics Academy of PLA, Chongqing 401331, China

[a]zhaoliang@yznu.edu.cn, [b]chongwang@cqu.edu.cn, [c]huzd6503@163.com, [d]xumingjia0411@163.com, [e]yangyuxin1883@163.com

Abstract

In response to domestic policy adjustments and the international market expansion of China's civil engineering industry, the demand for civil engineering professionals with an international perspective has significantly increased. This paper examines the undergraduate civil engineering program jointly offered by Yangtze Normal University and Universiti Sains Malaysia, focusing on the construction and implementation of an integrated teaching system for the "Civil Engineering Materials" course. Addressing challenges such as differences in curriculum systems, teaching methods, experimental teaching, assignments, and examinations between China and foreign countries, this paper proposes several innovative improvement measures: developing a curriculum content system that integrates international and local elements, achieving seamless integration of classroom and experimental teaching, expanding knowledge acquisition channels through a combination of online and offline methods, establishing a Sino-foreign exchange mechanism that facilitates both regular and instant communication, and creating a dynamic cyclic teaching model that incorporates teaching and feedback. These measures aim to enhance the teaching effectiveness of the "Civil Engineering Materials" course, improve students' international competitiveness, and ensure they meet the engineering practice needs both domestically and internationally. Ultimately, the goal is to build a teaching system that leverages the strengths of both Chinese and Malaysian approaches, cultivating high-quality, application-oriented civil engineering professionals who understand international standards and can adapt to domestic requirements.

Keywords

Sino-foreign cooperative education; Civil Engineering Materials; Integrated teaching system; International perspective; Application-oriented talents.

1. Introduction

To prevent and mitigate local government debt risks, the General Office of the State Council issued the "Measures for Strengthening the Management of Government Investment Projects in Key Provinces (Trial)" (Guobanfa [2023] No. 47) at the end of 2023. This measure requires 12 provinces and cities, including Tianjin, Neimenggu, Liaoning, Jilin, Heilongjiang, Guangxi, Chongqing, Guizhou, Yunnan, Gansu, Qinghai, and Ningxia, to strengthen the management of

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

government investment projects. Except for basic livelihood projects such as water supply, heating, and power supply, no new urban rail transit and suburban railway projects are to be constructed in 2024, and some projects that have started but have not exceeded 50% investment must be suspended or slowed down [1]. Against the backdrop of a sluggish real estate industry, the national restrictions on infrastructure investment and construction will undoubtedly have a greater impact on the development of China's civil engineering industry. In this context, more and more civil engineers are targeting the vast overseas market, aiming to bring China's advanced technology and experience abroad.

Since the beginning of the 21st century, China's economy has developed rapidly, especially with the introduction of the "Belt and Road" initiative and the concept of a "Community of Shared Future for Mankind," which have greatly promoted China's transnational investment, talent flow, and cooperative production. As China's ties with the world become increasingly close, especially in the civil engineering industry, there is a need for a large number of high-quality civil engineering talents with an international perspective, familiarity with international affairs, and international work capabilities. However, China's higher education started late and has a weak foundation, and the cultivation of international talents still cannot meet the development needs. Therefore, drawing on advanced foreign educational experiences and introducing high-quality foreign educational resources for Sino-foreign cooperative education has become one of the important ways for the international development of China's higher education [2]. As of October 2024, there are 33 Sino-foreign cooperative education projects in Chongqing [3], among which Yangtze Normal University and Universiti Sains Malaysia have jointly offered an undergraduate education program in civil engineering.

The civil engineering (Sino-foreign cooperative) program at Yangtze Normal University, by introducing the advanced educational concepts and high-quality educational resources of Universiti Sains Malaysia, jointly cultivates high-quality, application-oriented, international talents who are well-rounded in moral, intellectual, physical, aesthetic, and labor development. These students systematically master the basic knowledge of civil engineering disciplines such as theoretical mechanics, material mechanics, civil engineering materials, and road and bridge engineering. They also acquire basic skills in construction machinery, engineering surveying, construction organization, and have the basic abilities of preliminary design, construction, management, and quality inspection of civil engineering projects. They are capable of technical and management work in various projects such as housing construction, roads, bridges, and tunnels, with a solid theoretical foundation, broad professional knowledge, strong practical abilities, and innovative capabilities [4].

"Civil Engineering Materials", as a fundamental course in the civil engineering (Sino-foreign cooperative) program, covers the properties, characteristics, uses, processing methods, and quality control of various civil engineering materials. Through this course, students gain an in-depth understanding of the performance of different materials, enabling them to select and use materials effectively in engineering projects to ensure safety and economy. It also provides essential material knowledge for subsequent professional courses such as the principles of concrete structure design and civil engineering construction, helping students better understand theoretical concepts and form a comprehensive knowledge system. Additionally, the course includes experiments that stimulate students' interest in learning. By observing experimental phenomena and engaging in hands-on operations, students enhance their understanding of civil engineering materials, improve their problem-solving skills, and master basic performance testing methods. Furthermore, "Civil Engineering Materials" fosters students' innovative awareness and abilities, enabling them to explore the performance and application methods of new materials and contribute to technological advancements in the civil engineering field.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

Therefore, the study of “Civil Engineering Materials” lays a solid foundation for the subsequent learning and practice of students in the civil engineering (Sino-foreign cooperative) program. It is crucial for cultivating professional abilities and comprehensive qualities. The localization of high-quality educational resources from Universiti Sains Malaysia during the course learning process is particularly important.

2. Current Teaching Status and Existing Problems of “Civil Engineering Materials”

In the teaching process of "Civil Engineering Materials" for the Engineering Cost major and the Civil Engineering (Sino-foreign cooperative) major, significant differences were found between the Chinese and Malaysian curriculum content systems (as shown in Table 1), causing certain difficulties for Chinese students during their studies.

Table 1. Comparison of Teaching Characteristics between Chinese and Malaysian Courses

	Chinese Course	Malaysian Course
Ideological Education	Yes	No
Knowledge System	Chinese	British
Teaching Focus	Emphasized	Dispersed
Teaching Mode	Offline	Online + Offline
Language Environment	Chinese	English
Course Experiments	Verification	Verification + Open
Regular Assignments	Fixed	Flexible
Exam Difficulty	Low	High

2.1. Ideological Education

The Malaysian course is taught entirely according to the original foreign content, without ideological education elements. The Chinese course has a significant advantage in this aspect, deeply exploring the ideological and political education elements of the course, combining knowledge transmission with value guidance, and having a clear educational awareness. Sino-foreign cooperative education is about running Chinese universities and cultivating talents to serve China's socialist construction. Therefore, the talent cultivation philosophy of Sino-foreign cooperative education should prioritize China's educational philosophy. Especially in the past two decades, China's civil engineering industry has made significant developments and progress in technological innovation, green buildings, sustainable development, and infrastructure construction, earning the title of "infrastructure maniac." Thus, there are numerous cases that can be integrated into the course as ideological elements.

2.2. Knowledge System

The Malaysian knowledge system follows the British system, which has developed over hundreds of years in the civil engineering industry and is relatively mature, but the standards used are relatively outdated. The Chinese side has rapidly developed in the field of civil engineering technology, forming an independent knowledge system with relatively new standards. For example, in the “Civil Engineering Materials” course, the Malaysian standard for concrete mix design is "Design of Normal Concrete Mixes" BRE 1988 [5], which has been in use for 36 years, while the Chinese standard is “Code for Design of Ordinary Concrete Mix Proportions” JGJ55-2011 [6], which has been in use for only 13 years. What are the respective advantages of these two standards, which one has better overall performance, and which one has wider applicability? Detailed theoretical calculations and experimental studies have found

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

that, while ensuring concrete strength, the British standard has lower overall costs, and the Chinese standard has better durability, each with its unique advantages. In the entire "Civil Engineering Materials" course, and even in all professional courses, there will be many conflicts between Chinese and foreign knowledge systems, so balancing these relationships will be crucial for course learning, professional development, and talent cultivation.

2.3. Teaching Focus and Methods

The Malaysian course mainly teaches cement, concrete, bricks, steel, polymers, and wood [7], while the Chinese course mainly teaches cement, concrete, bricks, mortar, asphalt, ceramics, and glass [8]. Comparatively, the Chinese course includes asphalt, ceramics, and glass, but excludes wood. In domestic civil engineering projects, except for the repair of a few ancient and imitation ancient buildings, wood is almost not used, while asphalt is extensively used in road construction. Therefore, the content taught in the Chinese course is more in line with domestic actual needs.

The Malaysian course emphasizes heuristic teaching of “less teaching in class, more learning after class”, relying more on students’ self-learning and encouraging them to study independently after class. Therefore, the teaching content is relatively shallow and broad. The Chinese teaching mainly focuses on classroom lectures and encourages students to review the taught knowledge points after class, with more emphasis on key points and deeper difficulties. Students, accustomed to exam-oriented education from a young age, are not adapted to the Malaysian teaching methods. Additionally, the course is taught entirely in English, which raises the learning threshold, reduces the interest of students who are not good at English, and causes a divergence in learning attitudes, with some students developing a “slacking off” mentality. The “free-range” teaching method of the Malaysian course does not fit the actual situation of Chinese students.

2.4. Course Experiments

Compared to the Chinese course, the Malaysian course has more sufficient experimental hours. The Malaysian course includes 4 verification experiments and 1 open experiment, while the Chinese course includes 3 verification experiments. Verification experiments are processes where accurate operational requirements are completed according to preset steps within an existing framework to obtain expected experimental results, allowing experimenters to master basic experimental operation skills during the process. Open experiments, on the other hand, place more emphasis on the design of steps, which depends on the experimenter's understanding of the exploratory experiment's purpose. Experimenters need to design experimental steps through innovative thinking activities based on their needs and complete the operations, thus requiring more innovative thinking and hands-on abilities from students. However, in actual experiments, the selection of topics and step design are disconnected from real needs, and students' innovative thinking and hands-on abilities are somewhat lacking, resulting in less than expected experimental outcomes.

2.5. Assignments and Exams

Malaysian assignments are mostly subjective and highly flexible. For example, a 2021 assignment required students to go to a building materials store, find 5 different types of building materials, discuss their characteristics and functions/applications, and take a group photo in front of the store. The Chinese assignments mainly consist of after-class exercises, with relatively fixed content and less flexibility.

Malaysian assessments focus more on the process, with regular quizzes and final exams each accounting for only 25%, and the difficulty is higher than the classroom teaching content and assignment exercises. The final exam content is flexible, with a total of 5 major questions, of which students choose 4 to complete. Each question is divided into multiple parts and is

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

relatively complex, including short answers, case analysis, and calculations. Chinese assessments focus more on results, with mid-term exams accounting for only 10% and final exams accounting for 60%, meaning "one exam determines success or failure." The final exam consists of standard multiple-choice questions, true/false questions, fill-in-the-blank questions, term explanations, short answers, and calculations, with content mainly from after-class exercises and course key points.

3. Construction of the Teaching System

3.1. Establishing a Curriculum Content System that Integrates Internationalization and Localization

Thoroughly explore the curriculum content systems of both Chinese and foreign courses in “Civil Engineering Materials”, analyzing their similarities, differences, advantages, and disadvantages. Extract high-quality content suitable for students in the Civil Engineering (Sino-foreign cooperative) major and incorporate it into the “Civil Engineering Materials” (Sino-foreign) course. Integrate international knowledge with domestic engineering cases. Ensure the curriculum meets the common theoretical and practical foundations required for both internationalization and localization. Consider the characteristics of both Chinese and foreign systems, manage their intersection, penetration, and integration, and establish a curriculum content system that effectively combines internationalization and localization.

3.2. Establishing a Training Model that Integrates Classroom Teaching and Experimental Teaching

Align closely with the development needs of the Civil Engineering (Sino-foreign cooperative) major. Design experimental content based on key theoretical course points, teach students the principles and methods of experiments in the classroom, and then guide them through actual operations during experiments to observe the results. This process helps students deeply understand the learning content and improve their practical application abilities, forming a training model that integrates classroom teaching and experimental teaching. Additionally, encourage students to participate in practical training at off-campus practice bases during their spare time to address the current lack of practical teaching and engineering practice experience. Through off-campus practice, students can benefit from the complementary roles of full-time and part-time teachers, and the integration of classroom teaching with off-campus experimental teaching. This approach emphasizes the cultivation of comprehensive practical abilities, compensating for the shortcomings of a single teaching method and meeting the professional development needs of civil engineering in an international context.

3.3. Establishing Knowledge Acquisition Channels that Integrate Online and Offline Methods

On the basis of ensuring the supplementation of domestic knowledge points through offline tutoring courses, relying on online learning platforms such as Learning Through, Rain Classroom, and MOOCs, establish an online learning platform that integrates pre-study, online courses, homework, quizzes, and content expansion. Additionally, share content such as experimental operation videos and replays of foreign teaching videos to enrich the sources of knowledge and broaden the channels for acquiring knowledge.

3.4. Establishing Sino-Foreign Communication Channels that Integrate Regular and Instant Communication

Establish a regular online/offline meeting mechanism with foreign teachers and teaching management personnel to discuss content and operational issues in the teaching process. Use instant communication tools such as email, WhatsApp, and WeChat to create real-time

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

communication channels with foreign teachers to handle temporary emergencies such as teacher illness, class adjustments, and major school events.

3.5. Establishing a Dynamic Cyclic Teaching Model that Integrates Teaching and Feedback

Implement a continuous cycle of designing teaching activities, executing teaching, collecting and analyzing feedback, expert demonstration, teaching adjustment, and re-implementation. This approach allows for timely adjustments to teaching strategies and methods, optimizing and improving teaching content, and enhancing teaching quality.

3.6. Establishing a Teaching Course Group that Integrates On-Campus and Off-Campus Resources and Improving the Feedback Evaluation Mechanism

Establish a regular online/offline meeting mechanism with foreign teachers and teaching management personnel to discuss content and operational issues in the teaching process. Use instant communication tools such as email, WhatsApp, and WeChat to create real-time communication channels with foreign teachers to handle temporary emergencies such as teacher illness, class adjustments, and major school events.

4. Practical Effects

Under the framework of Sino-foreign cooperative education, oriented by application needs and aiming to construct an integrated teaching system of internationalization and localization, the following main practical effects have been achieved:

Integration of Internationalization and Localization: Combining the characteristics of Sino-foreign cooperative education, advanced foreign teaching concepts and technologies in civil engineering materials have been introduced and integrated with domestic teaching practices and engineering needs. This has resulted in a teaching system for “Civil Engineering Materials” that has an international perspective while fitting China’s national conditions.

Combination of Theory and Practice: Emphasizing the combination of theory and practice through experimental teaching and engineering practice enables students to deeply understand and master the basic properties and application technologies of civil engineering materials. This approach cultivates students’ practical abilities and innovative spirit.

Construction of a Dynamic Cyclic Teaching Model: A dynamic cyclic teaching model that integrates “teaching and feedback” has been established. This model optimizes and improves teaching content and methods through continuous teaching practice and student feedback, thereby enhancing teaching quality.

Integration and Connection Across Courses: The teaching not only covers the knowledge of the “Civil Engineering Materials” course but also emphasizes integration and connection with other courses such as engineering chemistry, material mechanics, principles of concrete structure design, and civil engineering construction. This approach broadens students’ knowledge and comprehensive qualities.

Construction of an International High-Level Faculty Team: The focus on the internationalization of the faculty team includes introducing excellent teachers from Universiti Sains Malaysia and strengthening international exchanges and cooperation among domestic teachers. This enhances the academic level and teaching ability of the faculty.

Close Integration of Industry, Academia, and Research: Leveraging the “Industry+” China-Malaysia Intelligent Construction Industry-Education Cooperation Platform in Chongqing, the integrated development of industry, academia, and research is promoted through close cooperation with domestic and foreign enterprises and research institutions. This enables

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

students to access the latest research results and engineering application cases in civil engineering materials, enhancing their engineering practice abilities and innovative awareness.

5. Conclusion

Significant differences exist between the curriculum content systems of China and Malaysia, impacting course learning, professional development, and talent cultivation. The teaching process should not entirely replicate the foreign model. For students who do not plan to study or work abroad, mastering the domestic knowledge system is crucial for completing graduation projects, meeting domestic training requirements, and developing within China. Conversely, for students intending to study or work abroad, mastering the domestic knowledge system and bringing excellent domestic professional technology abroad will facilitate deeper international exchanges and cooperation, benefiting their overall personal development.

Therefore, in the teaching process, foreign teachers should adhere to the original foreign content to ensure the course's "authenticity." However, Chinese teachers should supplement this with domestic advantages, incorporating superior teaching content and engineering cases from China. This approach creates a complementary relationship between domestic and foreign curriculum content systems, adapting to China's actual conditions and development needs. Additionally, Chinese teachers should enhance the cultivation of professional English learning abilities, focusing on professional vocabulary, literature reading, and the use of modern translation tools.

In summary, this paper, driven by Sino-foreign cooperative construction and oriented by application needs, aims to establish an integrated teaching system that leverages the strengths of both Chinese and Malaysian sides. It analyzes and addresses the current deficiencies in the "Civil Engineering Materials" (Sino-foreign) course, constructs a new curriculum content system, enriches teaching resources, and aligns closely with international applications. This approach fundamentally cultivates high-quality, application-oriented talents with an international perspective, familiarity with international affairs, and the capability to work internationally. If you follow the "checklist" your paper will conform to the requirements of the publisher and facilitate a problem-free publication process.

Acknowledgments

The present work was funded by the Education and Teaching Reform Research Project of Yangtze Normal University (No. JG2024313) and the Ministry of Education's Cooperative Education Project (No. 220606711134117).

References

[1] Information on: www.sohu.com/a/763937028_268713

[2] Li Shuyan: A Case Study on the Localization of High-Quality Educational Resources in Sino-Foreign Cooperative Education in Western China (Doctoral dissertation, Southwest University, Chongqing, China 2021). p.32.

[3] Information on: www.crs.jsj.edu.cn/index/sort/1006

[4] Information on: tumu.yznu.cn/2020/0708/c3736a172160/page.htm

[5] Dayaratnam C T, Franklin R E, Erntroy H C, et al. Design of Normal Concrete Mixes. BRE Press, 1988, p. 2-3.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202412_7(12).0020

[6] Ministry of Housing and Urban-Rural Development of the People's Republic of China. JGJ55-2011, Standard for Mix Proportion Design of Ordinary Concrete. Beijing: China Architecture & Building Press, 2011, p. 2-5.

[7] Zhao Liang, Qin Linyuan, Xiao Ying, et al. The Path Analysis of the Innovation and Development of 'Civil Engineering Materials' Curriculum Under the Background of Sino-Foreign Cooperative Education. International Journal of Education and Humanities. Vol. 6 (2023) No. 1, p. 152-154.

[8] Jiao Baoxiang. Civil Engineering Materials. Beijing: Higher Education Press, 2019, p. 1-5.