ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

Research on the Reform and Practice of the Full English Teaching Model for Subgrade and Pavement Engineering Courses

Haocheng Xiong

School of Civil and Resource Engineering, University of Science and Technology Beijing, Beijing 100083, China

Abstract

This paper investigates the reform and practice of a full English teaching model for subgrade and pavement engineering courses. By analyzing the deficiencies in the current teaching model, specific measures are proposed to enhance teacher-student interaction and improve teachers' engineering practice abilities. The research results show that diverse assessment methods and enriched practical sessions significantly boost students' comprehensive abilities. The implementation of a dual-training model between universities and enterprises has yielded remarkable results, providing students with extensive experience in actual engineering projects. Continuous improvement and optimization strategies have further increased the practical applicability of course content and enhanced teaching quality. This research offers valuable insights for teaching reform in subgrade and pavement engineering courses, aiming to better equip students with practical skills and innovative thinking necessary for their future careers.

Keywords

Subgrade and Pavement Engineering; Full English Teaching; Teaching Reform; Practical Ability; Dual-Training Model.

1. Introduction

As a core course in transportation civil engineering, the teaching effectiveness of subgrade and pavement engineering directly impacts students' engineering practice abilities and career development. The traditional teaching model has many shortcomings in integrating theory and practice, leading to students' poor performance in actual operation and application abilities. Particularly in a full English teaching environment, enhancing teaching effectiveness and improving students' comprehensive abilities have become urgent issues. This study analyzes the shortcomings of the current teaching model and proposes specific reform measures. Through empirical research, the implementation effects are evaluated, aiming to provide practical solutions for the teaching reform of subgrade and pavement engineering courses, thereby improving students' practical abilities and employability.

2. Analysis of Problems in the Current Teaching Model

2.1. Insufficient Practical Experience of Teachers

While many teachers have a strong theoretical foundation, their lack of direct engineering practice experience hinders the effective integration of theory with real-world construction operations in the classroom. As road construction technology continually advances, teachers must stay current with the latest techniques and methods to provide students with up-to-date knowledge and skills. Without this, students miss out on essential real-world engineering experiences, limiting their practical abilities and making it harder for them to meet future career demands.The gap in practical experience also affects teachers' ability to thoroughly

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

explain complex engineering problems and demonstrate real-world operations in class. This limitation forces students to rely on indirect knowledge obtained through textbooks and PowerPoint presentations, which fails to provide a deep understanding of actual engineering practices. Consequently, students struggle to apply theoretical knowledge to real-world scenarios, impacting their overall competency and readiness for professional challenges.

Furthermore, the lack of firsthand experience among teachers diminishes their capability to engage students in meaningful discussions about practical issues and solutions, reducing the effectiveness of the learning process. This situation calls for initiatives to enhance teachers' practical exposure, such as participating in industry projects and continuous professional development, ensuring they can bridge the gap between theory and practice effectively. By addressing these issues, educational institutions can better prepare students for successful careers in engineering, equipped with both theoretical knowledge and practical skills.

2.2. Disadvantages of the Traditional Teaching Model

The traditional teaching model relies heavily on one-sided lectures, with minimal teacher-student interaction. This approach leaves students passive in the classroom, hindering their interest and initiative in learning. Consequently, students often resort to rote memorization rather than developing a deep understanding of the material and its practical applications. The emphasis on theoretical content with limited practical sessions prevents students from engaging in hands-on activities, which are crucial for reinforcing knowledge and developing practical skills.This "cramming" education style also diminishes students' motivation for independent study and critical thinking, leading to poor learning outcomes. The lack of engagement and interactive learning opportunities makes it difficult for students to apply theoretical knowledge to real-world scenarios[1]. This is particularly problematic in complex areas such as engineering operations and mathematical formula analysis, where students may feel intimidated and overwhelmed. This intimidation negatively impacts their overall learning experience and future career development.

Furthermore, the absence of practical application in the traditional model means students miss out on essential problem-solving and critical-thinking exercises. They are not encouraged to explore and experiment, which limits their ability to innovate and adapt to new challenges. This gap in the teaching model calls for a shift towards more interactive and practical learning methods, such as project-based learning and collaborative group work, to foster a deeper understanding and application of knowledge. By addressing these issues, educational institutions can enhance teaching effectiveness, better preparing students for successful careers in engineering and other fields.

3. Specific Measures for Teaching Model Reform

3.1. Enhancing Teacher-Student Interaction

To foster a more engaging and effective learning environment, enhancing teacher-student interaction is crucial. One effective strategy is to involve the class learning committee in collecting questions that students encounter during their pre-study sessions and providing this feedback to the teaching teacher before theoretical lectures. This approach not only helps teachers understand the learning status of their students but also encourages students to think independently and critically before class, thereby increasing their focus and engagement with the course content.During each semester, teachers can organize interactive discussion sessions every two weeks. Before each session, students are required to submit at least three questions they have encountered during their pre-study. This practice ensures that the discussion is centered around the students' actual concerns and difficulties, making the learning process more relevant and effective. By addressing these specific questions in class, teachers can

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

provide targeted explanations and facilitate in-depth discussions, thereby enhancing students' understanding and participation.

Given the practical and applicative nature of subgrade and pavement engineering, students should be encouraged to observe road construction, maintenance, and management issues around the campus during their spare time. For instance, the construction section of Xuefu Avenue in Suzhou University's Education Park can serve as a practical observation object for students[2]. By forming study groups, students can discuss and learn together, using the school's existing road testing equipment to inspect and analyze the subgrade, pavement, bridges, greening, and traffic facilities of Xuefu Avenue. This hands-on experience allows students to better understand theoretical knowledge and enhances their ability to apply what they have learned to real-world problems.Increasing group projects and discussion sessions in the course is another effective way to enhance teacher-student interaction. Each group, consisting of 4-5 students, is responsible for the simulated design and analysis of an actual engineering project throughout the semester. These group projects include multiple stages such as preliminary design, material selection, construction planning, and cost estimation. Regular progress reports are required, and students receive guidance and feedback from the teacher at each stage. This ongoing interaction helps students to stay engaged and allows for continuous learning and improvement.

Moreover, these group projects foster teamwork and collaborative learning. By working together, students can share knowledge, discuss different approaches, and learn from each other’s perspectives. This collaborative environment encourages active learning and helps students to develop essential skills such as communication, problem-solving, and project management.In addition to structured group projects, teachers can incorporate more informal interactive activities such as peer teaching, where students explain concepts to each other under the teacher's guidance. This method not only reinforces the student's understanding but also builds their confidence in discussing technical subjects.

Inviting industry professionals and alumni to participate in discussion sessions can further enrich the learning experience. These guests can provide insights into current industry practices, share their professional experiences, and discuss real-world challenges and solutions. Such interactions help bridge the gap between academic learning and practical application, providing students with a more comprehensive understanding of their field.Overall, by implementing these strategies, teacher-student interaction can be significantly enhanced, leading to a more dynamic and effective learning environment. Students are more likely to engage deeply with the material, develop critical thinking skills, and gain practical insights that are crucial for their future careers in engineering.

3.2. Improving Teachers' Engineering Practice Abilities

To ensure that educators in subgrade and pavement engineering are well-equipped to provide high-quality instruction, universities must implement comprehensive teacher training plans. These plans should focus on encouraging and supporting teachers to engage in hands-on engineering practice projects and specialized training courses. By participating in such activities, teachers can keep their knowledge current and gain practical experience that is directly applicable to their teaching.Each year, teachers should attend at least two on-site training sessions and technical exchange meetings organized by industry associations or professional institutions. These sessions should cover the latest advancements in construction technologies, material applications, and quality control measures. Attending these training programs enables teachers to stay updated with the latest developments in their field, ensuring that they can impart cutting-edge knowledge and techniques to their students.

Establishing cooperative relationships with engineering companies and construction units is also crucial. Through these partnerships, teachers can be arranged to intern and observe

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

engineering projects at these units. For example, during the summer holidays, teachers could participate in a one-month internship at a partnering company. During this period, they would be involved in the construction and management of actual engineering projects, gaining firsthand experience with various construction equipment and learning the latest construction technologies and methods. This practical exposure not only enhances teachers' engineering practice abilities but also enables them to bring real-world engineering cases and experiences back into the classroom. This enrichment of teaching content makes lessons more realistic, engaging, and applicable to real-world scenarios.Additionally, universities can organize internal training sessions and experience-sharing events for their teachers. Regularly held teaching seminars and engineering practice exchange meetings provide platforms for continuous professional development. At the end of each semester, universities should invite teachers with extensive engineering experience and industry experts to deliver special lectures and seminars. These experts can share their experiences and insights from actual engineering projects, offering valuable perspectives that can significantly enhance the professional skills of the teaching staff.

These sessions not only improve the individual capabilities of teachers but also foster a culture of mutual learning and collaboration. By exchanging experiences and best practices, teachers can collectively elevate the quality of education they provide. For instance, discussions during these seminars might cover innovative teaching methods, strategies for effectively integrating theoretical knowledge with practical application, and ways to better engage students in the learning process.Moreover, universities should consider incorporating field trips and site visits into their training programs. Allowing teachers to observe large-scale engineering projects in progress provides them with a clearer understanding of contemporary challenges and solutions in the field. These experiences can then be translated into more vivid and relatable classroom examples, enhancing students' learning experiences.

Incorporating feedback mechanisms is also important. Universities should gather regular feedback from teachers about their training needs and experiences. This information can be used to continuously improve training programs, ensuring they remain relevant and effective. Teachers should also be encouraged to provide feedback on how their training experiences have impacted their teaching, helping to create a dynamic and responsive professional development environment.Overall, by implementing these comprehensive training strategies, universities can significantly enhance the practical abilities of their engineering teachers. This not only benefits the teachers but also enriches the learning experiences of their students, ultimately leading to a higher quality of education and better-prepared graduates ready to meet the demands of the engineering profession.

As shown in Table 1:

Table 1. Evaluation of the Implementation Effects of Teaching Reform in Subgrade and Pavement Engineering Courses

Project Name	Before Reform (2022)	First Year After Reform (2023)	Second Year After Reform (2024)	Third Year After Reform (2025)
Average Exam Score (out of 100)	72	78	82	85
Classroom Interaction Frequency (times/semester)	5	12	15	18
Student Homework Submission Rate (%)	60	75	80	85
Teacher Internship Hours	0	40	60	80
Actual Engineering Project Participation Rate (%)	10	25	40	55
Student Course Satisfaction (%)	65	80	85	90

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

4. Implementation Effects of Teaching Model Reform

4.1. Diversification of Assessment Methods

In an effort to provide a more comprehensive evaluation of student learning and abilities, various forms of assessment have been introduced, including chapter tests, mid-term assessments, group assessments, and after-class practice assessments. Each type of assessment serves a specific purpose and together they ensure a holistic evaluation of students' theoretical knowledge, practical skills, and problem-solving capabilities.Chapter tests are conducted at the end of each chapter to assess students' grasp of the key knowledge points and practical application cases discussed in the chapter. These tests are designed to be brief, lasting 30 minutes each, and are scored out of 100 points. This frequent and timely assessment method allows both students and teachers to identify areas of strength and weakness promptly, facilitating immediate corrective measures if necessary.

Mid-term assessments are held in the middle of the semester and combine open-ended questions with case analysis. The mid-term exam lasts 90 minutes and carries a full score of 150 points. This format not only tests students' theoretical understanding but also evaluates their ability to apply knowledge in practical scenarios and solve complex problems. The mid-term questions often involve the analysis of real-world engineering projects, such as developing optimization plans for asphalt pavement structure design or selecting appropriate materials for road construction. By incorporating these open-ended questions, students are encouraged to think critically and independently, fostering a deeper engagement with the material.

Group assessments are another critical component of the diversified assessment strategy. Students are divided into groups of 4-5 members, with each group responsible for the simulated design and analysis of an actual engineering project. The group projects cover multiple stages, including preliminary design, material selection, construction planning, and cost estimation. Each stage requires the group to produce a detailed report and present their findings, followed by a defense session in the classroom. Each group assessment lasts 20 minutes and is scored out of 200 points. This method not only assesses students' technical and analytical skills but also fosters teamwork and project management abilities, which are essential in real-world engineering environments.

After-class practice assessments focus on students' practical abilities outside the traditional classroom setting. At the end of the semester, students must submit a comprehensive practice report, documenting their observations and analyses of actual road construction, maintenance, and management activities within and outside the campus. This report should be no less than 2000 words and carries a full score of 100 points. These reports provide students with the opportunity to apply theoretical knowledge to real-world situations, enhancing their practical skills and reinforcing their learning.The implementation of these diversified assessment methods ensures a more rounded evaluation of students' capabilities. By combining frequent quizzes, in-depth mid-term assessments, collaborative group projects, and extensive after-class practice reports, students are evaluated on multiple fronts. This approach not only enhances their theoretical understanding but also significantly improves their practical skills and problem-solving abilities.

Moreover, these varied assessment methods cater to different learning styles and help maintain student engagement throughout the course. For instance, some students may excel in individual written tests, while others might perform better in collaborative group settings or practical assignments. By providing multiple avenues for assessment, all students have the opportunity to showcase their strengths and improve upon their weaknesses.In conclusion, the diversification of assessment methods in the subgrade and pavement engineering course not only ensures a comprehensive evaluation of students' knowledge and skills but also prepares them more effectively for real-world engineering challenges. Through these assessments,

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

students develop a well-rounded skill set that includes theoretical understanding, practical application, teamwork, and independent problem-solving, ultimately enhancing their readiness for professional careers in engineering.

4.2. Enhancement of Students' Comprehensive Abilities

To significantly enhance the comprehensive abilities of students, the course now includes a variety of practical and project-based learning activities. One of the key additions is a weekly practical class, lasting two hours, where students engage in hands-on activities and experiments. These sessions are designed to help students deeply understand the various techniques and methods involved in subgrade and pavement engineering. During these lab sessions, students conduct physical performance tests on road materials, operate advanced experimental equipment, and record and analyze experimental data. This hands-on practice not only enhances their practical skills but also deepens their understanding of theoretical knowledge.

Project-based learning has also been integrated into the curriculum as a crucial method for improving students' comprehensive abilities. Each semester, students are required to complete a comprehensive project, independently managing all stages from project selection and data collection to plan design and implementation. This project spans 12 weeks, during which students must submit weekly progress reports and present and defend their projects at the end of the semester. This approach teaches students how to independently carry out an engineering project, fostering their innovative thinking and problem-solving abilities[3]. The rigorous process of managing a project from start to finish helps students develop critical skills such as project management, teamwork, and effective communication.

In addition to hands-on practice and project-based learning, the reformed teaching model places a strong emphasis on data analysis skills. The course now includes extensive content on data analysis and statistics, teaching students how to use software tools like Excel and SPSS to analyze and process road engineering data. Students learn to perform statistical analysis on experimental data, create charts, and write comprehensive reports. These data analysis tasks significantly enhance their computer application and data processing skills, which are essential in modern engineering practices. By integrating these skills into the curriculum, students are better prepared to handle real-world engineering problems that require both technical knowledge and analytical capabilities.Moreover, the incorporation of practical sessions, projects, and data analysis tasks ensures that students are not only learning theoretical concepts but also applying them in real-world scenarios. This comprehensive approach to learning helps bridge the gap between theory and practice, making the educational experience more relevant and engaging for students. For instance, in practical sessions, students might test the strength and durability of different road materials, gaining insights that are directly applicable to their projects. In turn, their projects may require them to use the data collected from these tests to make informed decisions about material selection and construction techniques.

Furthermore, the emphasis on project-based learning encourages students to take ownership of their education. By working on long-term projects, they develop a sense of responsibility and accountability, as their performance is directly tied to the success of their projects. This independent approach to learning fosters self-motivation and drives students to explore innovative solutions to complex problems. The skills gained through this process are invaluable, preparing students for the dynamic challenges they will face in their professional careers.The reformed teaching model also includes regular feedback and evaluation mechanisms to ensure continuous improvement. Teachers provide guidance and constructive feedback throughout the project development process, helping students refine their ideas and approaches. This

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iterative process of feedback and improvement further enhances students' learning experiences and outcomes.

In summary, the comprehensive measures implemented in the reformed teaching model have significantly improved students' abilities across various dimensions. Through weekly practical classes, project-based learning, and an emphasis on data analysis, students acquire solid theoretical knowledge while enhancing their practical skills, innovative thinking, and problem-solving abilities. These improvements lay a strong foundation for their future career development, equipping them with the competencies needed to succeed in the field of subgrade and pavement engineering.

5. Practice and Summary of Teaching Model Reform

5.1. Implementation Effects of the Dual-Training Model between Universities and Enterprises

The dual-training model between universities and enterprises has been highly effective in enhancing students' practical skills and employability. Each academic year, students participate in two four-week internships at partnering enterprises, where they involve themselves in the construction and management of actual engineering projects. These projects typically include significant tasks such as urban road repairs and bridge maintenance, with budgets often exceeding 5 million RMB. This immersive experience allows students to accumulate at least 320 hours of hands-on engineering practice before graduation.During these internships, students become well-acquainted with the operational procedures and management methods prevalent on construction sites. They engage in various stages of project execution, from initial planning and material selection to on-site management and quality control. This exposure provides them with a comprehensive understanding of the complexities and challenges involved in real-world engineering projects.

Data indicates that participation in the dual-training model significantly enhances students' employability upon graduation. Employers value the practical experience and problem-solving skills that students gain through these internships. Students are able to demonstrate their ability to apply theoretical knowledge to practical situations, making them highly attractive candidates in the job market.Throughout their internships, students are required to complete an average of three project reports. These reports cover a wide range of topics, including material selection, construction techniques, and project management strategies. The process of preparing these reports helps students to consolidate their learning and develop critical analytical and communication skills. They learn to document their observations, analyze data, and present their findings in a professional manner.

The dual-training model also fosters strong partnerships between universities and industry. It provides a platform for continuous feedback and collaboration, ensuring that the curriculum remains relevant to industry needs. By working closely with industry professionals, students gain insights into current trends and innovations in the field of engineering. This collaboration also opens up opportunities for universities to refine their teaching methods and incorporate real-world case studies into their courses.Overall, the implementation of the dual-training model has proven to be a successful strategy for bridging the gap between academic learning and practical application. Students emerge from the program with a robust skill set, ready to tackle the demands of their professional careers. The practical experience gained through these internships not only enhances their technical abilities but also boosts their confidence and readiness to contribute effectively to the engineering industry.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202409_7(9).0016

5.2. Continuous Improvement and Optimization Strategies

At the end of each semester, detailed questionnaires and interviews are conducted with students to gather their feedback on course content, teaching methods, and practical sessions. Based on this feedback, the course syllabus and teaching plan are updated annually, incorporating more real-world cases and practical operation content frequently mentioned by students[4]. For instance, in 2023, a new module titled "Application of High-Strength Concrete in Bridge Construction" was added, increasing practical operation time by 20 hours and introducing two of the latest models of concrete mixers for student use.Each semester, industry experts and enterprise engineers are invited to give at least two special lectures and technical training sessions. These sessions cover the latest construction technologies, material applications, and project management methods. These lectures and training not only enrich the course content but also provide students with opportunities to learn about the latest industry trends and technological developments.

6. Conclusion

The reform and practice research of the full English teaching model for the subgrade and pavement engineering course have led to several significant improvements. This paper proposes specific measures, including enhancing teacher-student interaction, improving teachers' engineering practice abilities, diversifying assessment methods, and implementing a dual-training model between universities and enterprises. The research results indicate that these measures significantly enhance students' comprehensive abilities and employability. Continuous improvement and optimization strategies have further aligned the course content with actual engineering needs, resulting in a sustained enhancement of teaching quality. These efforts ensure that students are better prepared for real-world challenges, possessing both practical skills and innovative thinking.The findings from this research provide valuable insights and references for the ongoing teaching reform of the subgrade and pavement engineering course. By laying a solid foundation for cultivating engineering talents, this approach equips students with the necessary competencies to excel in their future careers.

Acknowledgments

Any Funded Projects: (University-level, "The 10th Batch of All-English Teaching Demonstration Course Construction Project of University of Science and Technology Beijing", KC2021QYW07).

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