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Reform and Practice of Engineering Mechanics Courses in the Electrical Engineering Major in the Context of Engineering Education Accreditation

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ABSTRACT

With the gradual promotion of Engineering Education Accreditation, the reform of the "Engineering Mechanics" course in the electrical engineering major is particularly urgent. Based on the background of Engineering Education Accreditation, this paper discusses the importance of the "Engineering Mechanics" course in the electrical engineering major, analyzes the shortcomings of the course setting and the new requirements brought by Engineering Education Accreditation, and proposes four main ideas for curriculum reform: strengthening the combination of theory and practice, dynamically updating course content, optimizing the school-enterprise cooperation model and establishing a diversified evaluation mechanism. Through the analysis of specific teaching cases, the effectiveness of these reform measures is verified, and corresponding response strategies are provided for the challenges that may be faced during the implementation process to ensure the effectiveness and sustainability of teaching reform. Finally, looking to the future, the importance of continuously promoting curriculum reform is emphasized to cultivate high-quality engineering talents that better meet the needs of the industry.

KEYWORDS

Engineering Education Accreditation; Electrical Engineering; Engineering Mechanics; Curriculum Reform; Teaching Cases.

1. INTRODUCTION

With the advancement of globalization and the rapid development of technology, the quality standards and training objectives of engineering education in various countries have gradually become unified to adapt to the complex needs of industry and society. As an important means to ensure that engineering education meets the needs of the industry, Engineering Education Accreditation has gradually become one of the educational goals of universities in various countries. Engineering Education Accreditation not only focuses on the teaching of basic knowledge of the subject, but also pays more attention to students' practical problem-solving ability, the cultivation of innovative thinking, and the improvement of interdisciplinary collaboration ability (Zhang et al., 2024). In this context, curriculum setting, teaching methods and teaching quality control have become the core concerns of engineering education. As a basic course for engineering students, especially electrical engineering students, the course of "Engineering Mechanics" bears the dual responsibility of cultivating students' mechanical knowledge and engineering application ability. However, the traditional course setting and teaching methods of "Engineering Mechanics" are usually based on theoretical teaching, ignoring the importance of practical links, resulting in certain limitations on

students' hands-on ability and innovative thinking. This education model is difficult to meet the requirements of modern Engineering Education Accreditation. Therefore, it is imperative to reform the engineering mechanics course (Chen, 2024).

2. BASIC REQUIREMENTS FOR ENGINEERING EDUCATION ACCREDITATION

The basic requirements for engineering education accreditation are aimed at ensuring the quality of engineering education in colleges and universities and cultivating high-quality engineering talents that meet the needs of the industry.

First, engineering education accreditation requires colleges and universities to clearly define training objectives and graduation requirements. These objectives should reflect the comprehensive development of students in terms of knowledge, practical ability, professional literacy and innovation awareness to meet industry standards and enhance students' professional adaptability (Zhang et al., 2023). In terms of the curriculum system, the curriculum needs to cover basic science, professional core courses and rich practical links to ensure that students have solid theoretical knowledge and strong practical operation capabilities. At the same time, the course content should be continuously updated with technological progress and industry needs to ensure that students' learning content is consistent with current engineering practice (Chen et al., 2024).

Second, the faculty and teaching resources are the core support for course quality. The school needs to be equipped with a team of teachers with engineering practice experience and provide sufficient experimental facilities and practical opportunities to create a good learning environment (Wang & Liu, 2023). The quality assurance mechanism is an important part of the certification. By establishing a sound teaching quality monitoring and evaluation system, schools can continuously improve teaching content and methods to ensure the stability and continuity of teaching quality (Xu, 2023).

Thirdly, student performance evaluation is also a core requirement of certification. Certification not only focuses on students' academic performance, but also emphasizes the evaluation of students' comprehensive abilities, including practical ability, communication ability, teamwork and innovative thinking, in order to cultivate graduates with comprehensive professional qualities (Yang, 2024).

In summary, Engineering Education Accreditation promotes the standardization and internationalization of engineering education in colleges and universities, and improves the quality and employment competitiveness of engineering talents through multiple requirements, so that students can better adapt to the future development needs of the engineering industry.

3. NECESSITY OF REFORMING THE COURSE OF ENGINEERING MECHANICS IN THE CONTEXT OF ELECTRICAL ENGINEERING

In the training program of electrical engineering, the course of Engineering Mechanics is usually a basic compulsory course to lay a theoretical foundation for subsequent professional courses. However, with the popularization of Engineering Education Accreditation and the improvement of the requirements for professional engineering education, the existing course setting has some shortcomings in terms of content depth, teaching methods and students' practical application ability. Therefore, the reform of the course of Engineering Mechanics in the context of electrical engineering is imperative.

Since China joined the Washington Accord in 2016, the domestic Engineering Education Accreditation system has gradually aligned with international standards, and the reform of engineering courses has become more urgent. In the electrical engineering major, the reform direction of the course of Engineering Mechanics should focus on students' ability to apply mechanical

knowledge to solve engineering problems in order to meet the certification requirements (Zhang, 2023). Specifically, Engineering Education Accreditation encourages the introduction of the concept of Outcome-Based Education (OBE) into course design to clarify students' learning goals, improve students' engineering practice ability through diversified teaching methods, and strengthen the cultivation of interdisciplinary application ability (Huang & Li, 2024).

In the practice of the reform of the Engineering Mechanics course, engineering schools in the United States and Europe have gradually introduced Project-Based Learning (PBL) and Case-Based Teaching. Through real projects in the field of electrical engineering, students can acquire the ability to analyze and solve practical engineering problems while learning the principles of mechanics. This teaching model effectively improves students' practical ability and innovative thinking, and adapts to the industry's demand for engineering professionals (Johnson & Davis, 2024).

In contrast, the Engineering Mechanics courses in domestic universities are still mostly in the traditional theoretical teaching stage, with limited practical content and lack of diversified evaluation methods. This situation is expected to be improved under the promotion of Engineering Education Accreditation. By introducing project practice, case teaching and other methods, it not only enriches the teaching content, but also enhances students' learning experience and practical operation ability (Wang et al., 2024). Engineering Education Accreditation also encourages universities to add experimental links related to electrical engineering in the Engineering Mechanics course, such as mechanical analysis in the structural design and installation of electrical equipment. Through these interdisciplinary experiments and project practices, students can apply the theoretical knowledge learned in class to actual engineering projects, realize knowledge transfer and improve professional skills (Zhao & Yang, 2024). The certification system also requires diversified course evaluation methods, such as adding process evaluation to examine students' project completion and problem-solving ability, so that the course reform is more in line with industry needs.

In summary, driven by Engineering Education Accreditation, the "Engineering Mechanics" course of the electrical engineering major needs to be comprehensively reformed from content, teaching methods to evaluation system, to enhance students' practical ability and promote the integration of interdisciplinary knowledge. This can not only effectively improve the teaching quality, but also lay a solid career foundation for students in the increasingly competitive engineering field.

4. SPECIFIC IDEAS FOR THE REFORM OF ENGINEERING MECHANICS COURSES

In the current context of Engineering Education Accreditation, the reform of engineering mechanics courses is particularly important. Especially in the electrical engineering major, the course setting is insufficient and lacks projects and cases combined with practical applications, which urgently needs systematic reform. The following four specific reform ideas are proposed to improve the practicality and scientificity of engineering mechanics courses.

4.1. Introducing Real Engineering Cases

In the engineering mechanics course, real engineering cases related to electrical engineering should be added to help students combine theoretical knowledge with practice. For example, by analyzing the loads on high-voltage transmission lines and substations, the stress conditions under different loads (such as wind loads and ice and snow loads) can be explored. Through case teaching, students can not only understand the practical application of mechanical principles, but also improve their ability to solve engineering problems. This teaching method has been proven by many studies to effectively enhance students' learning interest and engineering practice ability (Chen et al., 2021).

4.2. Design Project-oriented Course Modules

The course content is divided into multiple modules, including theoretical learning, case analysis and project practice. Each module should be designed around a specific electrical engineering project, such as structural safety analysis and equipment strength calculation in power systems. Through group cooperation, students can assume different roles in the project (such as designers and analysts) to enhance their teamwork ability and engineering thinking. This project-oriented teaching method has been widely used in engineering education abroad with significant results (Mills et al., 2022).

4.3. Systematicity and Integrity of Course Content

Engineering Education Accreditation requires that course content be systematic and complete. Therefore, in the reform, it should be ensured that the course covers the basic principles of mechanics and its application in electrical engineering. It is recommended to introduce the research results of modern mechanics, such as the application of material mechanics and fluid mechanics in power equipment. Through a systematic knowledge structure, students can understand the development trends and industry standards of current technologies while mastering theoretical knowledge. In addition, the course should be updated regularly to ensure that it is consistent with engineering practice (Wang et al., 2023).

4.4. Establish a Continuous Evaluation and Feedback Mechanism

In the process of curriculum reform, it is crucial to establish an effective evaluation and feedback mechanism. The implementation effect of the course can be evaluated regularly through various forms such as course evaluation, student feedback, and peer review to ensure that the achievement of course objectives is consistent with the requirements of Engineering Education Accreditation. Through continuous evaluation and adjustment, problems in course implementation can be discovered and solved in a timely manner, thereby continuously improving course quality and teaching effectiveness. At the same time, teachers should participate in this mechanism and continuously improve their teaching ability through reflection and discussion.

5. CURRICULUM REFORM CASES AND PRACTICE

In 2023, the electrical engineering major of our school launched a comprehensive reform of the "Engineering Mechanics" course, with the goal of improving the quality of the course and enhancing students' practical application ability. Reform measures include introducing case analysis, strengthening experimental links, and carrying out school-enterprise cooperation. The following is an example of the teaching case of wind turbine force analysis.

5.1. Case Background

With the rapid development of renewable energy, wind energy has become one of the clean energy sources widely used worldwide. As an important equipment for wind energy conversion, the structural design and force analysis of wind turbines are crucial. In the engineering mechanics course of the electrical engineering major, the introduction of the wind turbine force analysis case can enable students to master theoretical knowledge in practice, while improving their engineering practice ability and ability to solve practical problems.

5.2. Teaching Process

Theoretical Learning (2 weeks). Before the case begins, teachers should arrange two weeks of theoretical learning, including: the basic structure and working principle of wind turbines; basic

knowledge of mechanics, especially the relevant theories of statics and dynamics; related calculation methods, such as force decomposition, synthesis and material strength calculation. Learning materials can include textbooks, research papers, and reports from professional organizations.

Experimental preparation (1 week). Under the guidance of the teacher, students are divided into groups to draw model drawings according to the design standards of wind turbines, and use 3D printing technology to make a small wind turbine model, which is required to simulate the force analysis under actual working conditions. At the same time, necessary experimental equipment is prepared, such as sensors (force sensors, angle sensors), fans (simulating wind speed), and data acquisition equipment.

Practical experiment (2 weeks). In the laboratory, install the prepared wind turbine model in front of the fan to ensure its stability and safety. Turn on the fan, simulate different wind speeds, and record the force data of the wind turbine at each wind speed. Use force sensors and angle sensors to record wind force, speed, torque and other data. Use MATLAB or Excel to analyze the collected data and draw force change diagrams, speed and output power relationship diagrams, etc.

School-enterprise cooperation (1 week). In order to improve students' practical ability and industry adaptability, it is recommended to establish a cooperative relationship with local wind energy companies. Through school-enterprise cooperation, arrange students to visit wind power generation enterprises to understand the working environment, maintenance and management of actual wind turbines. Invite industry experts to give lectures to students, share actual engineering cases and technical experience, and enhance students' understanding of the combination of theory and practice.

Practical effect evaluation (1 week). After the case is over, conduct an evaluation of the practical effect, including student reports, results display and feedback collection. Each group of students writes an experimental report, including theoretical analysis, experimental process, data analysis, result discussion and conclusion, etc. Organize a results exhibition, each group of students presents their research results, and defends, and accepts comments from teachers and peers. Collect students' feedback on the course, understand the difficulties and suggestions they encounter in the learning process, so as to facilitate the subsequent improvement of the course.

5.3. Expected Results and Reflections

Through this case, students can not only have a deep understanding of the force analysis of wind turbines, but also improve their teamwork and problem-solving skills in practice. Through school-enterprise cooperation, students can gain a broader perspective and practical experience, laying the foundation for their future careers. In the subsequent implementation, we can further collect students' learning performance data, analyze the effectiveness of case teaching, and continuously optimize the teaching plan by combining theoretical and practical feedback to ensure the realization of the goals of engineering mechanics curriculum reform.

6. CHALLENGES AND COUNTERMEASURES OF CURRICULUM REFORM AND PRACTICE

In the above case teaching, although students are provided with opportunities to combine theory with practice, they still face multiple challenges in the implementation process. The following is a discussion of these challenges and their countermeasures in combination with specific teaching cases to ensure the effectiveness and sustainability of curriculum reform.

6.1. Challenges

Difficulties in combining theory with practice. The gap between the abstractness of theoretical knowledge and the concreteness of practical operations may cause students to feel at a loss when

performing actual calculations and data analysis. For example, when students conduct force tests on wind turbines in the laboratory, how to combine experimental data with theoretical models is often a challenging task.

Coordination issues in school-enterprise cooperation. Although school-enterprise cooperation can provide students with opportunities for internships and practice, in actual implementation, the goals between schools and enterprises may not be consistent. For example, enterprises are more concerned about the rapid improvement of skills, while schools focus on the comprehensive development and long-term training of students. This mismatch of goals may lead to a significant reduction in the effectiveness of the cooperative project and affect students' actual learning experience.

Insufficient evaluation mechanism. The current evaluation system often focuses on the examination of theoretical knowledge, but lacks effective evaluation criteria for students' performance in practical projects. In the project of wind turbine force analysis, how to comprehensively evaluate students' practical ability, data analysis ability and teamwork ability is still an urgent problem to be solved.

6.2. Countermeasures

Strengthen the combination of theory and practice. Teachers should adopt the project-based learning (PBL) method in the course to combine theoretical knowledge with practical cases. In the wind turbine force analysis project, teachers can enhance students' practical ability and teamwork spirit by letting students work together in groups to solve specific problems, such as designing wind turbines and analyzing their forces.

Optimize the school-enterprise cooperation model. In school-enterprise cooperation, schools should clarify the common goals of cooperation, formulate detailed cooperation plans, and ensure that the resources of both parties are effectively integrated. By establishing an "industry advisory committee" and inviting engineers and technicians from enterprises to participate in course design, project guidance and evaluation, students' practical ability can be enhanced. At the same time, students are encouraged to intern in enterprises and apply classroom knowledge to actual work to deepen their understanding.

Establish a diversified evaluation mechanism. Schools should build a diversified evaluation system that includes not only theoretical examinations but also focuses on the evaluation of practical ability. Comprehensive evaluation can be carried out through various forms such as experimental reports, project presentations and teamwork evaluations. In the wind turbine force analysis project, the evaluation can include the role of students in the project, participation and the quality of the final results, which fully reflects the learning effect of students.

7. CONCLUSION

In the context of Engineering Education Accreditation, the reform of the "Engineering Mechanics" course in the electrical engineering major is imperative. Through case analysis, experimental reinforcement and school-enterprise cooperation, students' practical ability and comprehensive quality can be effectively improved. In the face of the ever-changing engineering education environment, we will continue to promote curriculum reform and strive to cultivate electrical engineers who meet the needs of the times.

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