

Challenges and Teaching Reform Strategies in Vocational College Engineering Training Courses

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Abstract: With the rapid development of vocational education, engineering training has become a crucial course for cultivating highly skilled technical professionals, highlighting its importance. However, vocational college engineering training courses still face numerous challenges during the actual teaching process, which affect the effectiveness of course teaching and the enhancement of students' engineering competence. This article thoroughly analyzes the main problems existing in current engineering training course teaching, focusing on four aspects: students' cognitive differences, inadequate course development, poor course adaptability, and limited teaching resources. Based on this analysis and previous research findings, targeted strategies are proposed, including enhancing students' course cognition, clarifying course positioning, improving course adaptability, and optimizing the allocation of teaching resources. Furthermore, this article preliminarily verifies the effectiveness of some reform strategies through a small-scale teaching experiment. This study aims to provide theoretical guidance and practical reference for enhancing the teaching quality of vocational college engineering training courses.

Keywords: Vocational colleges; Engineering training; Teaching reform; Course development; Practical teaching

Online publication: August 6, 2024

1. Introduction

Engineering training is a comprehensive practical course offered by higher vocational colleges to cultivate students' engineering awareness, engineering literacy, and practical skills ^[1]. This course aims not only to strengthen students' understanding and mastery of engineering theory and basic skills but also to foster their engineering thinking, innovation consciousness, and practical hands-on abilities ^[2]. With the rapid development of modern engineering technology and the increasing demand for highly skilled technical professionals in society ^[3,4], engineering training courses play an increasingly important role in the talent cultivation system of vocational colleges.

However, vocational college engineering training courses still face numerous challenges and difficulties during the actual teaching process ^[5]. These problems not only affect the effectiveness of course teaching but also hinder the comprehensive improvement of students' engineering literacy. Therefore, it is necessary to

conduct an in-depth analysis and reflection on the existing teaching models of engineering training courses in order to propose targeted reform strategies that optimize course development and improve teaching quality.

2. Main problems faced by engineering training courses

2.1. Students' poor understanding and acceptance of the course

Engineering training courses in vocational colleges primarily target freshmen who have just transitioned from high school. These students generally lack a clear understanding of their professional orientation and future career needs^[6,7]. Due to the specialized and conceptual nature of engineering training course names^[8], as well as the poor connection with the content studied in high school, students often struggle to fully comprehend and value this course, even considering it as secondary. This cognitive bias severely affects students' acceptance of the course and their motivation to learn, thereby impeding the achievement of the course's intended teaching goals.

2.2. Limited reference resources and unclear course positioning in course development

As an emerging comprehensive practical course, engineering training has not yet been widely popularized in China^[9]. This lack of popularity limits the availability of teaching resources and successful case studies that can be referenced during the course development process. Some vocational colleges, when offering this course, excessively borrow construction models from traditional internship courses such as metalworking internships, resulting in unclear course positioning and the failure to fully demonstrate the characteristics and advantages of engineering training courses. Additionally, due to insufficient reference materials, teachers face numerous difficulties in course design, content arrangement, and selection of teaching methods.

2.3. Poor adaptability of course modules to different majors

As a public foundational course for all students, engineering training aims to develop engineering skills and literacy among all students^[10,11]. However, in actual teaching, due to the emphasis on machining operations, assembly of mechanisms, and craftsmanship, students from non-engineering majors such as humanities and business often struggle to find interest and resonance in these project contents^[12]. Furthermore, the uniformity and standardization of course content lead to a lack of targeted and adaptable engineering training for students from different majors, thus failing to meet the personalized training needs of different students.

2.4. Scarcity of teaching equipment and practical training facilities

Another significant issue in the teaching of vocational college engineering training courses is the scarcity of teaching equipment and practical training facilities^[13,14]. With the increase in student numbers and the continuous updating of course content, existing teaching equipment and training facilities often struggle to meet the growing teaching demands. This not only affects teaching quality and effectiveness but also severely hampers the effective cultivation of students' practical skills and innovative abilities. Additionally, as engineering training courses place significant emphasis on students' practical hands-on experiences, overcrowded training facilities may also pose safety risks^[15].

3. Strategies for addressing the issues

To address the aforementioned issues, based on previous research findings and survey analysis, this paper proposes the following strategies.

3.1. Enhancing students' understanding and acceptance of the course

To enhance students' understanding and awareness of engineering training courses, a combination of online and offline approaches can be used. During the online pre-learning phase, students can be introduced to basic information about the course, such as the location, teaching methods, and learning projects. This helps students develop a preliminary understanding of the course. In terms of instructional design, incorporating real-life examples and engineering case studies closely related to the course content can enhance its relevance and practicality. During offline teaching, activities such as career connections and project presentations can help students clarify the learning objectives and professional value of the course, thereby increasing their motivation and interest.

3.2. Clarifying course positioning and enriching course resources

To address the lack of reference materials for course development, vocational colleges should strengthen communication and cooperation with domestic and international universities and industry enterprises. They should actively introduce advanced engineering training concepts and teaching methods. Additionally, considering the characteristics of the institution, talent development objectives, and existing teaching resources, it is essential to clarify the positioning and objectives of the engineering training course. Developing course outlines, teaching cases, and practical training projects that are tailored to the institution's needs can help form a distinctive course system. Furthermore, collaboration with industry partners can enrich the course content and practical aspects by incorporating real engineering cases and projects.

3.3. Enhancing adaptability of course modules to different majors

To address the issue of poor adaptability of course modules to different majors, vocational colleges should fully consider the characteristics and needs of different majors and design and adjust course modules accordingly. Specifically, conducting internal surveys and analyzing industry demands can help identify the core competency requirements of engineering training courses for different majors. By aligning the talent development objectives of the institution with the competency requirements of the industry, it is possible to create training objectives and competency profiles for different majors. Modularizing the course projects based on these profiles can facilitate personalized training for students from different majors. Additionally, implementing a "modular + core course" curriculum system and offering elective modules such as electronics production and 3D printing can allow students to choose modules that align with their interests and career plans. This approach not only meets the diverse needs of students from different majors but also stimulates their interest and initiative in learning.

3.4. Optimizing resource allocation and strengthening equipment updates and facility development

To address the scarcity of teaching equipment and practical training facilities, vocational colleges need to optimize resource allocation and enhance equipment updates and facility development. On the one hand, existing teaching equipment and training facilities should be properly planned and allocated to ensure their full utilization. Enhancing communication and collaboration between different colleges and departments can facilitate resource sharing and complementarity, thereby improving resource utilization efficiency. On the other hand, actively seeking government and social funding support is crucial for expanding the scale of practical training facilities, increasing training workstations, and acquiring advanced equipment to provide students with more practical opportunities. Additionally, vocational colleges should strengthen cooperation with industry enterprises and explore new models of co-building training bases or laboratories to make full use of the industry's engineering practice resources. Establishing sound equipment management systems and maintenance

mechanisms is vital to ensure the normal operation and effective utilization of equipment. Furthermore, providing training and management for students on equipment usage can enhance their skills and awareness, reducing equipment damage and waste.

4. Teaching practice and effect analysis

To verify the feasibility and effectiveness of the above reform strategies, we conducted small-scale practical explorations in the teaching of engineering training courses in vocational colleges. The main reform measures include:

- (1) Strengthening online and offline promotion, using the model of promoting course project results to enhance students' awareness of the course: College students are the most willing to accept new things and have the courage to experiment. As the first practical course for freshmen, engineering training is far from the courses that students encounter in secondary education in terms of course name and content. Most college students only develop a disinterest in learning due to the unknown. Based on the personality traits of college students in this area, in the construction of the engineering training course, the first step is to build a "course stage" in the minds of students through the introduction of online craftsmanship spirit, the preparation of course enterprise scenarios, and the display of course effects. As shown in **Figure 1**, it is an enterprise scenario that lays the groundwork for a module project before class: the work tasks of outstanding alumni in real life and the pre-promotion of the course are carried out. At the same time, after practice, students are allowed to bring their work out of the classroom in the form of work returns, as shown in **Figure 2**, which is a personal name seal made by laser processing for students. This directly establishes a work ethic for students, where hard work pays off. At the same time, having a solid wooden name badge on hand is an excellent way to promote the course. When new students see the badges and ask about their origin, they will learn that these name badges are a product of the engineering training course project, sparking their interest in the course and its activities. The achievement promotion model is dynamically formed and can be promoted for a long time.



Figure 1. Work Tasks of Outstanding Alumni video



Figure 2. Personal name stamps made by students through laser processing

- (2) Sorting out the teaching objectives of the course, guiding it towards the needs of enterprises and professions, and optimizing the content structure of the course: The teaching objective of the engineering training course is to cultivate students' skills and qualities. Most of the practical courses that students come into contact with before college are based on their interests or the training direction of middle and high schools, emphasizing the cultivation of specific qualities such as aesthetic literacy and literary literacy, while neglecting students' career development plans, personal future career, and the development of corresponding enterprises. This teaching practice is guided by the specific needs of enterprises and professions, combined with professional needs to reorganize teaching objectives and cultivate students' skills, majors, and literacy needs. Through engineering simulation scenario mode, the course content and structure are optimized, and the course construction is rationalized.
- (3) Introducing a modular course selection mechanism, focusing on student adaptability, and increasing the number of self-selected module projects: Students choose their adaptive course tasks based on their receptivity, hands-on ability, and interests, and capture the adaptive modules within them. Students complete the designated learning tasks and enhance skill training with the same direction, positioning, degree, and personality through different modules of carriers, as shown in **Figures 3** and **4**.



Figure 3. Adaptation project: Galileo's Pendulum

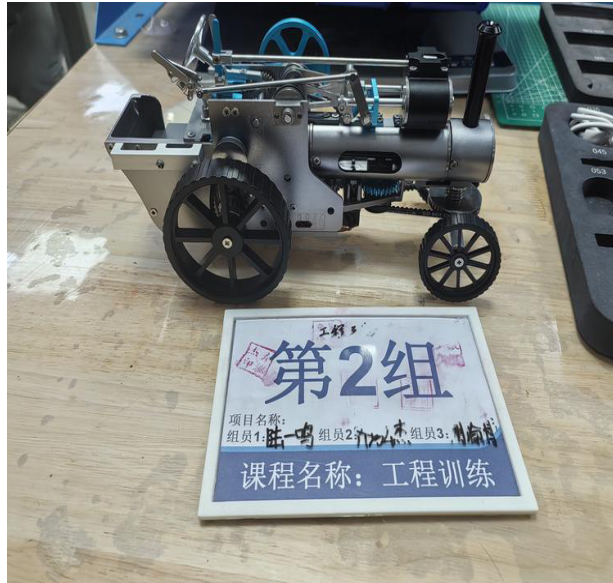


Figure 4. Adaptation project: Steam Locomotive

Through half a semester of teaching practice, we have initially achieved the following results: students' overall recognition of the course and interest in learning have significantly improved; the course content is more diverse, reflecting a certain degree of professional adaptability; the construction of school-enterprise cooperation bases provides students with a more authentic practical environment. Specifically reflected in:

- (1) Increased student classroom participation: The attendance results of the engineering training course on the learning platform show that since the reform, the average attendance rate of students in electronic attendance has increased from 79% before the reform to 93%;
- (2) Improved course satisfaction: Based on the student evaluation organized by the school each semester and the department-level specialized questionnaire for the engineering training course, a final satisfaction survey of students showed that 90% of students were "very satisfied" or "satisfied" with the course.
- (3) Improvement in course completion excellence rate: Since the reform, the practical training results of the engineering training course have significantly improved compared to the previous year, and the excellence rate (above 90 points) has increased from 17% to 43%.

Overall, the teaching reform has achieved initial results, but there are also some shortcomings, such as limited types and quantities of elective modules and the need to strengthen the depth of school-enterprise cooperation. In the subsequent practice, we will continue to optimize and improve the reform measures, and continuously improve the teaching quality of engineering training courses.

5. Conclusions and outlook

Engineering training courses in vocational colleges play a crucial role in cultivating students' engineering literacy and practical skills. However, these courses still face several challenges in the teaching process, such as differences in students' course understanding, unclear course positioning, poor course adaptability, and a scarcity of teaching resources. Based on the analysis of these main issues, this paper proposed a series of reform strategies, including enhancing students' course understanding, clarifying course positioning, improving course adaptability, and optimizing the allocation of teaching resources. Through small-scale teaching experiments, we

have achieved certain results in improving the teaching quality and student engagement in engineering training courses.

Looking ahead, we will continue to deepen the teaching reform of engineering training courses and strive to build a more scientific and comprehensive curriculum system. In terms of course content, we will continuously update and enrich the course modules based on the development of emerging engineering technologies, incorporating content from cutting-edge fields such as artificial intelligence, new energy, and intelligent manufacturing to keep up with the times. At the same time, we will innovate teaching methods and approaches, actively exploring new teaching models such as flipped classrooms, blended learning, and virtual simulation training to enhance students' learning experience and course engagement. In terms of practical teaching, we will further strengthen cooperation with industry enterprises. In addition to co-building training bases, we will also explore new models of school-enterprise cooperation, such as "order-based" training, to provide students with more authentic and immersive practical environments. Furthermore, we will enhance the cultivation of students' innovation awareness and abilities in the course teaching, designing more heuristic and inquiry-based practical projects to encourage students to discover and solve problems in practice, fostering highly skilled technical talents with innovative spirit and practical skills.

Acknowledgments

Thanks to Dr. Xiaojiao Wang from Beijing Polytechnic for his assistance in calculation.

Funding

Science and Technology Project of Beijing Polytechnic (Project leader: Yueyi Li; Project number: 2024X016-SXY)

Disclosure statement

The authors declare no conflict of interest.

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