

Fault Dilemma and Cohesion Optimization of Mechanical Courses in Intelligent Construction Major

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Abstract

With the rapid development of intelligent construction, the integration of mechanical engineering and intelligent technologies has become crucial for cultivating interdisciplinary talents. However, mechanical courses in intelligent construction programs are facing a prominent “fault dilemma”, manifested in disconnections between traditional mechanical knowledge and intelligent construction demands, fragmented curriculum systems and inadequate practical application. This paper analyzes the causes of such faults from curriculum content, teaching methods and interdisciplinary integration. It further proposes optimization strategies for curriculum cohesion, aiming to provide a reference for improving the quality of mechanical course teaching in intelligent construction majors.

Keywords: Intelligent construction; Mechanical courses; Curriculum fault; Curriculum cohesion; Educational reform

Introduction

Intelligent construction, as a core direction of the transformation and upgrading of the construction industry, relies heavily on the integration of mechanical engineering, information technology and civil engineering [1]. Mechanical courses, which lay the foundation for students to master intelligent construction equipment, automation technologies and robotic applications, play an irreplaceable role in the training system. However, influenced by factors such as outdated teaching concepts and disjointed curriculum design, mechanical courses in many universities have gradually shown a “fault” phenomenon: on the one hand, traditional mechanical knowledge (e.g., classical mechanics, conventional machinery design) cannot effectively connect with intelligent technologies (e.g., Internet of Things, artificial intelligence); on the other hand, the separation between mechanical courses and other professional courses (e.g., BIM technology, digital construction) leads to students’ inability to apply mechanical knowledge to solve practical problems in intelligent construction [2]. This paper focuses on the “fault dilemma” of mechanical courses in intelligent construction majors, explores its specific manifestations and underlying causes and puts forward targeted cohesion optimization strategies, thereby promoting the organic integration of mechanical education and intelligent construction talent training goals.

The “Fault Dilemma” of Mechanical Courses in Intelligent Construction Major

Disconnection between curriculum content and industry demand

Traditional mechanical courses in intelligent construction programs still focus on the principles of general machinery, such as material mechanics, mechanical design and construction machinery operation [3]. However, the intelligent construction industry increasingly demands knowledge of intelligent equipment, such as construction robots, automated formwork systems and digital control of mechanical arms. The outdated content

makes it difficult for students to understand the working principles of intelligent construction equipment, resulting in a fault between theoretical knowledge and practical application. For example, when learning about construction machinery, students only master the basic structure of traditional cranes but lack the ability to analyze the intelligent control systems of unmanned cranes, which directly affects their adaptability to future work.

Fragmentation between mechanical courses and interdisciplinary courses

Intelligent construction is a typical interdisciplinary field, requiring the integration of mechanical engineering, computer science and civil engineering [4]. However, in current curriculum systems, mechanical courses are often set independently, lacking effective connection with courses such as “Intelligent Sensing Technology”, “BIM Application” and “Construction Automation”. For instance, students learn about mechanical transmission in “Mechanical Design” but cannot combine it with the sensor data acquisition in “Intelligent Sensing Technology” to analyze the intelligent adjustment of mechanical equipment. This fragmentation leads to students’ inability to form a systematic knowledge framework, making it difficult to solve complex engineering problems in intelligent construction.

Insufficiency in practical teaching and intelligent skills training

Mechanical courses attach great importance to practical teaching, but the existing experimental and practical links are mostly based on traditional mechanical equipment, lacking intelligent elements [5]. For example, laboratory equipment is still dominated by ordinary lathes and hydraulic systems, while intelligent construction-related equipment such as modular construction robots and 3D printing equipment are rarely involved. This makes students lack hands-on experience in operating and debugging intelligent mechanical systems, resulting in a fault between theoretical knowledge and intelligent operation skills.

Cohesion Optimization Strategies for Mechanical Courses

Updating curriculum content to adapt to intelligent construction demands

It is necessary to integrate intelligent elements into mechanical courses to bridge the gap between traditional content and industry needs. To achieve this, introducing knowledge of intelligent mechanical systems is essential, such as adding chapters on “Intelligent Control of Construction Machinery” and “Introduction to Construction Robots” to help students master the composition and working principles of intelligent equipment. At the same time, strengthening the connection between mechanical principles and digital technologies is equally important, as explaining how mechanical transmission is combined with IoT sensors [6] to realize real-time monitoring of equipment status can enhance students’ understanding of the integration of mechanics and intelligence. Moreover, inviting experts from intelligent construction enterprises

to participate in curriculum design ensures that the content remains aligned with the latest industry practices, thus making the curriculum more relevant and practical.

Promoting interdisciplinary integration to strengthen curriculum cohesion

To break the fragmentation between mechanical courses and other disciplines, constructing a modular interdisciplinary teaching system is key. A feasible starting point is setting up interdisciplinary courses like “Intelligent Mechanical and BIM Integration” and “Robotics in Construction Engineering”, which seamlessly integrate mechanical knowledge with BIM modeling and robotic control technologies. Complementing this, designing Project-Based Learning (PBL) tasks [7]-such as having students complete the design of an intelligent concrete pouring robot-requires the application of mechanical design, programming and structural engineering knowledge, thereby naturally realizing the cohesion of multiple courses. Additionally, establishing a curriculum coordination mechanism that mandates teachers of mechanical courses and information technology courses to jointly compile teaching syllabuses and design integrated teaching cases further strengthens the interdisciplinary connections.

Innovating practical teaching to improve intelligent application abilities

Practical teaching should be optimized to enhance students’ ability to apply mechanical knowledge in intelligent scenarios. A fundamental step is building an intelligent mechanical laboratory equipped with construction robots, automated assembly lines and digital simulation platforms, as this allows students to conduct hands-on experiments in areas such as intelligent equipment debugging and path planning. To extend this practical experience beyond the campus, strengthening school-enterprise cooperation and establishing off-campus practice bases with intelligent construction enterprises enables students to participate in the operation and maintenance of intelligent mechanical equipment on site, providing them with valuable real-world exposure. Furthermore, introducing virtual simulation technology, which uses software to simulate complex working conditions of intelligent construction machinery, helps students master the troubleshooting methods of mechanical systems in a risk-free virtual environment, complementing their practical skills.

Conclusion

The “fault dilemma” of mechanical courses in intelligent construction majors is a key issue restricting the training of high-quality interdisciplinary talents. By analyzing the manifestations and causes of the fault, this paper proposes optimization strategies from curriculum content updating, interdisciplinary integration and practical teaching innovation. These strategies aim to realize the effective cohesion of mechanical courses with intelligent construction demands and other disciplines, thereby improving students’ comprehensive ability to apply mechanical knowledge in intelligent scenarios. Future research can further explore the evaluation system of curriculum cohesion effect and carry out

empirical studies in more universities to provide more practical references for the reform of mechanical courses in intelligent construction majors.

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