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Teaching Reform of Civil Engineering Construction Course under the Background of AI

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Abstract

With the large-scale implementation of generative artificial intelligence, digital twin, BIM and other technologies in the construction industry, the construction industry is transforming from the traditional manual construction mode to the intelligent construction mode, and the demand for industry post ability has changed significantly. As a core compulsory course of civil engineering undergraduate major, civil engineering construction undertakes the task of imparting professional knowledge such as construction technology, construction organization and site management. The traditional classroom teaching mode has practical contradictions such as lack of practical scenes, lagging update of teaching content, insufficient individualized training of students, and single assessment method. The teaching practice shows that the reasonable introduction of AI auxiliary tools can make up for the shortcomings of traditional teaching field conditions, enrich classroom case resources, and strengthen students' engineering practice thinking. However, it also faces practical challenges such as students' excessive dependence on AI output content, professional information distortion, and teachers' teaching ability can not keep up with technical iteration. This study can provide reference for the digital teaching reform of construction courses in similar engineering majors, and help to cultivate compound civil engineering talents with both traditional construction skills and intelligent construction literacy.

Keywords

Artificial intelligence, civil engineering construction, teaching reform, intelligent construction, new engineering

1. Introduction

In recent years, the rapid popularization of generative large models has brought new opportunities for curriculum reform. Many educational researchers in China have carried out relevant explorations on the integration of AI into the teaching of engineering courses. Some colleges and universities have proposed the "AI + literature verification" teaching operation mode, trying to use AI tools as students' learning aids, rather than directly replacing students' thinking. However, at this stage, the application of artificial intelligence in civil engineering construction courses in many colleges and universities still stays at a shallow level. Simply playing intelligent site video lacks complete teaching design, does not form a teaching process suitable for this course, and lacks coping strategies for negative problems caused by AI. For example, students directly copy AI to generate homework, AI outputs construction specification error information and other practical problems.

Based on the above situation, based on the teaching practice of undergraduate civil engineering construction course, this paper analyzes the outstanding problems existing in the course teaching in the AI era, constructs a set of landing course teaching reform plan, analyzes the practical obstacles in the implementation process of the reform, and gives the corresponding solutions, so as to provide practical reference for the digital upgrading of civil engineering construction course.

2. Main Problems Existing In Civil Engineering Construction Course in AI Era

2.1 There Is a Mismatch between the Teaching Objectives and the Needs of Industry Talents

The traditional course teaching goal focuses on the memory of traditional construction technology knowledge points, so that students can master the textbook process principle and do the construction organization design as the main goal. Under the background of intelligent construction, in addition to traditional technology, a large number of digital tools such as AI quality identification, intelligent site platform and digital twin schedule simulation are introduced into construction positions. The industry needs students to understand both traditional construction principles and intelligent equipment output results, and have preliminary digital analysis capabilities. The existing curriculum outline generally lacks the training goal of intelligent construction related ability, and the three goals of knowledge, ability and accomplishment have not formed a complete unity. After the students are trained to enter the job, they need to spend a long time to adapt to the intelligent engineering environment.

2.2 The Updating Speed of Teaching Content Lags Behind the Development of Industry

The revision cycle of civil engineering construction textbooks is generally long, and the content of the textbooks focuses on mature traditional construction techniques. There are few frontier contents such as AI safety monitoring, prefabricated intelligent construction, and construction robot construction. Most of the classroom teaching is carried out around the teaching materials, and the digital teaching case resources available to teachers are limited. Although some teachers will independently supplement industry cases, the cases are fragmented and not systematically integrated into the course chapters.

Traditional construction knowledge and AI intelligent construction technology are in a state of mutual separation. Students cannot understand how artificial intelligence can be applied to specific construction processes such as earthwork, formwork and concrete.

3. Implementation Path of Teaching Reform of Civil Engineering Construction Course under the Background of AI

3.1 Reconstruct the Teaching Goal of the Trinity Curriculum

Establish a three-in-one curriculum goal system of "knowledge ability literacy". At the knowledge level, students firmly grasp the traditional core knowledge of earthwork engineering, formwork engineering, reinforced concrete engineering, hoisting engineering, construction organization design and so on. At the same time, we should understand the basic principles of AI in construction safety, quality and schedule management, be familiar with the main functional modules of intelligent site, and understand the basic concepts of construction robot and digital twin construction. At the level of ability, we should focus on cultivating students' ability to analyze construction schemes, learn to use AI large models to collect engineering data reasonably, and at the same time be able to identify the errors of AI output content, combine the results of specifications and literature verification, and form the ability to analyze engineering problems. At the level of literacy, we should strengthen the awareness of engineering ethics, establish the concept of construction safety and quality priority, and cultivate students' rigorous and realistic engineering thinking, so as to dialectically view the advantages and limitations of artificial intelligence tools. The syllabus clearly includes the ability of intelligent construction into the course objectives, and meets the actual needs of the industry positions.

3.2 Optimizing the Teaching Content System of Iterative Course

Break the shackles of teaching materials and build a teaching content framework of "traditional core knowledge + AI intelligent construction technology + typical engineering cases." First, retain the main content of traditional construction technology, which is the foundation of the course, and traditional process teaching cannot be weakened because of the introduction of AI. Secondly, the intelligent application cases are embedded in the original chapters to explain the AI monitoring and early warning cases in the construction of deep foundation pits. Explain the concrete construction to supplement the AI appearance quality identification case; explain the construction organization design to supplement the AI-assisted progress simulation content to achieve the integration of old and new knowledge, rather than setting up isolated chapters separately. Third, build a dynamic update course case resource library, and jointly collect real and intelligent site project materials from enterprise engineers, including construction short videos, digital twin platform screenshots, and AI safety identification site records. Establish a regular update mechanism for content, and continuously supplement the latest industry norms and typical engineering cases into teaching resources. Fourth, moderately carry out the integration of curriculum ideological and political education, combine the development of intelligent

construction industry, guide students to understand the transformation and upgrading of construction industry, and establish a sense of responsibility in the industry.

In view of the high-risk process that is difficult to observe on site, visual teaching is carried out in combination with AI virtual simulation and construction animation. The abstract process is transformed into a dynamic demonstration to help students understand the process logic. Under the class, AI teaching assistant tools are used to answer students' high-frequency questions and reduce the burden of teachers' repetitive answering questions. It is necessary to make it clear that AI is only used as an auxiliary means, and the core concepts, principles and norms must be checked by teachers to prevent AI from misleading students with wrong professional information.

4. Challenges and Countermeasures in the Implementation of Reform

The integration of artificial intelligence into the teaching of civil engineering construction course is accompanied by multiple practical challenges while improving teaching efficiency. First, the output of civil engineering professional content by generative AI will have standard reference errors and process logic errors, and students' lack of discrimination ability is easily misled. The corresponding countermeasure is to force the addition of norms and literature verification links in the teaching design. Each operation using AI requires students to check the content against authoritative data, and teachers repeatedly emphasize the limitations of AI tools in the classroom. Secondly, students' learning effect is polarized, and students with strong autonomous learning ability can use AI to expand their horizons; some inert students directly copy the generated results and give up thinking training. In this regard, it is necessary to optimize the assessment method, pay more attention to the derivation and modification process, weaken the weight of the finished text, and use the process material as an important basis for scoring. Third, the workload of teaching resources construction is large, and the continuous updating of intelligent construction cases requires long-term investment. Through school-enterprise cooperation, curriculum resources can be jointly developed to reduce the personal burden of teachers. Fourth, some of the existing virtual simulation platforms are not well combined with the AI model. Schools can gradually iteratively upgrade the practical teaching platform according to the teaching needs.

Generally speaking, AI is a teaching assistant tool, which cannot replace teachers' teaching guidance or students' engineering thinking training. The curriculum reform cannot simply pursue technical hotspots. It must be firmly based on the teaching objectives of the civil engineering construction course itself, taking the improvement of students' professional comprehensive ability as the starting point, and technology serves the goal of educating people, rather than putting the cart before the horse.

5. Conclusion

With the rapid development of intelligent construction industry, the teaching reform of civil engineering construction course must be carried out. The traditional teaching mode has shortcomings such as insufficient practical conditions, slow content update, and single evaluation method. Artificial intelligence technology provides a new path to solve the above pain points. This paper proposes a complete curriculum reform plan from six aspects: reconstruction of teaching objectives, iterative update of teaching content, innovation of mixed classroom mode, expansion of digital practice, assessment of multiple processes, and improvement of teachers' ability. The core of the reform is not to replace teachers' teaching with AI, but to use AI as an auxiliary learning tool to train students' ability to collect information, identify information, solve practical engineering problems, adhere to the traditional construction technology foundation teaching, and increase the teaching content of intelligent construction at the same time.

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