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Research on Teaching Reform of "Engineering Project Management Theory and Application" Course in the AI Era

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Abstract

With the rapid development of artificial intelligence technology, the field of engineering project management is undergoing profound changes. The traditional teaching mode of engineering project management courses can no longer meet the industry's demand for versatile talents, making teaching reform imperative. Focusing on the integration of artificial intelligence (AI) with the teaching of the “Engineering Project Management” course, this paper explores the impacts of the development of AI technology on the reconstruction of teaching content, the innovation of teaching methods, and the evaluation system, etc., in combination with the characteristics of the course. It also analyzes the problems existing in the integration of AI into teaching and the corresponding.

Keywords

Artificial intelligence; Engineering project management; teaching reform

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1. Introduction

Against the backdrop of a new round of global technological revolution and industrial transformation, artificial intelligence (AI) technology is penetrating into various industries at an unprecedented speed, and the engineering project management industry is no exception. Engineering projects have the characteristics of large investment scale, long construction period, multiple participating parties, high technical complexity, and multiple risk factors. Traditional management models are no longer able to meet the increasingly complex management needs. AI technology, with its powerful data processing capabilities, intelligent decision support functions, and self-learning abilities, has shown great potential for application in cost control, quality supervision, risk warning, and other aspects, providing the possibility for the intelligent upgrade of engineering project management. This development trend also puts forward higher requirements for the cultivation of engineering management talents. As a core course for engineering management-related majors, the teaching content and mode of “Theory and Application of Project Management” directly affect students’ professional qualities and career competitiveness. However, the

integration of emerging technologies such as AI in the current course teaching is not deep enough. Exploring the deep integration of artificial intelligence and engineering project management in the course teaching has become the focus of the course reform.

This article analyzes the characteristics of engineering project management courses, explores the feasibility and specific paths of integrating artificial intelligence technology with the teaching of engineering project management courses, and proposes reform measures from the aspects of teaching content, teaching methods, and practical systems; Analyzed the problems faced and proposed corresponding countermeasures and suggestions.

2. Characteristics of Engineering Project Management Theory and Application Course

2.1. The course is highly comprehensive

Engineering projects are the most common and typical type of project, aimed at forming fixed assets. The object of engineering projects is engineering technology systems with specific requirements. The task of engineering project management is to ensure the completion of projects within established constraints such as schedule, cost, and quality. Although students may only engage in a certain part of project management in actual employment environments, there are close connections between various modules of project management, such as the compression of schedules that may lead to increased costs or decreased quality. Therefore, students need to have a systematic understanding of the project management knowledge system. This is also a key requirement for studying engineering project management courses. The comprehensiveness of this course is also reflected in the interdisciplinary integration of content. Engineering project management involves various fusion technologies, including engineering professional technology, management science, information technology, law, environmental science, and other fields. By applying AI technology, knowledge graphs among various disciplines can be generated, enhancing students' understanding of the content of project management courses.

2.2. Course teaching is guided by practice

The course "Theory and Application of Engineering Project Management" has strong applicability, so the design of this course should adhere to a practical orientation, and teaching should focus on how to cultivate students' ability to solve practical problems in engineering management. This characteristic requires that teaching content must be deeply coupled with the requirements of engineering projects, breaking down complex issues involved in the entire lifecycle of engineering projects and integrating them into corresponding course modules. With changes in internal and external environments and the emergence of new problems, it must be continuously revised and improved. The integration of AI technology can create "immersive training scenarios" for practical teaching, providing assistance in cultivating students' practical abilities.

2.3. The course focuses on addressing the complexity of engineering project management

Engineering projects involve multiple stakeholders, including owners, designers, construction parties, suppliers, etc. Due to conflicting goals and information asymmetry among these stakeholders, the development of engineering projects is hindered, which increases the difficulty of communication and coordination in project management. In addition, there are multiple goals in engineering projects, including schedule goals, cost goals, quality goals, etc. These goals are not isolated and have complex relationships of mutual influence and restraint. Taking nuclear power engineering as an example, if the construction period is compressed, it may lead to insufficient frequency of welding process testing, bury equipment operation safety hazards, and fail to guarantee quality and safety goals. In the process of project management, it is necessary to consider the phased characteristics and internal and external environment of the entire project lifecycle, dynamically weigh the priority of these goals, which reflects the complexity of engineering project management. Project managers are required to have extensive knowledge and diverse skill backgrounds, be able to coordinate various links, and solve complex problems. This is also the ability that engineering project management courses need to focus on cultivating.

2.4. The course focuses on cultivating research abilities

This course is a postgraduate course, which is different from undergraduate teaching. At the postgraduate stage, in addition to mastering the knowledge system and cultivating practical abilities, it should also reflect the feature of “research”. Through learning, it aims to cultivate students’ innovative awareness and research capabilities. In course teaching, it is necessary to enable students to break away from the thinking of mechanical application and examine the applicability and limitations of the existing theoretical system and methods from an academic perspective. Guide students to explore the integration laws of technology and management with scientific methods. Project management in engineering projects requires continuous exploration of new management models and methods, and AI provides “innovative tools and perspectives” for such research.

With the rapid development of artificial intelligence technology, engineering project management is also undergoing digital transformation. In the process of project planning, resource allocation, cost, schedule, and quality control, artificial intelligence technology can be applied to analyze and process data, providing technical support for engineering project management decisions. In the planning and design stage, BIM technology can be applied to strengthen multidimensional collaboration. In the construction stage, AI technology can be used to collect real-time data, improving on-site management efficiency. As engineering project managers, one should understand the application scenarios of cutting-edge technologies such as artificial intelligence and the Internet of Things in management, and possess the core ability to transform these AI technologies into project management effectiveness. Therefore, in the context of artificial intelligence, the teaching of the course “Theory and Application of Project Management" should focus on the integration entry points of artificial intelligence technology in teaching content, teaching methods and evaluation systems.

3. Challenges Faced by Integrating Artificial Intelligence Into the Teaching of Engineering Project Management Courses

3.1. Delayed construction of teaching staff

The cross-integration of artificial intelligence and project management in engineering has put forward higher requirements for teachers’ knowledge structure and ability, and brought greater pressure to teachers’ course teaching preparation work. At present, teachers in the project management major of engineering have not yet mastered the knowledge and skills related to AI deeply enough. Professional teachers are often good at the theory and practice of project management, but their understanding of AI technology mostly remains at the level of tool usage, making it difficult to explain in depth the matching logic between algorithm principles and engineering problems[1]. Moreover, some professional teachers lack on-site engineering experience and are unable to integrate technical knowledge points with the actual pain points of engineering management. Moreover, the rapid update of AI technology requires teachers to constantly learn and update their knowledge.

3.2. Insufficient teaching resources

The application of artificial intelligence in project management is still in its infancy, and relevant teaching resources are relatively scarce, such as appropriate textbooks, case libraries, and experimental platforms. Although some textbooks have added chapters on AI, they are mostly simple listings of technical concepts and lack in-depth analysis of the adaptation of AI technology to project management scenarios[2]. Teachers’ self-compiled lecture notes are difficult to form a system, and students also lack authoritative references. There are relatively few innovative application cases of AI, and a systematic teaching case library has not been formed, which is not conducive to students’ learning of the experience of reasonable application of AI.

3.3. In terms of teaching methods, the advantages of AI have not been fully utilized

In course teaching, the rigidity and backwardness of teaching methods make it difficult to transform the technical advantages of artificial intelligence into teaching

effectiveness, which has become an important driver for promoting curriculum reform. For example, if the classroom only adopts the traditional mode of "theoretical teaching+case analysis", and teachers only emphasize that AI can be applied in engineering project management such as schedule optimization and risk assessment, students, although mastering the theoretical framework of project management, will find it hard to develop the ability to decompose problems with digital intelligence thinking[3].

At the same time, the introduction of AI technology in teaching content requires students to have certain foundations, including mathematical foundations and computer skills. However, students' current foundations are uneven, and some students have a weak grasp and understanding of AI technology, which will also affect learning effects and enthusiasm. This is disconnected from the goal of cultivating high-level engineering management talents with digital intelligence innovation capabilities.

In addition, artificial intelligence technology could support diversified methods such as case simulation and interactive teaching, but the existing teaching has not fully utilized these tools, leading to low student participation, which is not conducive to the improvement of learning efficiency.

3.4. The evaluation method is single and cannot stimulate students' initiative to use AI

The current course assessment still focuses on theoretical written tests and program design, emphasizing the evaluation of knowledge memory and conventional problem-solving abilities, but neglecting the examination of students' abilities in digital thinking, such as data-driven decision-making, cross-scenario technology transfer, and complex problem decomposition. The deviation of evaluation orientation makes students lack the motivation to actively use AI tools to innovate and solve engineering problems.

4. The Path of Integrating Artificial Intelligence and Engineering Project Management Course Teaching

4.1. Strengthen teacher training

Strengthening the construction of the teaching staff: developing a teacher training plan, organizing teachers to participate in training courses and academic exchange activities related to AI technology, big data analysis, etc., to enhance teachers' professional competence. Introduce talents with a combined background in AI and engineering project management to enrich the teaching staff. Encourage teachers to collaborate with enterprises, understand the application scenarios of artificial intelligence technology in engineering project management, participate in AI application practices in actual engineering projects, and accumulate teaching experience[4].

4.2. Intensify the development of teaching resources and integrate AI technology and concepts into teaching content

Expanding the development of teaching resources that integrate artificial intelligence with engineering project management is not only a requirement for knowledge transfer, but also a key layout for cultivating the core competitiveness of future engineers. In the teaching of engineering project management courses, modules such as integrated management, scope management, schedule management, cost management, quality management, resource management, communication management, risk management, procurement management, and stakeholder management are generally explained separately, mainly considering the input information, methods, and results of each module management. The traditional teaching content system has not taken into account the integration of artificial intelligence and cannot meet the talent cultivation goals in the era of new quality productivity. Therefore, one of the core paths of teaching reform in this course is to reconstruct the content. On the basis of the traditional teaching content system, an artificial intelligence basic knowledge module is added, and the application of big data technology, machine learning methods, etc. in various engineering project management modules is analyzed. Integrating AI with the core content of engineering project management: Deeply integrating AI technology with various aspects of engineering project management, and reconstructing the teaching content system. In the progress management section, an AI-based progress prediction model is introduced to explain how to use historical project data to train the model and achieve dynamic prediction and optimization of project progress;

Introducing cutting-edge industry cases and practices: Collecting and organizing successful application cases of artificial intelligence in engineering project management at home and abroad, such as analyzing the application of BIM technology in multi-disciplinary collaborative design in the construction of the Hong Kong Zhuhai Macao Bridge; Exploring how smart construction sites in Xiong'an New Area can achieve seamless supervision of project management through the use of technologies such as big data, cloud computing, the Internet of Things, and artificial intelligence. Through case analysis, students can understand the application scenarios and effects of AI technology in practical projects, and enhance their understanding and application abilities of knowledge.

4.3. Applying AI to enhance teaching interactivity and participation

The development of AI has strengthened teaching interaction and communication. In course teaching, more multimedia resources can be integrated to make theoretical knowledge more intuitive through animations, videos, etc. The construction of online learning platforms can facilitate teachers to send course outlines, teaching materials, online tests, and assignments in a timely manner, which facilitates course management and organization, allowing teachers to interact and communicate with students in real time. With the help of online learning platforms, AI intelligent Q&A systems can also be introduced to timely answer students' questions and improve learning efficiency. In course teaching, heuristic teaching can also be used to publish discussion topics, such as discussing the application of AI algorithms in optimizing project resource allocation, reconstructing engineering project management processes based on digital transformation, etc. Encourage students to use AI big models correctly, process massive data in engineering project management, use the advantages of AI for deep mining and expansion, break down problems from a systematic and intelligent perspective, and cultivate students' innovative ability to solve complex engineering problems with digital thinking[5].

4.4. Constructing a diversified teaching evaluation system to comprehensively measure students' abilities

Emphasize the combination of process evaluation and outcome evaluation: Apply learning platforms to record students' classroom participation, online learning progress, group discussion performance, practical project achievements, etc., and together with the final exam scores, form a comprehensive evaluation result. Process evaluation can promptly provide feedback on students' learning situations, assist teachers in adjusting teaching strategies, and also motivate students to actively participate in the learning process. Adopting multidimensional evaluation indicators: In addition to knowledge mastery, attention should also be paid to students' ability development, such as AI tool application ability, data analysis ability, problem-solving ability, teamwork ability, innovation ability, etc. Design corresponding evaluation criteria and methods for different ability indicators. For example, students' practical project achievements can be evaluated from the rationality of the scheme, the progressiveness of technology, and the application effect. At the same time, AI assisted tools can be introduced in course evaluation, such as automatic grading and analysis of students' assignments, lab reports, project results, etc. AI assisted evaluation can not only improve evaluation efficiency, but also reduce the interference of human factors and ensure the fairness of evaluation.

5. Conclusions

With the development of artificial intelligence technology, the traditional teaching mode of engineering project management courses has many problems in teaching content, methods, practical systems, and evaluation methods, which are difficult to meet the talent needs of the intelligent era industry. Therefore, teaching reform is necessary and urgent. By strengthening teacher training, restructuring teaching content, innovating teaching methods, and building a diversified evaluation system, we can promote the deep integration of artificial intelligence and engineering project management courses, and cultivate more engineering project management talents that meet the requirements of the intelligent era.

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