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Research on Project Management Ability Cultivation of Engineering Management Major in Colleges and Universities based on AI-assisted Teaching

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Abstract: This study addresses the insufficient integration of AI technology with project management competency development in engineering education during the digital transformation of the construction industry. Through analyzing practical demands for professional talent cultivation, we explore AI-assisted teaching pathways. The research discusses two key aspects: the synergy between technological application and pedagogical leadership, and the alignment of scenario-based simulations with industry needs. We propose two guiding principles: synergistic integration of AI tools and faculty guidance, as well as contextualized project management scenarios with AI simulation adaptation. Three implementation strategies are developed: creating AI-powered scenario-based simulation modules, utilizing AI-generated risk analysis reports, and establishing AI-driven personalized diagnostic systems. The "principle-guided implementation" collaborative training framework identified in this study effectively resolves the disconnect between technology and pedagogy while addressing targeted training gaps, providing actionable solutions for universities to enhance students' project management competencies in engineering education.

Keywords: AI-assisted teaching, university engineering management, project management capability, scenario-based simulation, dynamic risk analysis

As the construction industry undergoes digital and intelligent transformation, engineering management professionals with AI application capabilities have become an urgent industry need. However, current project management training in university engineering programs faces challenges such as fragmented AI technology implementation, simulated scenarios detached from real-world industry contexts, and imprecise competency assessments, resulting in a gap between students' abilities and job requirements. Against this backdrop, exploring how AI-assisted teaching can address these training pain points and achieve deep integration of technological empowerment and professional skill enhancement has become a key issue driving educational reform in engineering management programs. The following sections will elaborate on specific cultivation principles and strategies to address these challenges.

1. Principles for Developing Project Management Competencies in Engineering Management Programs at Universities Through AI-Assisted Teaching

1.1 The principle of synergy between AI instrumentality and teacher dominance

The essence of AI-assisted teaching lies in defining the boundaries of technological tools while maintaining teachers 'guiding role in shaping project management competency development. From an instrumental perspective, AI should focus on high-efficiency, repetitive tasks in project management—such as automatically consolidating project progress data, calculating multi-dimensional cost variances, and identifying potential risks in construction workflows. By rapidly generating visual analytics through algorithms, AI helps students bypass tedious data processing and concentrate on understanding management logic [1]. However, teachers must play a pivotal role in critical instructional phases. For instance, when reviewing AI-generated progress deviation reports, instructors should guide students to trace underlying construction organization issues rather than fixating on raw data. Following AI scenario simulations, teachers should organize group discussions to deepen students' ability to evaluate project decision rationality. Additionally, adjusting AI tool applications based on student feedback prevents over-technologization that might undermine independent analytical skills. This "AI-enhanced efficiency + teacher-guided learning" collaborative model effectively leverages technological advantages while ensuring the depth and accuracy of project management competency development.

1.2 Project management scenario and AI simulation adaptation principle

AI simulation design must deeply align with the authentic scenarios and core requirements of engineering management projects, avoiding superficial applications that disconnect technical expertise from professional contexts. In scenario construction, AI simulations should cover all critical phases of the project lifecycle—from cost estimation during bidding and tendering stages, resource coordination in construction phases, to acceptance control at completion. Each scenario must incorporate real-world variables such as material price fluctuations, weather impacts, and policy adjustments, while adhering to the process standards outlined in the "Construction Project Management Specifications" [2]. The AI simulation should feature dynamic interactivity: when students adjust management plans during simulations, the AI should not only display immediate results like schedule shortening or extension but also generate correlation analyses. These include ripple effects of resource reallocation on subsequent processes and potential risks of cost adjustments impacting project quality. This adaptive design ensures that AI simulations genuinely enhance core project management competencies rather than serving as mere technical demonstrations.

2. Strategies for cultivating project management ability of engineering management majors in colleges and universities based on AI-assisted teaching

2.1 Develop AI project management scenario simulation module

The development of the AI-based project management scenario simulation module follows a progressive process of "requirement anchoring-architecture design-iterative optimization". Through collaboration with industry enterprises and frontline instructors, we conducted requirement research to identify core processes and typical issues throughout the engineering management lifecycle. This included clarifying key variables in sub-scenarios such as schedule control and cost accounting, along with construction workflow logic, resource constraints, and cost components, ultimately establishing a scenario variable database [3]. The front-end adopts a visual interface supporting drag-and-drop adjustments for management plans, while the back-end integrates real-time computing engines embedded with core engineering management algorithms. This ensures real-time generation of dynamic data like project timelines, costs, and resource utilization rates after student operations, along with annotated data correlation logic such as how process adjustments affect critical paths. After module completion, small-scale trials were conducted with students to collect operational

feedback and competency enhancement data. Collaborating with enterprise technical experts, we refined scenario authenticity and algorithm accuracy to develop a mature module tailored to educational needs.

2.2 Generate dynamic project risk analysis reports using AI

The AI-driven dynamic project risk analysis process follows a three-phase workflow: "data preprocessing-AI deep analysis-student application guidance". Educators collaborate with AI specialists to establish data input standards, defining formatting and cleaning rules for multi-dimensional data such as construction logs and material prices. This ensures the AI accurately extracts actionable insights while filtering out noise from data [4]. The AI system then performs trend prediction and anomaly detection using machine learning algorithms, automatically flagging risk points like material price fluctuations exceeding thresholds or schedule deviations. Dynamic reports are generated with prioritized risk rankings based on probability and impact severity, featuring causal analysis breakdowns and data-backed visualizations rather than just conclusions. Instructors guide students through in-depth report interpretation, explaining AI's analytical logic. Students are encouraged to identify hidden risks not covered by the initial report by applying project management theories, then formulate response strategies using both the original report and supplementary analyses. This creates a closed-loop system of "data-driven input-AI analysis-human refinement".

2.3 Build an AI-based personalized project management capability diagnosis system

The implementation process should establish a complete workflow encompassing "data collection, model construction, and diagnostic recommendations". This involves defining multi-dimensional data collection parameters that include not only operational metrics from project simulations—such as progress adjustment frequency and cost accounting errors—but also incorporates information like assignment quality and classroom interaction performance. Through tagging mechanisms, these data points are correlated with competency dimensions including schedule management and cost control [5]. The capability diagnostic model is developed by setting industry-standard thresholds for each competency dimension, then employing AI algorithms to analyze student data and generate diagnostic reports highlighting strengths, weaknesses, and gap magnitudes. Personalized recommendations are delivered through AI-driven task matching from specialized training libraries: students with weak cost accounting skills receive scenario-based optimization exercises, with progress tracking and dynamically adjusted follow-up content. Meanwhile, instructors leverage diagnostic reports to provide targeted coaching addressing cognitive gaps not covered by AI, achieving complementary integration of technical diagnostics and human guidance.

Conclusion

This study clarifies the role and pathways of AI-assisted teaching in cultivating project management capabilities for engineering management majors at universities. It defines boundaries for AI technology application, leveraging its efficiency advantages in data processing and scenario simulation while ensuring teachers 'leading role in instruction, thereby aligning AI simulations with professional realities. Starting from module development, risk analysis, and personalized diagnostics, the research achieves integrated implementation of AI technology within the training process. The established "principles guide direction-strategies support execution" framework has effectively enhanced students' practical decision-making abilities in project management, providing a systematic framework for professional teaching reform.

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