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TEACHING REFORM IN ENGINEERING MANAGEMENT PROGRAMS AT APPLIED LOCAL UNDERGRADUATE INSTITUTIONS

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Abstract: This study examines the engineering management program at applied local undergraduate institutions. Addressing current challenges such as outdated curricula, monotonous teaching methods, insufficient practical experience among faculty, and constrained practical teaching facilities, it proposes a teaching reform scheme centered on the Outcomes-Based Education (OBE) philosophy. The research systematically explores pathways for cultivating applied talents in engineering management through course objective design, teaching content optimization, deepening university-industry collaboration, implementing the "1+X" certificate system, and establishing a dual-mentor system. By strengthening the integration of theory and practice, constructing a diversified assessment system, and improving university-industry coordination mechanisms, the approach aims to enhance students' practical engineering abilities and innovative awareness, promote continuous improvement in teaching quality, and provide a feasible reference for cultivating high-caliber applied talents in engineering management programs at local undergraduate institutions.
Keywords: Applied undergraduate education; Engineering management; Teaching reform; Industry-education integration; Project-based teaching

1 INTRODUCTION

The cultivation of applied undergraduate talent responds to the demands of economic and social transformation and upgrading, while also representing an inevitable necessity for higher education institutions to define their institutional positioning and pursue rational development. Strengthening the organic integration of theory, practice, and innovation to enhance students' comprehensive qualities facilitates the achievement of cultivating multi-skilled professionals. Engineering management is an emerging interdisciplinary field integrating engineering technology with management science. It has evolved from disciplines including management engineering, international construction engineering and management, international engineering, real estate management, and related specializations. Currently, the program operates under the principle of "engineering as the vehicle, management as the direction, integrating engineering and management with industry-academia collaboration," providing robust support for China's engineering construction sector. China's construction industry is rapidly expanding, leading to a more regulated building market that is on a healthy development trajectory. The "Two New and One Heavy" construction policy, alongside urban renewal, metropolitan area development, urban clusters, urban belts, and central city initiatives, heralds broader market prospects for the sector. Annual engineering investments amounting to trillions demand substantial engineering management talent, positioning the discipline for greater prominence. Engineering management is a discipline characterized by strong applied and practical dimensions, primarily aiming to cultivate students' ability to apply theoretical knowledge, execute practical operations, and demonstrate innovation. Achieving this educational objective necessitates a focus on practical teaching processes. However, current practical teaching in engineering management programs suffers from issues such as a lack of practical teaching bases, poor teaching effectiveness, and inadequate practical teaching skills among faculty. Within this educational environment, students' practical application and innovative capabilities remain underdeveloped, failing to meet corporate talent standards. This results in persistently low employment rates and hinders students' future career prospects. Consequently, effective teaching reforms are imperative for engineering management programs. These reforms should intensify practical teaching efforts and elevate their quality, thereby equipping students to meet corporate demands and boosting graduate employability. The following sections explore specific teaching reform measures for engineering management programs.

2 ANALYSIS OF CURRENT TEACHING PRACTICES

2.1 Outdated Talent Development Programs

As the core blueprint and overarching plan guiding talent cultivation within higher education institutions, the importance of the talent development program is self-evident. An exceptional program design functions like a precise navigation system, requiring foresight, adaptability, and innovation. Specifically, it must adeptly identify and address the urgent talent demands of national development strategies and regional economies. Simultaneously, it must align closely with industrial frontiers, incorporating advanced technologies, emerging knowledge systems, and future-oriented skills into teaching plans. This ensures students acquire not outdated knowledge, but tools for future competitiveness.

Yet within current educational practice, a significant **lagging phenomenon** plagues certain institutions. These universities tend to perpetuate and cling to traditional, even antiquated, training models and curricula. This path dependency creates a severe disconnect between their talent development programs and the rapid external changes. While the external world iterates at breakneck speed in technology, industry, and business models, these training programs appear frozen in time—characterized by sluggish content updates, rigid knowledge structures, and conservative competency targets.

The direct consequences of this lag are severe: universities are unable to adequately cultivate the innovative and entrepreneurial talent urgently required to align with national development priorities and meet the demands of market transformation and upgrading. In our era, the demand for talent has shifted from "knowledge-based" to "capability-based" and "interdisciplinary." The market craves high-caliber individuals possessing the capacity for resolving complex problems, critical thinking, interdisciplinary knowledge integration, and a strong entrepreneurial spirit. Yet clinging to traditional approaches often means teaching content remains stuck in the simple repetition of foundational theories, practical components lack authentic business scenarios, and coverage of emerging fields like artificial intelligence, big data, and green technology is inadequate—let alone effectively stimulating students' innovative potential and entrepreneurial drive.

2.2 Monotonous Teaching Methods

The teaching process for engineering project management courses is largely dependent on how the instructor delivers the material. It relies on a combination of classroom lectures and post-class exercises to impart knowledge, employing a monotonous teaching approach that relies entirely on the instructor's personal knowledge base and teaching experience. This approach lacks sufficient appeal and struggles to motivate students, with distractions and inattentiveness frequently occurring during lectures. Moreover, the inherently abstract nature of the theoretical knowledge makes comprehension particularly challenging for students without practical engineering exposure. This readily fosters aversion to the subject, undermining teaching effectiveness and objectives. Crucially, theoretical concepts such as safety management, quality management, quality control, cost control, and schedule control require in-depth application through real-world engineering case studies. Without this practical grounding, instruction remains theoretical and detached, severely hindering students' theoretical learning. Moreover, constrained by limited teaching hours, practical sessions are both scarce and unsystematic, primarily relying on project simulation exercises. This approach bears little resemblance to real-world engineering practice, resulting in students merely memorizing textual content without applying acquired knowledge to practical scenarios. Consequently, they fail to achieve genuine application of learning, with knowledge fading over time and hindering the development of practical skills.

2.3 Low Student Engagement

The reliance on purely theoretical instruction leaves students lacking spatial imagination and with a vague grasp of fundamental concepts. Conducting stress analysis on structural members, deriving formulas, and applying engineering principles proves exceptionally challenging. Consequently, student engagement remains low, and teaching outcomes are suboptimal. As a structural design course, our current teaching primarily relies on manual calculations, whereas industry predominantly uses software. Manual calculations involve complex, lengthy formulas, diverse symbols and coefficients, and variable code requirements for construction details. Students widely perceive this course as challenging, fostering a tendency to develop aversion to the subject.

2.4 Some teaching staff are unaware of the content they are teaching.

The teaching content for engineering management programs is broadly divided into two main areas: firstly, theoretical knowledge and practical skills centered on civil engineering technology; secondly, management and economic theories, methodologies, and legal knowledge relevant to civil engineering. The majority of teaching staff in the department have backgrounds in civil engineering technology, either through their academic specialization or professional experience. Only a minority graduated from engineering management-related programs or have extensive experience in the field. This is particularly true for younger lecturers, many of whom transitioned directly from graduation into teaching roles without substantial professional experience. Consequently, they often find themselves ill-equipped to guide students through practical teaching activities, inevitably leading to suboptimal teaching outcomes.

2.5 Practical teaching at construction sites presents certain difficulties.

Within engineering management programs, practical training at construction sites is crucial for developing students' engineering awareness and management capabilities. However, its implementation frequently encounters significant obstacles. Firstly, the complex environment of construction sites presents inherent safety risks. Universities, prioritizing safety and management considerations, impose stringent approval procedures and frequency restrictions on student site access, thereby limiting practical opportunities. Secondly, engineering projects exhibit cyclical and phased characteristics, with teaching content varying significantly across different construction stages. This makes it challenging for universities to cover the entire engineering management process within the limited time available. Furthermore, construction companies, under pressure from production tasks and deadlines, often struggle to allocate sufficient time and resources for teaching activities, highlighting the inadequacy of current university-industry collaboration mechanisms.
The challenges identified—outdated curricula, monotonous pedagogy, and a lack of practical exposure—demand a comprehensive overhaul of the engineering management educational ecosystem, centered on the foundational principles of Outcomes-Based Education (OBE). Successfully transitioning to an applied talent model necessitates moving beyond superficial modifications to core curriculum and truly embedding the desired graduate competencies into every phase of program design and delivery.

3 KEY COMPONENTS AND IMPLEMENTATION PATHWAYS OF TEACHING REFORM

3.1 Adopting the "1+X" System to Deepen Industry-Academia Collaboration

In today's era of digital and intelligent development, higher vocational colleges place particular emphasis on industry-academia collaboration, establishing corresponding regulations to safeguard such partnerships, yet the outcomes remain limited. Many enterprises, preoccupied with production tasks, reduce collaboration to superficial arrangements—merely taking students on internships to perform basic duties[1]. For construction project management students, deepened industry-academia partnerships offer precisely the opportunity to develop practical talent cultivation programs and provide professional practice platforms. The pilot implementation of the "1+X" certificate system represents a "cross-boundary" collaboration between schools and enterprises in dual-track, collaborative education. By establishing standardized industry-academia collaboration platforms and implementing robust cooperation and evaluation mechanisms, institutions ensure efficient, orderly partnerships that enhance the quality of talent development. Engaging experienced technical personnel from industry as teaching staff allows enterprise mentors to share real-world project challenges and solutions in the classroom—narratives that students often find particularly engaging. Furthermore, the "1+X" certificate system, through deepening industry-academia collaboration, creates broader development opportunities and platforms for students, offering diverse internship and employment prospects. Under this framework, students continuously hone their professional competence and technical skills within authentic workplace settings. This approach ensures a steady supply of high-caliber applied professionals to the construction sector, powerfully advancing the industry's sustainable development through skilled talent.

3.2 Optimizing Teaching Content

The curriculum for higher vocational construction engineering management programs predominantly relies on theoretical instruction, featuring relatively monotonous teaching methods and content. Consequently, adjusting and optimizing teaching approaches and content has become a critical research focus. The 1+X certificate system introduces professional skills certification assessments, aligning course content more closely with industry demands. Simultaneously, it enhances practical teaching components to improve students' operational capabilities and professional competence. In practical teaching, course content is systematically organized into modularized teaching units. Instruction is structured around each module, with video and textual materials for sub-modules collated and uploaded to Learning Pass. Relevant tasks are assigned to facilitate online learning, enabling analysis of student progress and outcomes for subsequent curriculum refinement. Leveraging Learning Pass's digital tools, a teaching case repository for 1+X certificate skill level assessments is established . This system requires students to obtain both academic qualifications and corresponding professional skill level certificates, ensuring they possess both a solid theoretical foundation and practical operational capabilities. Furthermore, the 1+X certificate system drives the updating and optimization of course content, aligning teaching materials more closely with industry demands. It also fosters innovation in teaching methodologies, such as introducing project-based learning and case-based teaching, to cultivate students' practical abilities and innovative thinking.

3.3 Establishing a Systematic and Scientific Assessment Approach

Surveys of undergraduate engineering management students reveal divergent developmental priorities: some emphasize theoretical knowledge, while others excel in practical application. Existing assessment methods, centered on end-of-term examinations, inevitably fail to reflect students' comprehensive competencies. Aligned with our college's applied talent cultivation model and the characteristics of engineering project management courses, we have adopted a blended assessment approach combining closed-book examinations, practical training assessments, and continuous performance evaluation. This approach appropriately increases the weighting of practical training while reducing the emphasis on

continuous assessment and closed-book examinations, thereby establishing a systematic and scientific assessment framework. The composition of each component's weighting is as follows:

3.4 Designing Course Learning Objectives and Assessment Methods Guided by "OBE"

Guided by the principles of Outcome-Based Education (OBE)[2], the design of course learning objectives and assessment methods should be closely aligned with the knowledge, competencies, and qualities students should possess upon graduation[3]. The OBE philosophy emphasizes a "student learning outcomes-centered" approach, meaning that the starting point and ultimate goal of the teaching process should be "what students can do and to what extent they can do it." Therefore, in the teaching reform of the Engineering Management program, course objectives should be designed in reverse from industry demands, ensuring that each course contributes to achieving the program's overall educational goals. Firstly, in setting course teaching objectives, specific achievement indicators for students in terms of knowledge, skills, and comprehensive qualities should be clearly defined. For instance, through core courses such as "Engineering Project Management," "Engineering Cost Control," and "Construction Organization Design," students should master the principles of full-process project management and acquire professional competencies in construction planning, schedule control, and quality and safety management[4]. Concurrently, emphasis should be placed on cultivating students' professional ethics, communication and collaboration skills, and information management capabilities to equip them for the demands of digital transformation in the construction industry. Secondly, teaching implementation should adopt an outcomes-driven approach through a "backward design" methodology. This entails determining teaching content and activities based on graduation requirements and course objectives, achieving "learning for application" through project-based, case-based, and contextualized teaching. Thirdly, assessment methods should embody the principles of "whole-process evaluation" and "multi-dimensional assessment." Traditional written examinations, or closed-book tests, often assess only rote knowledge, failing to comprehensively evaluate students' integrated application abilities[5]. In line with OBE principles, assessments should span the entire cycle of "learning process – practical performance – outcome delivery," incorporating diverse evaluation methods such as classroom participation, project assignments, interim reports, teamwork, and final project deliverables. Assessment criteria must correspond directly to course objectives to ensure consistency between teaching, learning, and assessment. Finally, to guarantee the achievement of teaching objectives, course resources and teaching conditions must be optimized and re-engineered[6]. Textbooks, practical components, and laboratory resources should be systematically integrated to advance the development of high-quality courses and teaching materials, establishing a multi-tiered practical teaching system. Concurrently, continuous teaching quality monitoring and feedback mechanisms should facilitate dynamic refinement of teaching content, methodologies, and assessment frameworks, forming a continuously optimized teaching feedback loop. Through these measures, the Engineering Management program can genuinely implement the OBE philosophy, constructing a course teaching and assessment system centered on learning outcomes and competency development, thereby providing robust support for cultivating applied professionals.

3.5 Developing Digitalized and Experiential Learning Resources

To combat monotonous teaching methods and low student engagement, institutions must invest heavily in developing sophisticated, digitalized teaching resources[7]. The theoretical concepts of engineering management—like complex scheduling or stress analysis—are best grasped through visual and interactive media. This includes the creation and utilization of Virtual Reality (VR) and Augmented Reality (AR) simulations that allow students to navigate a simulated construction site, identify safety hazards, or visualize the clash detection process in BIM models, all from the classroom. A centralized digital case library is paramount. This repository should be populated with real-world project documentation (contracts, schedules, risk registers) donated by industry partners, allowing students to analyze authentic, complex engineering problems. Furthermore, leveraging Learning Management Systems (LMS) for continuous, adaptive assessment and personalized feedback is vital. Digital tools enable self-paced learning for foundational knowledge, freeing up limited classroom time for critical-thinking exercises, complex problem-solving, and collaborative project work guided by the dual-mentor system. This blend of digital resource utilization and experiential learning directly addresses the practical skill deficit among faculty and students alike, ensuring the learning process is dynamic, relevant, and outcome-focused. The objective is to transform the classroom from a passive lecture hall into an active, high-fidelity engineering office environment.

3.6 Implementation of a Dual-Supervisor System

Engineering management is a multidisciplinary field, producing graduates equipped with both technical and managerial competencies—comprehensive professionals capable of spanning production, construction, service delivery, and management processes[8]. As educators play a pivotal role in developing these integrated skills, any deficiency in either theoretical knowledge or practical operational abilities hinders the achievement of this objective. In practice, teaching staff often possess strong theoretical expertise but lack practical operational skills[9]. Consequently, institutions must proactively address this imbalance. Recognizing that practitioners in the field possess strong practical abilities but often lack theoretical grounding, universities may adopt a dual-mentor system. Under this approach, academic faculty members responsible for theoretical instruction would be paired with industry technicians as co-mentors. Academic staff would deliver foundational theoretical knowledge, while industry practitioners would lead practical teaching sessions[10]. This

collaborative model enables both mentors to leverage their respective strengths, thereby achieving the educational objectives of the Engineering Management program.

Firstly, selection measures should be implemented. Theoretical instructors may continue to be drawn from within the academic faculty, while practical teaching staff should be recruited through engagement with supervision firms, construction enterprises, and similar entities. This involves appointing engineers or project managers possessing extensive frontline experience to deliver practical instruction. Secondly, scheduling arrangements must be made. On-campus theoretical instructors should cultivate students' mastery of professional theoretical knowledge upon enrollment, emphasizing the effective development of comprehension skills. They should also communicate the discipline's characteristics and developmental trajectory to students, fostering sound learning methodologies. Practicum instructors may be engaged during the second year of study, when students possess foundational theoretical knowledge and are ready to deepen their understanding of practical operations. Each student may undertake weekend or holiday placements at the practicum instructors' actual work sites, with this process continuing until graduation.

4 CONCLUSION

Through systematic research and practical exploration into teaching reforms for engineering management programs at applied local undergraduate institutions, the following conclusions and insights emerge. Presently, China's local undergraduate institutions face numerous challenges in cultivating applied engineering management talent, including outdated curricula, monotonous teaching methods, insufficient practical experience among faculty, and constrained practical teaching conditions. These issues directly impede the integration of theoretical knowledge with engineering practice, resulting in diminished competitiveness in the job market. This paper proposes systematic reform strategies and implementation pathways centered on curriculum restructuring, pedagogical innovation, deepened industry-academia collaboration, and the introduction of Outcome-Based Education (OBE) principles, offering viable solutions for innovating talent cultivation models in engineering management programs. Looking ahead, as educational digitalization converges with intelligent construction technologies, engineering management programs should further explore novel pedagogical approaches such as virtual simulation teaching and intelligent assessment systems. Concurrently, higher education institutions should proactively integrate into regional economic development strategies, strengthen collaborations with industry associations and corporate groups, and foster a collaborative education mechanism involving government, academia, industry, and research. This approach will drive continuous enhancement in the teaching quality of engineering management programs.

COMPETING INTERESTS

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