# Exploration of Quality Evaluation Methods for Engineering Professional Courses Aligned with the Development of New Quality Productive Forces

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**Abstract.** The emergence of new quality productive forces imposes elevated and more nuanced demands on workforce competence and talent development paradigms. Educational evaluation serves as a critical mechanism for ensuring that institutional processes consistently prioritize quality enhancement and pedagogical improvement. This paper examines the evolving requirements for talent cultivation under the framework of new quality productive forces, synthesizes exemplary practices in the development of emerging engineering disciplines and first-rate courses in China, and identifies core quality indicators for engineering curricula through this lens. A "seven-dimensional integrated" evaluation framework is proposed, encompassing course objectives, content architecture, instructional models, experimental engagement, assessment mechanisms, faculty development, and continuous improvement. The framework underscores the integration of innovation throughout the curriculum, with particular attention to cultivating advanced competencies and analytical thinking. By aligning with the national strategy of coordinated advancement in education, technology, and talent development, this study offers both theoretical grounding and practical direction for engineering education reform.

**Keywords:** High-quality Development, New Quality Productive Forces, Quality Evaluation of Engineering Professional Courses, Innovation, Talent Cultivation.

## 1 Introduction

High-quality development necessitates theoretical advancements in understanding productive forces. In fostering new quality productive forces, talent emerges as the most dynamic and essential driver. To accelerate scientific and technological self-reliance and to anchor education within the broader national strategy of modernization, it is imperative to align educational objectives with the evolving demands of productive forces [1]. This requires the seamless integration of education, technology, and talent


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into a synergistic ecosystem. A key lever in this transformation is the comprehensive reform of educational evaluation [2], which functions as a pivotal mechanism for steering pedagogical innovation and institutional improvement. In cultivating top-tier innovative talent, emphasis must be placed on value orientation, model innovation, systemic design, and governance support [3], thereby advancing a high-quality development framework for education that underpins Chinese modernization.

Traditional approaches to evaluating engineering courses have predominantly focused on knowledge coverage, procedural standardization, and examination performance. These models often exhibit entrenched biases—prioritizing theoretical transmission over applied capability, rote learning over creative thinking, and disciplinary silos over interdisciplinary integration. Such limitations render them inadequate for addressing the competency requirements posed by new quality productive forces, which demand heightened capacities in innovation, cross-domain integration, and practical problem-solving.

## 2 New Requirements for Workforce Quality under the Development of New Quality Productive Forces

Grounded in the philosophy of innovation-driven development, new quality productive forces necessitate a fundamental reconfiguration of workforce competencies. The following dimensions capture the enhanced or emergent qualities required of talent in this context:

### 2.1 Solid Foundation in Fundamental Sciences and Advanced Technological Literacy

A robust command of core disciplines such as mathematics and physics, combined with the ability to integrate emerging technologies—including artificial intelligence, big data, quantum information, and biotechnology—is essential. This underpins the capacity to comprehend, apply, and innovate at the intersection of foundational knowledge and cutting-edge tools.

### 2.2 Advanced Engineering Practice and Innovation Capacity

The ability to translate theoretical insights into actionable solutions for complex engineering challenges is paramount [4]. This includes proficiency in system design, iterative development, and optimization, underpinned by innovative thinking and hands-on application skills.

### 2.3 Interdisciplinary Integration Competence

Effective problem-solving in real-world engineering contexts increasingly requires the capacity to traverse disciplinary boundaries and synthesize knowledge from diverse fields. This demands systems thinking and the ability to address multifaceted challenges through integrated approaches.

### 2.4 Digital Literacy and Intelligent Application Skills

Proficiency in leveraging digital tools and intelligent systems is no longer optional. It constitutes a core competency for addressing domain-specific engineering problems through data-driven and automated means.

### 2.5 Lifelong Learning and Self-Development Capabilities

Given the accelerating pace of technological change and the diminishing half-life of knowledge, the capacity for sustained intellectual curiosity, efficient information acquisition, and adaptive learning is critical for professional longevity and relevance.

### 2.6 Team Collaboration and Global Competence

As academic exchange and cross-cultural collaboration intensify, the ability to communicate effectively, coordinate multidisciplinary teams, and operate within a global context has become indispensable. This includes project management skills and an international perspective on competition and cooperation [5].

## 3 Exemplary Practices in Emerging Engineering and First-Rate Course Development

### 3.1 Curricular Restructuring and Interdisciplinary Integration

Institutions have increasingly dismantled traditional departmental boundaries to establish interdisciplinary platforms. For instance, Fudan University's "Emerging Engineering Pilot Program" offers foundational training followed by flexible specialization in areas such as intelligent technology and microelectronics. Tianjin University's "Future Technology College" focuses on cutting-edge domains like artificial intelligence and energy storage, emphasizing project-based, systems-oriented curricula that integrate computer science, electronics, mechanics, biology, and management.

### 3.2 Project-Based Learning and Innovation Cultivation

Real-world engineering challenges serve as the pedagogical backbone in project-based learning models. Zhejiang University integrates "Design Thinking" and "Engineering Innovation" courses throughout its programs, exposing students to authentic problems from the outset. Harbin Institute of Technology (Shenzhen) incorporates enterprise projects into classroom instruction, shifting the learning paradigm from lecture-exercise to problem-iteration loops involving identification, collaboration, prototyping, and refinement.

### 3.3 Deepened Industry-Education Integration

Collaborative initiatives such as Huawei's "Intelligent Base" and Tencent's "Rhinoceros Bird" Program exemplify the embedding of industrial expertise into academic settings. These partnerships involve co-developed curricula, shared laboratories, and mentorship by industry professionals. Beihang University's collaboration with aerospace institutes enables graduate students to engage in research aligned with industry needs, reducing post-graduation transition time and enhancing professional readiness.

### 3.4 Ideological and Ethical Integration in Courses

Beyond the initial wave of ideological education integration, institutions are now advancing toward discipline-specific embedding of values. Courses increasingly incorporate themes of craftsmanship, engineering ethics, patriotism, and social responsibility. For example, semiconductor courses may include case studies on China's technological resilience, while measurement courses draw on precision engineering examples from aerospace missions. This approach nurtures engineers who are not only technically proficient but also ethically grounded and nationally minded.

## 4 A Quality Evaluation Framework for Engineering Courses Aligned with New Quality Productive Forces

The proposed framework is grounded in the principles of student-centeredness, outcome-based education, innovation orientation, interdisciplinary integration, and continuous improvement. It aims to cultivate students' critical thinking, complex problem-solving abilities, original inquiry, collaborative skills, and practical competencies, while also shaping their innovative confidence, entrepreneurial spirit, and social responsibility.

### 4.1 Evaluation Dimensions and Weighting

Distinguishing itself from conventional evaluation models that prioritize factual recall and examination scores, the proposed framework introduces seven first-level indicators, each accompanied by a weight and a set of second-level indicators with corresponding observation points. These weights are designed to be adjustable based on course type and institutional context, while remaining stable within comparable categories to ensure evaluative consistency.

**Course Objective Positioning** (0.15)
*Value Orientation* (0.4): Cultivation of patriotism, ethics, and responsibility.
*Frontier Relevance* (0.3): Alignment with industrial and technological trends.
*Challenge Level* (0.3): Cognitive demand and innovative potential.
**Content Architecture** (0.25)
*Interdisciplinary Integration* (0.3): Synthesis of related disciplinary knowledge.
*Dynamic Adaptability* (0.4): Responsiveness to technological evolution.

*Project Orientation* (0.3): Use of comprehensive projects as organizing units.

**Instructional Models** (0.15)

*Student-Centeredness* (0.4): Emphasis on inquiry, collaboration, and practice.

*Methodological Diversity* (0.3): Adoption of project-based, case-based, and flipped classroom approaches.

*Digital Integration* (0.3): Utilization of smart tools and virtual platforms.

**Experimental Engagement** (0.10)

*Innovation Focus* (0.5): Design-oriented and exploratory tasks.

*Industry Collaboration* (0.3): Real-world projects and mentorship.

*Virtual-Physical Integration* (0.2): Simulation for high-cost or high-risk scenarios.

**Assessment Mechanisms** (0.10)

*Process Orientation* (0.3): Emphasis on continuous evaluation.

*Diversity of Formats* (0.3): Portfolios, presentations, peer review.

*Competency Focus* (0.4): Assessment of problem-solving, innovation, and collaboration.

**Faculty Competence** (0.15)

*Engineering Experience* (0.4): Industrial engagement and practical insight.

*Pedagogical Innovation (*0.6): Commitment to teaching reform and methodological advancement.

**Continuous Improvement** (0.10)

*Feedback Diversity (0*.5): Input from students, alumni, employers, and peers.

*Data-Driven Adjustment* (0.5): Use of analytics to identify weaknesses and implement refinements.

### 4.2 Evaluation Methodology

Each second-level indicator is assessed using a four-point scale: Excellent (90), Good (80), Fair (60), and Poor (35). These scores enable quantitative analysis and cross-course comparability. The framework is designed to be piloted across diverse institutions and disciplines, with iterative refinement based on feedback from instructors, students, and evaluators. Data-driven adjustments ensure the model's validity, reliability, and practical applicability.

### 4.3 Alignment with New Quality Productive Forces

The framework operationalizes the logic chain: technological strategy → talent demand → educational objectives → curricular design → talent outcomes → innovation capacity → productive force advancement. It marks a departure from traditional, teacher-centered, knowledge-focused models toward a dynamic, student-centered, competency-oriented paradigm. Emphasis is placed on advanced content, demonstrable outcomes, appropriate challenge, and stakeholder satisfaction.

## 5 Conclusion

The rise of new quality productive forces is fundamentally reshaping the landscape of talent demand, prompting a paradigm shift in higher engineering education from knowledge transmission to competency cultivation. This study proposes a seven-dimensional, nineteen-indicator evaluation framework for engineering courses, designed to align pedagogical practice with national innovation strategy. By reforming the evaluative "baton," the framework translates macro-level policy imperatives into actionable educational improvements. It fosters the virtuous cycle of education enabling talent, talent driving innovation, and innovation propelling productive forces, thereby positioning engineering curricula as core platforms for cultivating the next generation of innovative engineers and skilled professionals.

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