# Analysis of Teaching Reform Pathways for Engineering Economics in the Era of Artificial Intelligence

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**Abstract: The rapid emergence of generative artificial intelligence has fundamentally challenged the traditional teaching model of Engineering Economics, which has long focused on computational modeling and analysis. This paper seeks to develop a coherent reform framework for the course in the AI era, aiming to shift the educational paradigm from "instrumental rationality" toward "value rationality". The goal is to move beyond training mere "computational technicians" and instead cultivate "decision analysts" capable of effectively leveraging AI technologies. The proposed comprehensive reform framework addresses four key dimensions: teaching objectives, content, methods, and evaluation. Specifically, teaching objectives should be redefined to emphasize the development of advanced economic decision-making capabilities; teaching content must be simultaneously streamlined and enriched, with a stronger focus on uncertainty analysis and the integration of AI ethics; teaching methods should transition to AI-enabled blended and project-based learning approaches; and evaluation systems need to evolve into process-oriented, multifaceted evaluations that incorporate "human-AI collaboration". Finally, the paper discusses the challenges inherent in implementing these reforms and proposes practical measures to ensure their success, providing both theoretical foundations and actionable guidance for curriculum innovation in the AI-driven era.**

**Keywords: Engineering Economics; Artificial Intelligence; Teaching Reform; AI Empowerment; Value Rationality**

## 1. Introduction

As a cornerstone course within engineering management, Engineering Economics fundamentally aims to equip future engineers and project managers with the ability to evaluate and select technical solutions within real-world economic contexts. Traditionally, the curriculum has placed excessive emphasis on deterministic economic evaluation methods, reinforced by extensive manual calculation exercises to consolidate key concepts. While this pedagogical approach has historically played a significant role[1], its limitations have become increasingly apparent amid the growing complexity of engineering practice and the widespread adoption of generative AI tools such as ChatGPT and DeepSeek[2-5]. A striking phenomenon is that even when students master all relevant formulas, they often find themselves at a loss when confronted with the inherent uncertainties of real project scenarios. This issue stems from an underlying conflation in traditional teaching between "calculation" and "decision-making", neglecting more critical facets such as deep problem comprehension, the establishment of foundational assumptions, risk evaluation, and value judgments amid dynamic circumstances. Given that AI can now swiftly and accurately perform all fundamental computations, the continued focus on repetitive manual calculation drills calls into question the core value of this course. This reality demands serious reflection and poses an unavoidable challenge to the very nature of instruction.

Therefore, this paper does not merely advocate for the introduction of AI as a novel instructional tool but rather seizes this opportunity to critically reassess and realign the pedagogical objectives of Engineering Economics toward cultivating students' economic decision-making capabilities. The formidable power of AI liberates both teachers and learners from tedious numerical operations, thereby enabling a concentrated focus on higher-value educational components such as defining complex problems, synthesizing decisions under multiple objectives, and balancing engineering ethics. Anchored in this contemporary context, the present study endeavors to construct a systematic framework for teaching reform that strategically transitions the course from “economic computation” to “economic decision-making”, ultimately exploring innovative pedagogical pathways aligned with the demands of emerging engineering education paradigms.

## 2. Reflection on the Current State

In light of the aforementioned context, a critical examination of the present teaching practices in Engineering Economics reveals a conspicuous disconnect between the course’s intended positioning and its day-to-day delivery. Ideally, this course should embody three fundamental attributes: first, interdisciplinarity and integration, balancing both technical and economic dimensions; second, practicality and decision-orientation, emphasizing applicability to real-world scenarios; and third, a synthesis of quantitative and qualitative approaches, recognizing that calculations are inseparable from qualitative judgment. However, the prevailing instructional approach tends to disproportionately favor quantitative analysis, while insufficiently addressing the first two attributes, resulting in three typical issues:

1. “Abacus-style” teaching: A substantial portion of class time is devoted to intricate manual computations, enabling students to grasp the mechanics of “how to calculate”, yet leaving them unclear about the underlying rationale or the economic significance of the parameters involved.
2. “Vacuum-sealed” case studies: The cases employed are often well-structured, data-complete “calculation problems” that fail to reflect real-world constraints such as policy shifts or market fluctuations. Consequently, students lack opportunities to practice formulating assumptions and making judgments under conditions of incomplete information.
3. “Result-oriented” evaluation: Evaluations place excessive emphasis on the correctness of final answers, neglecting critical cognitive processes involved in problem definition, variable selection, and risk trade-offs during decision-making.

With the increasing ubiquity of AI tools, these shortcomings have been further magnified. AI not only challenges the traditional value of knowledge transmission and computational training but also introduces new concerns regarding academic integrity and the validity of evaluations. Hence, the urgency for a comprehensive curriculum reform has never been greater, yet there remains a notable scarcity of in-depth investigations aimed at holistically restructuring the course in response to AI’s transformative impact.

## 3. Concrete Implementation Pathways for Teaching Reform

The fundamental thrust of this reform is to shift the course’s focus from “economic computation” to “economic decision-making”. Our aim transcends merely cultivating proficient “operators” of calculations; rather, we aspire to nurture future engineers and project decision-makers capable of exercising prudent judgment amid complex real-world conditions. To realize this transformation, a comprehensive framework is indispensable[6-8]. At its core lies a coherent logic: the redefinition of teaching objectives serves as the guiding beacon; the renewal of teaching content and methodologies constitutes the primary avenue of implementation; and the enhancement of evaluation mechanisms functions as both feedback and assurance. These three dimensions operate in concert, collectively advancing the cultivation of students’ economic decision-making competencies.

### 3.1 Redefining Teaching Objectives

The renewed teaching objectives should center on the cultivation of “decision-making capabilities”. To this end, the curriculum must appropriately de-emphasize rote memorization of formulas and proficiency in complex manual calculations, redirecting focus toward the development of higher-order cognitive skills that guide students from mere computational techniques to decision-making imbued with value judgments[9-10].

Specifically, this entails the enhancement of five key competencies:

1). Economic Insight: The ability to accurately identify the critical factors influencing a project’s economic viability and comprehend how their fluctuations impact overall outcomes.

2). Risk Appraisal: Strengthening the capacity for uncertainty analysis by employing methods such as scenario planning and sensitivity analysis to quantify risks, thereby fostering a profound understanding of the intrinsic interplay between returns and risks.

3). AI Tool Utilization and Critical Evaluation:

Proficiency in efficiently and rigorously leveraging AI-assisted analyses, coupled with the discernment to recognize potential errors and model biases inherent in these technologies.

4). Integrated Decision-Making: The capability to formulate persuasive solutions by holistically considering non-monetary factors—including environmental, social, and strategic dimensions—within a framework that is both technically feasible and economically rational.

5. Ethical Responsibility: The cultivation of awareness regarding the full lifecycle costs of engineering projects and a commitment to social responsibility, ensuring that decisions are sustainable and infused with humanistic concern.

## 3.2 Reconstruction of Teaching Content

By simultaneously "streamlining" and "fortifying" the curriculum, students are guided to incorporate the myriad uncertainties inherent in the real world when analyzing problems.

1). Streamlining: Reduce the instructional time devoted to static, single-scenario economic evaluations. Rather than fixating on the computational procedures, the pedagogical emphasis shifts toward a profound analysis of the economic implications behind the calculated results. For instance, traditional teaching might present a problem such as: "A shopping mall plans to invest 5 million yuan to build a smart parking facility, expecting an annual net income of 800,000 yuan over 10 years, with no residual value at the end. Given a benchmark discount rate of 8%, calculate the project's Net Present Value (NPV) and Internal Rate of Return (IRR), and determine its feasibility." This type of problem, characterized by clear structure and complete data, exemplifies a static single-scenario economic evaluation. However, in the AI era, students can instantly obtain answers by querying ChatGPT, DeepSeek, or similar tools. The extensive manual calculation training traditionally required has thus been significantly devalued. Consequently, under the AI paradigm, the instructional focus no longer demands students to manually compute NPV and IRR, but rather to engage with guiding questions such as: "What does an IRR of 9.6%, barely surpassing the 8% benchmark, signify? How resilient is the project to risk?" These prompts encourage students to delve deeply into the economic meaning of indicators, project profitability, and risk evaluation.

2). Fortifying: Elevating the Primacy of Uncertainty Analysis to Reflect Real-World Complexity: Sensitivity analysis, breakeven analysis, and scenario analysis are elevated to core modules on par with NPV, with ample instructional time allocated. For example, instead of providing fixed cash flows in the aforementioned case, parameters such as annual net income, investment cost, and discount rate are presented with inherent uncertainties. Students are tasked with conducting comprehensive uncertainty analyses—including breakeven and sensitivity analyses—using AI tools and/or Excel to evaluate the project's robustness under varying scenarios.

Introducing "Real Options" Thinking: Through case studies, students are exposed to strategic decision-making under high uncertainty, appreciating that the value of certain investments extends beyond immediate cash flows to encompass strategic flexibility and future growth opportunities. For example, teachers might pose: "What is the value of initially investing 1 million yuan in a pilot phase limited to one area, then deciding—based on one year of operational data—whether to invest the remaining 4 million yuan for full-scale deployment? How does this staged investment approach compare to a traditional one-time investment?" This discussion guides students to recognize the pilot project as a "real option" — a relatively low-cost investment (1 million yuan) that grants the right, but not the obligation, to commit to a larger investment later, thereby mitigating the risk associated with a lump-sum 5 million yuan outlay under uncertainty.

Adding an "AI-Enabled Economic Analysis" Module: Focus on designing precise and effective prompts that steer AI from basic computations toward comprehensive, sophisticated analyses. Crucially, students are encouraged to critically reflect on the reliability of AI-generated code and outputs, which fundamentally depend on the assumptions embedded in the input data distributions. Thus, AI serves as a powerful executor, but students must remain the architects of assumptions and the discerning evaluators of results.

Deepening "Solution Generation and Comparative Evaluation": Transcending the traditional framework of comparing pre-existing solutions, this reform introduces a "solution generation" phase. For instance, after selecting an optimal plan based on uncertainty analysis in the earlier case, teachers should further prompt students to explore whether alternative proposals with greater economic value and lower risk can be devised through optimizing financing structures, operational models, or other avenues.

### 3.3 Innovations in Teaching Methodology

In the era of artificial intelligence, achieving a genuine shift from passive reception to active inquiry among students calls for the flexible adoption of an integrated AI-enabled blended teaching model that spans pre-class, in-class, and post-class phases.

Pre-class: The emphasis lies on autonomous online exploration, where students engage with micro-lectures and undertake “human-AI collaborative” preparatory tasks, during which careful documentation of their interactive processes is encouraged.

In-class: The teacher functions as a facilitator, guiding activities such as “critical analysis and error correction” and “deep inquiry and decision-making”. The classroom environment also fosters “value debates”, where students might deliberate on contentious issues like “whether economically viable projects with environmental impacts should proceed.” In these discussions, students are expected to support their viewpoints with AI-generated data while also presenting considerations that extend beyond purely economic factors.

Post-class: The learning process is further enriched through “human-AI collaborative” project-based learning. For instance, groups of students may undertake an “Economic Feasibility Study of a Local Thermal Power Plant Retrofit Project”. With a clearly defined problem, students utilize AI to collect relevant information, develop dynamic financial models, and integrate quantitative and qualitative analyses to produce a comprehensive decision recommendation report, placing particular emphasis on articulating the decision-making rationale and the trade-offs involved.

### 3.4 Reform of Teaching Evaluation

As previously discussed, under the AI paradigm, the teaching objectives of Engineering Economics should prioritize the evaluation of decision-making rationale rather than computational accuracy. The evaluation system, serving as a guiding instrument, must align harmoniously with these renewed teaching objectives.

1). The weighting of closed-book final examinations should be substantially reduced. Such exams ought to emphasize students’ comprehension of concepts and their ability to apply methodologies, rather than their proficiency in performing intricate calculations.

2). A comprehensive, process-oriented evaluation framework should be established, encompassing activities such as classroom discussions, oral defenses, and the composition of project research reports. In the former, students’ spontaneous reasoning and logical argumentation skills are appraised through questioning and debate sessions. For research reports, evaluation criteria should be meticulously delineated to include clarity in problem definition, identification of critical variables, model validity, depth of risk analysis, and coherence of conclusions.

3). The adoption of “human-AI collaborative” evaluations is encouraged. While students may utilize AI tools in their assignments, it is imperative that they explicitly delineate the “AI’s contribution” versus “their own contribution” within their reports. The evaluative focus is placed predominantly on the latter, with particular attention to its critical rigor and originality.

4. Non-standardized answer formats should be incorporated into evaluations. Formats such as oral defenses and project presentations provide avenues to gauge students’ capacity for profound and reflective thinking.

## 4. Core Challenges in Implementing the Reform and Corresponding Strategies

### 4.1 Principal Challenges

At the faculty level, two predominant challenges emerge. Firstly, certain teachers may encounter gaps in their knowledge frameworks. While traditional Engineering Economics educators excel in deterministic model computations and theoretical derivations, they often possess limited familiarity with cutting-edge uncertainty analysis techniques, AI tools, and the pedagogical approaches required for project-based learning. Secondly, within the AI context, the role of the teacher transforms from a mere “conveyor of knowledge” to a “designer, facilitator, and motivator” of the learning process. This transition demands substantial effort in redesigning curricula, orchestrating classroom interactions, and evaluating complex learning trajectories. Such a shift not only tests educators' competencies but also challenges entrenched teaching philosophies and habitual practices, potentially eliciting resistance or anxiety among some faculty members unaccustomed to these new roles.

From the student perspective, adaptation difficulties to novel instructional models and ambiguous boundaries regarding academic integrity present significant obstacles. Many students remain accustomed to a passive learning paradigm characterized by "teacher lectures, student listening, and post-class exercises". The pivot toward active inquiry, collaborative teamwork, and open debate inherent in project-based learning may provoke confusion, apprehension, and skepticism—manifesting in questions such as "Why does the teacher not teach the essentials directly?"—thereby impeding their swift assumption of an autonomous learner identity. Concurrently, the advent of "human-AI collaboration" blurs the lines between legitimate use and academic misconduct. In the absence of clear guidelines, students risk falling into misconceptions or exploiting AI for sophisticated forms of cheating, thereby undermining the integrity of evaluations.

Moreover, there exists a pronounced scarcity of highly realistic, uncertainty-rich, and engineering practice-integrated comprehensive case studies essential for the reform. Existing textbooks predominantly feature simplified "calculation problem" cases, while the development of high-quality, industry-relevant cases by individual teachers demands considerable time investment and access to professional resources, posing a formidable challenge.

### 4.2 Safeguarding Measures

To address the aforementioned challenges faced by educators in the AI era, it becomes imperative to strengthen collaborative lesson planning and cultivate vibrant teaching communities. Regular pedagogical seminars should be convened to jointly develop instructional case studies, design project assignments, and share both triumphs and setbacks. Furthermore, fostering robust partnerships with industry enterprises and engaging seasoned engineers as "industry mentors" can provide invaluable co-guidance for student projects, thereby ensuring that the curriculum remains closely aligned with cutting-edge professional practices.

Regarding the prudent utilization of AI by students to enhance their learning outcomes, the establishment of a clear, equitable, and practicable code of conduct is paramount. A collaborative classroom dialogue aimed at formulating and publicizing an AI usage charter can effectively delineate the boundaries between legitimate AI assistance and potential academic misconduct. Additionally, students should be required to submit an AI Tool Usage Statement alongside major assignments or project reports, explicitly detailing which AI tools were employed, the specific stages at which they were utilized, and the manner of their application, while underscoring the portions independently completed by the student. Such transparency serves as a foundational pillar in upholding academic integrity.

## 5. Conclusion and Outlook

In the era of artificial intelligence, the true essence of teaching Engineering Economics hinges upon a fundamental shift—from an overemphasis on "instrumental" computational training to a profound cultivation of "value-driven" decision-making capabilities. By recalibrating teaching objectives, content, methodologies, and evaluation systems, the classroom transcends its traditional role as a mere conduit for formulas and algorithms, evolving into a dynamic arena where students confront authentic engineering challenges and simulate real-world decision processes. Educators, in turn, transcend the role of mere knowledge transmitters to become facilitators and collaborators, guiding students in harnessing AI tools to engage in exploratory learning.

Ultimately, the success of this course in the future should not be measured by the quantity of formulas memorized, but rather by students' capacity—augmented by AI—to navigate the intricate economic decisions inherent in engineering practice with clarity and responsibility. Only through such transformation can the engineers we cultivate emerge as the pivotal architects of exceptional project value, armed with profound economic insight, rigorous analytical prowess, and courageous, accountable decision-making.

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