Ideological and Political Education Design for Engineering Bidding and Contract Management Courses in a Project-Based Teaching Context

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Abstract. To address issues such as the absence of a framework, superficial integration, and difficulty in quantifying outcomes in ideological and political education within courses, this paper integrates ABET engineering education accreditation standards to construct a classification framework for ideological and political elements and map them to course modules. Using real engineering cases, it designs task chains and ethical decision points. A quasi-experimental design (N=156) was employed to validate effectiveness, with the experimental class demonstrating large effect sizes in dimensions such as rule of law awareness (d=1.47) and integrity consciousness (d=1.64), enabling professional teaching and ideological education to advance in tandem. This approach effectively enhances students' ideological and ethical cultivation while strengthening their awareness of the rule of law, integrity, and social responsibility.

Keywords: Engineering Bidding and Contract Management; Ideological and Political Education in Courses; Instructional Design; Project-Based Learning; Quasi-experimental study

1 Introduction

Engineering ethics education has become a global consensus in engineering education reform. ABET's engineering education accreditation standards list “Professional Ethics and Responsibility” as a core graduation requirement, emphasizing that students should be able to identify ethical issues in engineering contexts and make responsible judgments, thereby cultivating socially responsible engineers[1]. In China, the integration of ideological and political education into courses—as a strategic initiative for fostering virtue and nurturing talent—resonates with global trends in engineering ethics education. However, two key challenges remain: how to effectively integrate this education into curricula and how to evaluate its implementation[2].

Engineering Bidding and Contract Management is a required course for the Engineering Management program, designed to equip students with the ability to lead or participate in bidding and contract management for domestic and international engineering projects. This course inherently possesses distinct ideological attributes,

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covering core ethical issues such as laws and regulations, fair competition, integrity in contract fulfillment and social responsibility. However, current practices often remain at the level of superficial embellishment, lacking a systematic theoretical framework, actionable instructional design, and verifiable outcome assessment. Based on this, this paper integrates project-based learning with China's curriculum-based ideological and political education requirements to construct a classification framework for ideological and political elements. It designs exemplary project-based learning cases, aiming to provide transferable localized solutions for similar courses.

2 Course Feature Analysis

The course "Engineering Bidding and Contract Management" possesses distinct professional characteristics and advantages in ideological and political education[3]:

Emphasis on Both Professionalism and Practicality. The curriculum covers the entire business process of engineering tendering, bidding, contract formation and performance, and claims handling. It emphasizes the integration of theory and practice, utilizing project-based learning to enable students to learn in real or simulated work scenarios, thereby cultivating their ability to solve practical engineering problems..

Emphasis on Legal Compliance and Standardization. Engineering bidding activities must strictly adhere to national laws and regulations, upholding principles of openness, fairness, impartiality, and good faith. Contract management requires all parties to fulfill obligations legally and maintain market order. These elements provide a natural entry point for cultivating students' legal awareness, rule consciousness, and integrity.

High Standards for Social Responsibility and Professional Ethics. Engineering construction projects are vital to national development and public welfare. Practitioners must uphold a strong sense of social responsibility and professional ethics, strictly avoiding illegal activities such as bid rigging, bribery, and dual contracts. This presents real-world case studies and educational opportunities for cultivating students' professional ethics and social responsibility.

3 Ideological and Political Design of the Course

3.1 Principles for Ideological and Political Education Design in Courses

The design of ideological and political education in this course adheres to the following principles: First, unifying value guidance with knowledge transmission by integrating core socialist values into professional knowledge instruction. Second, combining explicit education with implicit education, ensuring the organic integration of ideological and political elements while avoiding rigid preaching[4]. Third, interconnecting theoretical instruction with practical teaching to cultivate students' professional competence and moral character through project-based practice.

3.2 Structured Classification Framework for Ideological and Political Education Elements in Courses

This course organizes its content around the bidding and tendering process as its central axis, with contract performance serving as the broader framework. It integrates procedural teaching content for each task point within the modules. It inspires students' patriotic sentiments through exemplary projects like the Lubuge Hydropower Station; Use actual engineering projects to deliver knowledge overviews, organize thinking, and engage students; Students undertake project-based learning collectively based on an actual engineering project (the Experimental Middle School Training Building Construction Project).This approach aims to stimulate students' initiative and creativity in learning while guiding them toward developing sound values[5]. Based on international consensus regarding engineering ethics education and China's professional accreditation standards for engineering education, this course establishes a classification system for ideological and political elements, mapping value cultivation objectives to specific course modules, as shown in Table 1.

Table 1. Classification Framework for Ideological and Political Education Elements.

Teaching Module	Key Teaching Points	Integration Points for Ideological and Political Education
Strengthening our nation is my responsibility.	Luobuge Hydropower Station and Mega-Project Case Study	Patriotic Education
Knowing the Engineering Market	Office Building Project (This project essentially covers the knowledge set required for students to undertake project-based learning)	National pride
Engineering Contract		Comply with the law Honesty and integrity
Overview of Bidding and Tendering		Social Responsibility Global Perspective
Project Bidding	Training Building Project for Experimental Middle School — Pre-Bid Decision-Making, Verification of Quantities, Preparation of Bid Documents	Teamwork and Collaboration Sustainable Development
Bid Evaluation	Training Building Project of Experimental Middle School — Bid Opening and Bid Evaluation	Diligent and responsible Fair and impartial
Project Award	Training Building Project for Experimental Middle School — Bid Award and Contract Negotiation	Civilized Etiquette Friendly Education
Engineering Claims	Training Building Project for Experimental Middle School — Construction Contract Claims	Self-protection Regulatory awareness
Bidding and Tendering Practices	Review all bidding and tender documents	Dialectical thinking Innovative mindset

This classification framework aligns with the "Professional Ethics and Responsibility" standards of ABET engineering education accreditation and the requirements of China's Guidelines for Ideological and Political Education in Higher Education Institution Courses, ensuring the systematic and evaluable nature of ideological and political education[6].

3.3 Typical Case of Project-Based Teaching: Preparation of Bid Documents for the Experimental Middle School Training Building Projects

This project is based on a real-world engineering case—the Experimental Middle School Training Building Project (gross floor area: 12,580 m², project cost: 42 million yuan). Students form simulated construction companies in groups of 4-5 members, experiencing the entire process from interpreting tender documents to submitting bid proposals. Three key ethical decision points are incorporated, as shown in Table 2.

Table 2. Three Key Ethical Decision Points in the Bid Document Preparation Process.

Task	Scenario Setup	Moral Decision Point	Integration of Ideological and Political Education
1.Compliance Review of Bidding Documents	Provide simulated tender documents containing biased clauses (such as specifying particular brands or setting unreasonable qualification thresholds).	Identifying the Boundaries Between Covertly Discriminatory Clauses and Reasonable Technical Requirements	In conjunction with Article 32 of the Implementing Regulations of the Bidding Law, discuss procedural justice and fair competition.
2.Bid Pricing Strategy Development	Three gray-area strategy options: submitting unbalanced bids, undercutting costs in bidding, and collusive bidding practices.	Balancing the maximization of winning bid probability with the baseline of compliant operations	Using real-world examples such as the "Xi'an subway faulty cable incident," we explore the trade-off between short-term gains and long-term reputation.
3.Construction Organization Plan Optimization	Require optimization of green construction measures without increasing costs.	Balancing the Conflict Between Economic Benefits and Ecological Responsibility	Aligning with the Dual Carbon Strategy: Exploring the Social Value of Green Building Technology Innovation

4 Course Evaluation and Outcomes

4.1 Course Assessment and Evaluation Mechanism

Course assessment encompasses three evaluation phases: pre-class, in-class, and post-class; involves three evaluation entities: self-assessment, peer assessment, and instructor assessment; employs three evaluation methods: qualitative, quantitative, and MVP (Most Valuable Player); and addresses three evaluation dimensions: formative, summative, and values-based. This approach implements a multi-dimensional,

comprehensive evaluation process covering ideological and political assessment, knowledge assessment, and competency assessment. As shown in Figure 1.

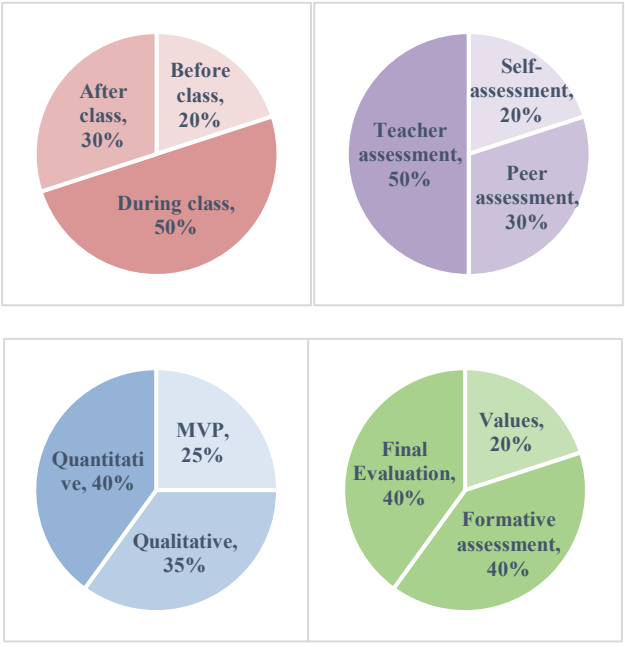

Fig. 1. Assessment Mechanism for the Course on Engineering Bidding and Contract Management.

4.2 Assessment of Teaching Effectiveness in Course-Based Ideological and Political Education

Quantitative Evaluation: Preand Post-Test Quasi-Experimental Design. The self-developed "Engineering Bidding Professional Ethics Competency Scale" was employed, comprising four dimensions: rule of law awareness, integrity consciousness, social responsibility, and professional identity. It utilized a 5-point Likert scale with Cronbach's $\alpha = 0.87$. Preand post-tests were administered to four parallel classes of the 2023 Engineering Management cohort (N=156). The experimental class integrated ideological and political education into teaching, while the control class followed traditional teaching methods. Results are shown in Table 3.

The results indicate that the experimental class demonstrated large effect size improvements ($d > 1.0$) across all four dimensions, significantly outperforming the control class. This confirms that integrating structured ideological and political education substantially enhances teaching effectiveness, enabling students to gain a deeper understanding of the social and cultural significance underlying knowledge while stimulating their interest and enthusiasm for learning. The preand post-test score comparisons are shown in Figure 2.

Table 3. Preand Post-Test Comparison of Course-Based Ideological and Political Education Effectiveness (M±SD).

Dimension	Group	Pre-test	Post-test	Increase	Cohen's d
Legal Awareness	Experimental Group	3.42±0.68	4.31±0.52	+26.0%	1.47
	Control Group	3.38±0.71	3.67±0.64	+8.6%	0.43
Integrity	Experimental Group	3.55±0.61	4.45±0.48	+25.4%	1.64
	Control Group	3.51±0.65	3.78±0.59	+7.7%	0.43
Social Responsi-	Experimental Group	3.28±0.72	4.12±0.58	+25.6%	1.29
bility	Control Group	3.31±0.69	3.52±0.66	+6.3%	0.31
Professional Eth-	Experimental Group	3.61±0.66	4.28±0.55	+18.6%	1.10
ics	Control Group	3.58±0.70	3.82±0.63	+6.7%	0.36

Note: $p < 0.01$, effect size $d > 0.8$ indicates a large effect.

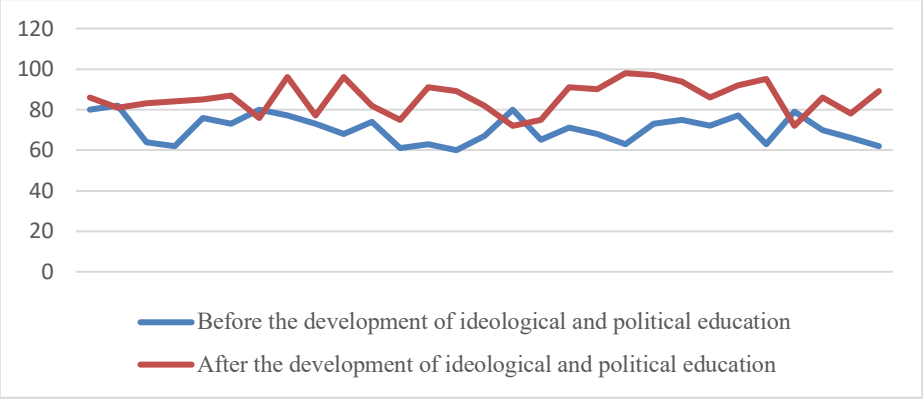

Fig. 2. Comparison of Student Performance Before and After Implementing Ideological and Politi-cal Education in Course.

Behavioral Indicators: Competition Performance and Career Choice Tracking. A follow-up study of experimental class students revealed: 23 awards in ethics-related case analysis at provincial-level or higher subject competitions (Category A), marking a 140% year-on-year increase; 24% of graduation projects adopted an engineering ethics perspective (compared to 12% in the control group); 27% of graduates secured positions at central state-owned enterprises and state-owned enterprises, exceeding the control group (10%); Employers reported these students demonstrate "strong rule-consciousness and high career stability."

5 Conclusion

This paper explores localized approaches to integrating ideological and political education into the "Engineering Bidding and Contract Management" course within the framework of international engineering ethics education. It constructs a classification system for ideological and political elements, mapping ABET ethics standards—

identifying ethical issues, understanding professional responsibilities, and making ethical judgments—to course modules. This classification system has been validated through two rounds of teaching iterations and can serve as a reference for designing ideological and political education in engineering management courses.

By incorporating actual engineering cases to create ethical decision points, this approach overcomes the challenges of generalized and abstract ideological integration. Compared to Dongchun's "micro-ideological education" model[7], this study emphasizes the embedding of ethics throughout the entire project lifecycle.

Quasi-experimental research confirms that structured ideological integration significantly enhances students' legal awareness (Cohen's d=1.47), integrity awareness (d=1.64), and social responsibility (d=1.29). Effect sizes meet the international standard for large effects in educational intervention research (d>0.8).

Limitations include a single-institution sample. Future work should conduct randomized controlled trials across multiple universities while developing international engineering ethics modules aligned with China's "Going Global" strategy for construction, addressing new demands for engineering talent cultivation in globalization.

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