# Research on Blended Case Teaching Driven by Task Sheets: Taking the Course 'Engineering Project Management' for Environmental Majors as an Example

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**Abstract: Under the background of the dual carbon strategy and the transformation and upgrading of the environmental protection industry, the cultivation of professionals in Environmental Science and Engineering has posed an urgent demand for project management competencies. To address the prominent problems in the traditional Engineering Project Management course, including the disconnect between teaching content based on construction engineering cases and environmental majors, low student engagement, and weak practical training links, this paper proposes a four-in-one teaching reform framework comprising teaching content restructuring, case process design, task sheet development, and practical activity organization. The study replaces traditional cases with authentic environmental engineering cases, constructs a blended case teaching process of online grouping, offline task-sheet-driven learning, and classroom presentation, develops three types of structured task sheets, namely problem analysis type, solution decision type, and diagram drawing type, and designs practical activities such as role-playing, scenario-based decision-making, and hands-on operations. Teaching practice demonstrates that this model effectively improves student engagement, the ability to apply theoretical knowledge, and team collaboration skills. This paper provides replicable teaching tools and implementation pathways for offering project management courses in environmental majors.**

**Keywords: Engineering Project Management; Environmental Science and Engineering; Blended Case Teaching; Task Sheet Design; Teaching Reform**

## 1. Introduction

### 1.1 Research Background and Significance

Against the backdrop of the deepening advancement of ecological civilization construction and the dual carbon strategy, China's economy and society are undergoing a comprehensive and profound green transformation [1]. The 15th Five-Year Plan explicitly takes carbon peak and carbon neutrality as the driving force, further highlighting the leading role of the dual carbon goals in the comprehensive green transformation of economic and social development and the building of a Beautiful China, and calls for the construction of a four-in-one policy system comprising carbon reduction, pollution mitigation, green expansion, and economic growth [2]. Meanwhile, as an important ecological barrier in the upper reaches of the Yangtze and Yellow Rivers, Sichuan Province is comprehensively advancing the construction of Beautiful Sichuan, implementing specific measures in the battle against pollution, including improving the emergency warning mechanism for heavy pollution weather, performance grading of wastewater treatment and discharge levels in key industrial enterprises, classified and hierarchical risk management and control of soil pollution, and the construction of zero-waste cities. Furthermore, the transformation and upgrading of the environmental protection industry and the rapid expansion of green jobs are reshaping the talent demand structure for the Environmental Science and Engineering discipline [3]. Data show that there are currently only about 100,000 practitioners in the dual carbon field in China, indicating a significant talent gap. Many regions have included green industry-related occupations in the 2025 catalogue of urgently needed and shortage occupations.

 

From the perspective of national and local policies, the implementation of various initiatives depends not only on environmental engineering expertise but also on management factors such as environmental protection inspection and rectification, decomposition of progress targets, and multi-sector collaborative execution. From the industry perspective, the demand for environmental professionals has shifted from traditional single technical operations such as environmental monitoring and pollution control to a composite competency system encompassing project planning, progress control, cost management, team coordination, and cross-departmental communication. For instance, environmental protection enterprises such as Capital Eco-Environment, China Everbright Environment, and China Everbright Environment have explicitly stated in their recruitment for positions such as environmental project managers that candidates with PMP or related project management certifications are preferred. This fully demonstrates that project management capability has transformed from an optional advantage into a core necessity for environmental professionals.

The Engineering Project Management course is precisely an elective course designed to respond to the demands of the nation, local governments, and the industry. However, an examination of the curriculum systems in domestic universities reveals that engineering project management courses have long been primarily offered to majors such as civil engineering and engineering management. Their teaching content typically uses construction engineering as a typical carrier, with case studies focusing on traditional civil engineering projects such as residential buildings, highways, and bridges [4]. In contrast, the core courses of Environmental Science and Engineering mainly center around pollution control technologies such as water, air, and solid waste. Systematic project management training that aligns with the actual needs of the environmental protection industry, such as schedule planning, project bidding simulation, and contract clause drafting, is generally lacking in the training programs. This training model, which emphasizes technical skills over management capabilities, creates a significant structural mismatch with the objective demands of the environmental protection industry's transition toward integration, systematization, and service orientation. Consequently, talent cultivation struggles to meet the industry's real needs for composite competencies. Therefore, faced with multiple pressures from macro policy guidance, regional development demands, and the industry talent gap, as well as the increasing complexity of environmental engineering projects, practitioners are required not only to possess professional technical knowledge but also to master core project management competencies.

+This study takes the Engineering Project Management course as a vehicle and aims to systematically restructure the teaching content and methods in light of the unique characteristics of the environmental engineering major, thereby providing a teaching practice reference for cultivating composite environmental talents with project management capabilities.

This study introduces targeted environmental engineering case studies and implements structured practical training to break down the disciplinary barriers between environmental technology and management knowledge, thereby promoting interdisciplinary integration. Through the reorganization of teaching content and the design of a task-sheet-driven blended case teaching process, this study aims to enhance the alignment between the training of environmental professionals and industry demands. Furthermore, by engaging students in simulated decision-making activities in roles such as project managers, evaluation experts, and bidders, this study strengthens students' awareness of risk, responsibility, and the concept of whole-life cycle management, cultivates their systematic engineering thinking and professional ethics, and supports their long-term career development.

### 1.2 Research Objectives and Questions

Based on the research background and significance outlined above, the overall objective of this study is to design and implement a teaching reform scheme for students majoring in Environmental Science and Engineering, using the Engineering Project Management course as a vehicle. The scheme aims to align with the characteristics of the environmental major and meet the actual demands of the industry, encompassing the restructuring of teaching content, innovation in teaching methods, and validation and improvement of teaching effectiveness. The specific research questions are as follows: How can the teaching content of the Engineering Project Management course be reorganized and optimized according to the characteristics of the Environmental Science and Engineering major? How can effective case teaching activities be designed to enable students to connect theory and practice through structured discussions? In the absence of quantitative pretest-posttest data, how can teaching effectiveness be evaluated and directions for improvement be identified through qualitative feedback? By systematically addressing these three questions, this study will provide a comprehensive reform scheme for offering engineering project management courses in Environmental Science and Engineering, covering teaching content, teaching methods, teaching tools, and effectiveness evaluation, and will serve as a reference for interdisciplinary course construction in similar institutions.

## 2. Course Status and Problem Analysis

### 2.1 Course Positioning and Teaching Content

The Engineering Project Management course is a professional elective course offered to four-year undergraduate students majoring in Environmental Science and Engineering, totaling 32 class hours and 2 credits. Traditionally, as a mature discipline, it has formed a systematic body of knowledge. The teaching content typically uses construction engineering as a typical carrier, covering eight major modules: project management overview, organization management, planning and decision-making, bidding management, schedule management, quality management, cost management, and information management. While this body of knowledge has fundamental value, the misalignment between the case carrier and the professional background is prominent. The lack of connection with the characteristics of environmental engineering projects, such as policy sensitivity, technical uncertainty, ecological impact assessment, and public participation, leads to a cognitive deviation among students, who perceive that this course is not closely related to their major. Therefore, while retaining the fundamental knowledge system in the teaching content, it is necessary to restructure the teaching content according to the characteristics of students majoring in Environmental Science and Engineering.

### 2.2 Teaching Status and Core Problems

Based on a survey of project management courses offered for environmental majors in similar institutions and continuous observation of teaching practices at our university, the following four core problems currently exist in course teaching.

(1) Insufficient alignment of teaching content and weak professional relevance. Course cases and practical training projects are primarily focused on construction engineering, lacking integration with the core courses of the environmental engineering major. For example, when learning schedule management, students have not been exposed to the preparation of schedules for the upgrading and expansion of wastewater treatment plants. This may lead to difficulties for students in transferring project management knowledge to environmental engineering practice, resulting in low student identification with the course.

(2) Monotonous teaching methods and limited student engagement. Traditional teaching is primarily lecture-based, with students acquiring knowledge through PPT presentations and note-taking. Case teaching is sometimes employed, but it often takes the form of storytelling or asking a few simple questions, lacking in-depth discussion and requirements for tangible outcomes, thus resulting in limited overall student investment.

(3) Weak practical application links and lack of hands-on skills training. Due to constraints of class hours and resources, students rarely have the opportunity to use project management software such as Microsoft Project or understand how to transfer this skill to their entire career. Practical skills such as schedule preparation, bidding document writing, and contract clause drafting are essentially absent. Course assessment is mainly based on a final written examination, with question types predominantly consisting of term explanation and short answer questions, lacking in-depth case analysis.

(4) Outdated course content and misalignment with industry demands. The course content has failed to incorporate new concepts in the field of project management in a timely manner. Meanwhile, emerging issues faced during the rapid development of the environmental protection industry, such as project management under the dual carbon goals, resolution of the Not-In-My-Backyard effect, and ecological restoration project evaluation, are not reflected in the course. This leads to a significant gap

 

between what students learn and the requirements of enterprise recruitment positions.

### 2.3 Causes of the Problems and Urgency of Reform

The emergence of the above problems can be attributed, on the one hand, to the long-term reliance of project management courses on the development of civil engineering disciplines, where resources and case libraries are more mature in the field of construction engineering, while environmental majors, for which the course is an elective, lack suitable teaching materials. On the other hand, the course has failed to adapt its teaching design according to the knowledge structure and future needs of environmental major students, simply applying a generic teaching model in a rigid manner. These problems will directly lead to a misalignment between talent cultivation and industry demands. Environmental major students entering project management positions in enterprises require a long adaptation period. Therefore, systematically promoting teaching reform and constructing a project management course teaching model that aligns with the characteristics of the environmental major has become an urgent task for improving the quality of talent cultivation.

## 3. Design and Practice of Teaching Reform

### 3.1 Environmentally Specialized Restructuring of Teaching Content

To address the problems of insufficient alignment of teaching content, weak professional relevance, and the misalignment between case carriers and professional backgrounds, this study restructured the course content according to the characteristics of the Environmental Science and Engineering major. The core idea of the restructuring is to use the eight core knowledge modules as the backbone, real or simulated environmental engineering cases as contextual carriers, and structured task sheets and diverse practical activities as teaching tools, thereby forming a new three-in-one teaching content system of knowledge-context-method.

Figure 1 presents the restructured knowledge graph of this course. The arrows in the figure indicate the correspondence and supporting relationships among the three layers. In the core knowledge modules layer, the eight theoretical modules, including Overview of Engineering Project Management (M1) and Engineering Project Organization Management (M2), are retained to ensure that students master the basic concepts, principles, and methods of project management. In the environmental engineering case module, one to three cases in the environmental engineering field are matched to each knowledge module. The selection of cases follows the principles of authenticity, comparability, and operability. For example, the Three Gorges Project and the Xiangxi Waste-to-Energy Project are actual engineering projects operating at the national or local level. Meanwhile, by comparing failed and successful cases of the same type of waste-to-energy projects, students' critical thinking is strengthened. To ensure the effectiveness of teaching content implementation, various teaching tools and activity formats, such as structured task sheets, role-playing, scenario-based decision-making discussions, and hands-on training, are adopted, aiming to transform abstract case discussions into concrete and productive learning tasks, ensuring that students learn by doing and do by learning.

Compared with traditional general project management courses, the restructured teaching content has the following three features. First, specialization of cases in environmental engineering. All cases revolve around the environmental engineering field, covering typical types of environmental projects such as waste-to-energy power generation, wastewater treatment, river ecological restoration, and contaminated site remediation. While learning project management theories, students are consistently immersed in an engineering context familiar to them, effectively reducing the difficulty of knowledge transfer, enhancing their identification with the course, and achieving interdisciplinary learning objectives. Second, comparative design of positive and negative cases. In modules such as organization management and planning and decision-making, comparisons between successful and failed cases are incorporated, such as the Xiangxi versus Hangzhou Jiufeng projects and the Daxing versus Zhuhai airports. Through comparative analysis, students are guided to identify key factors for project success and root causes of failure, cultivating risk awareness and critical thinking. Third, close integration of cases with tools. Each case is accompanied by corresponding structured task sheets or role-playing activities, ensuring that students complete the entire learning cycle of reading, analysis, discussion, and production within the limited class time. Through the restructuring of teaching content described above, students can master relevant knowledge in both project management and environmental engineering, laying a foundation for subsequent learning and career development.

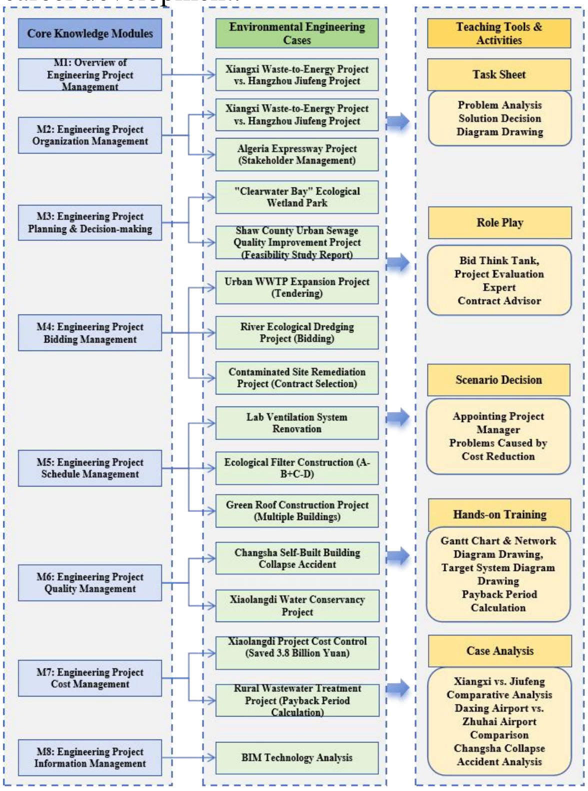


**Figure 1. Knowledge Graph**

### 3.2 Design of the Blended Case Teaching Process

The case teaching method effectively cultivates students' ability to analyze and solve complex problems by placing them in authentic decision-making contexts [5]. Active learning strategies in blended case teaching, such as group discussion, case analysis, and classroom presentation, can significantly enhance student engagement and learning outcomes [6,7]. Therefore, based on the environmentally specialized restructuring of teaching content, this study designed a blended case teaching process of online grouping, offline task-sheet-driven learning, and classroom presentation, integrating pre-class preparation, in-class discussion, and post-class evaluation.

The blended case teaching process is shown in Figure 2. Before class, the teacher creates a course class on the Smart Course platform and releases a task notification for the upcoming case teaching, requiring students to form groups of four to five. The teacher uploads case background materials, task sheet templates, and supplementary reading materials such as relevant policy documents and excerpts from technical specifications. Students are required to complete an initial reading of the case materials before class and think about guiding questions in the task sheet, such as What do you think is the main cause of the failure of this project? Considering the immersive nature of classroom discussion and the advantages of printed materials for annotation and highlighting, the teacher prints the case details, task sheets, and auxiliary tables on paper and distributes them uniformly during the first five minutes of class. This ensures that students can quickly engage in the session, facilitates in-depth face-to-face discussion within groups, and prevents distraction. Timed group discussion and task sheet completion constitute the core of the case teaching. Students are required to assign roles within the group, such as group leader, recorder, presenter, and timekeeper. Each student may take on different roles in different group activities, thereby developing various competencies. The teacher circulates among the groups, using guiding questions to promote deeper discussion. For example, in the case of the Xiangxi Waste-to-Energy Project, the teacher may ask: Which principle of organizational design does this problem violate? If you were the project manager, which aspect would you prioritize for adjustment? Within a limited time, after sufficient discussion, students can record their consensus on the task sheet, producing outcomes that can be submitted and presented. This model enhances student focus and efficiency. While circulating, the teacher can also assess student learning and identify common problems, preparing for subsequent feedback. Finally, the session proceeds to group presentation and collective evaluation. Each group is required to nominate a representative to deliver a three-to-five-minute presentation covering the core problems of the case, the group's analysis conclusions, proposed solutions, and theoretical justifications. After the presentation, other groups may pose questions or provide supplementary input. The teacher guides the questioning around key points of divergence in the case, promoting deep student thinking. The teacher provides comments on each group's proposal, highlighting strengths and weaknesses, and systematically connects specific phenomena in the case with the core theories of the course. Each group submits the completed task sheet to the teacher as a basis for process evaluation.

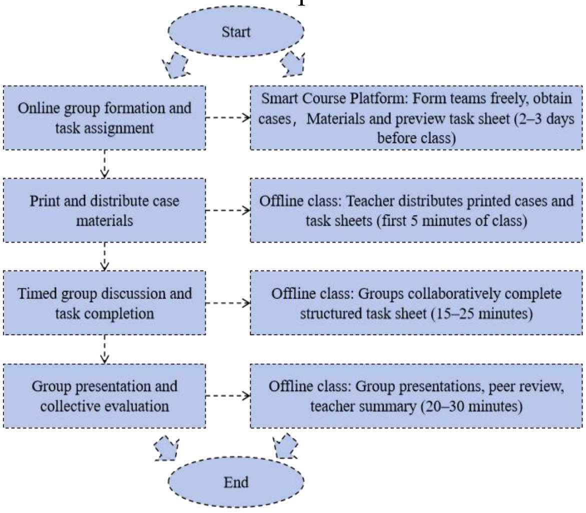


**Figure 2. Blended Teaching Flowchart**

Based on reflections from multiple rounds of teaching practice, the following points are crucial for the effective implementation of the process: (1) Alignment between case difficulty and time allocation: problem analysis type cases, such as the Xiangxi project, require approximately 20 minutes; solution decision type cases, such as bidding strategy, require approximately 25 minutes; and diagram drawing type cases, such as network diagrams, require approximately 15 minutes. (2) Scaffolding positioning of the task sheet: the task sheet should provide an analytical framework but should not be overly detailed, so as not to limit students' open-ended thinking. It is recommended to design a basic task sheet as mandatory and an extended task sheet as optional to meet the needs of groups at different levels. (3) Avoiding the free-rider phenomenon: in a small number of groups, some members may not participate actively in discussions. It is recommended to introduce an anonymous peer evaluation mechanism within the group, where group members rate each other's contribution, which serves as an adjustment coefficient for individual grades.

## 3.3 Task Sheet Design Principles and Functions

3.3.1 Design Principles of the Task Sheet

Task-based learning theory emphasizes that structured learning tasks can provide cognitive scaffolding for learners, helping them complete complex tasks that exceed their current capability level [8]. Based on cognitive constructivist learning theory and iterative reflections from multiple rounds of teaching practice, this study summarizes four core principles for task sheet design: structuredness, progressiveness, visualization, and theoretical relevance. Structuredness requires decomposing open-ended case problems into specific subtasks, forming a clear analytical path and preventing student discussions from becoming too vague or unfocused. Progressiveness requires arranging subtasks in order of increasing cognitive difficulty, from information extraction to analysis and evaluation, and then to creation and generation, corresponding to the understanding, analysis, evaluation, and creation levels of Bloom's cognitive taxonomy. Visualization requires that subtasks primarily take forms such as tables, checkboxes, fill-in-the-blank items, and arrow diagrams, facilitating students' rapid recording of consensus and reducing the burden of written description. Theoretical relevance requires students to establish correspondences between case judgments and specific theoretical concepts, promoting knowledge transfer and achieving the goal of lifelong learning. These four principles support and interconnect with one another, transforming case discussions from superficial conversations into evidence-based deep learning.

3.3.2 Three basic types of task sheets

According to different teaching objectives and case characteristics, this study developed three basic types of task sheets, applicable to three types of learning tasks: problem analysis, solution decision-making, and diagram operation, as shown in Table 1.

The problem analysis type task sheet is applicable to teaching scenarios involving analysis of project failure causes, accident roots, and management errors. Its core logic follows the sequence of phenomenon, theory, countermeasure, and implication. Taking the Analysis of Organizational Problems in the Xiangxi Waste-to-Energy Project as an example, the structure of the task sheet is shown in Table 2. The characteristic of this type of task sheet is that the theory comparison section requires students to establish connections between case facts and course concepts, thereby avoiding experience-based discussions that focus solely on the specific case without broader theoretical grounding.

**Table 1. Comparison of Three Basic Types of Task Sheets**

| Type | Applicable Scenario | Core Task | Cognitive Level | Typical Example |
|---|---|---|---|---|
| Problem analysis type | Analysis of failed or successful cases, accident attribution | Identify problems<br>Compare with theories<br>Propose countermeasures<br>summarize implications | Understand<br>Analyze<br>Create<br>Evaluate | Analysis of organizational problems in the Xiangxi Waste-to-Energy Project |
| Solution decision making type | Bidding strategy, contract selection, scheme comparison | Analyze context<br>List options<br>Weigh pros and cons<br>Make a decision | Analyze<br>Evaluate<br>Decide | Bidding strategy selection for the river ecological dredging project |
| Diagram drawing type | Network diagram drawing, Gantt chart drawing, objective system diagram construction | Understand logic<br>Draw manually<br>Compare and analyze<br>Summarize patterns | Understand<br>Apply<br>Analyze | Dual-diagram comparison for the laboratory ventilation renovation project |

**Table 2. Problem Analysis Type Task Sheet**

| Stage | Task Content | Cognitive Level | Response Format |
|---|---|---|---|
| Problem Identification | Identify three main problems in the organizational management of this project | Understand | Open-ended fill-in-the-blank |
| Theory Comparison | Compare with the Four Principles of Organizational Design, determine for each principle whether it is violated, and provide supporting evidence | Analyze | Checkbox plus written explanation |
| Countermeasure Proposal | Propose three specific improvement suggestions with theoretical justifications | Create | Table filling |
| Implication Summary | Summarize the core teaching implication of this case in one sentence | Evaluate | One-sentence fill-in-the-blank |

The solution decision-making type task sheet is applicable to teaching scenarios that require decision-making under constraints, such as bidding strategy formulation, contract type selection, and technical scheme comparison. Its core logic follows the sequence of context analysis, option comparison, decision justification, and risk prediction. Taking the Bidding Strategy Selection for the River Ecological Dredging Project as an example, the structure of the task sheet is shown in Table 3. The characteristic of this type of task sheet is that it requires students to articulate their reasons and justifications after making a choice, thereby preventing decision-making based on intuition and cultivating rational decision-making capabilities.

The diagram drawing type task sheet is applicable to hands-on teaching scenarios such as network diagram drawing, Gantt chart drawing, Work Breakdown Structure decomposition, and objective system diagram construction. Its core logic follows the sequence of understanding logic, drawing manually, comparative analysis, and pattern summarization. Taking the Dual-Diagram Comparison for the Laboratory Ventilation Renovation Project as an example, the structure of the task sheet is shown in Table 4. The characteristic of this type of task sheet is that it combines hands-on doing with reflective thinking, requiring students to conduct comparative analysis and pattern summarization after drawing, thereby avoiding the tendency of drawing for the sake of drawing.

**Table 3. Solution Decision-Making Type Task Sheet**

| Stage | Task Content | Response Format |
|---|---|---|
| Context Analysis | List the key constraints of this project, such as schedule, technology, and competitors | Bullet-point fill-in-the-blank |
| Strategy Selection | Choose one among high-price profit-seeking, low-price low-profit, and break-even non-profit | Checkbox plus justification explanation |
| Technique Application | Determine whether techniques such as unbalanced bidding are applicable and explain how to apply them | Table checkbox plus written explanation |
| Risk Prediction | List two major risks and corresponding countermeasures | Table filling |

**Table 4. Diagram Drawing Type Task Sheet**

| Stage | Task Content | Response Format |
|---|---|---|
| Gantt Chart Drawing | Draw a Gantt chart based on given work logic relationships | Draw bars in the table |
| Network Diagram Drawing | Express work logic relationships using an activity-on-arrow network diagram | Draw arrow diagrams in the blank area |
| Comparative Analysis | Answer which diagram makes it easier to identify the total project duration and why | Open-ended question and answer |
| Pattern Summarization | Summarize the advantages, disadvantages, and applicable scenarios of the two diagram types | Bullet-point fill-in-the-blank |

3.3.3 Pedagogical functions of the task sheet

Synthesizing the design and practice described above, the task sheet performs the following five core pedagogical functions in this course.

(1) Guiding function: providing an analytical framework to lower the cognitive threshold. Faced with complex engineering cases, students often do not know where to begin. The task sheet decomposes open-ended problems into specific subtasks, clarifying what to do first and what to do next, thereby giving discussion direction and sequence.

(2) Recording function: solidifying discussion outcomes and forming learning evidence. The consensus reached in group discussions is easily lost if not recorded promptly. The task sheet requires students to record their discussion results in tables, producing learning evidence that can be submitted and evaluated, while also providing an outline for subsequent presentations.

(3) Connecting function: mandating theoretical connections to promote knowledge transfer. In traditional case discussions, students tend to engage in experience-based discussions focused solely on the specific case, without establishing connections between concrete phenomena and abstract theories. By including sections such as theoretical justification and corresponding principles, the task sheet requires students to complete this connection, promoting deep processing and transfer of knowledge.

(4) Evaluation function: providing a basis for grading and enabling process evaluation. The quality of task sheet completion can directly serve as a component of the usual performance grade. The teacher can assess task sheets based on completeness, logical coherence, and accuracy of theoretical application, thereby achieving formative evaluation of students' learning processes.

(5) Reflective function: leaving blank spaces and posing follow-up questions to stimulate deep thinking. While providing a framework, the task sheet should also leave open spaces, such as What other factors do you think are relevant? or If you were the project manager, what would you do?, to stimulate students' critical thinking and creative thinking.

### 3.4 Design of Classroom Practical Training Activities

3.4.1 Design philosophy of practical training activities

Task-sheet-driven case teaching focuses on structured analysis and written output. However, the cultivation of project management capabilities in environmental engineering also requires students to engage in decision-making simulations, role-playing, and hands-on operations in more open contexts. Therefore, this study designed multi-dimensional classroom practical training activities that complement task-sheet teaching, together forming a three-in-one competency training system of analysis, decision-making, and operation. The design of practical training activities follows three core principles. First, learning by doing and doing by learning: practical training activities transform abstract knowledge of schedule management, bidding, contract selection, and other topics into concrete and actionable tasks, enabling students to deepen their understanding through the process of doing. Second, the principle of authenticity: practical training activities strive to simulate typical scenarios of real project management, such as bidding decisions, project manager appointment, and cost compression decisions. Even when it is impossible to fully replicate real projects under the time and condition constraints of the classroom, the core decision-making conflicts and constraints should be preserved, allowing students to experience the pressure and complexity of authentic management contexts. Third, equal emphasis on interest and challenge: activities incorporate forms such as group competitions, role-playing, and timed challenges to increase classroom engagement and a sense of participation. Meanwhile, by setting tasks of moderate difficulty, such as formulating a bidding strategy under multiple constraints, appropriate cognitive challenges are maintained to stimulate students' achievement motivation.

3.4.2 Examples of practical training activity types

Simulation and role-playing methods can help students understand the entire process of project management from the perspectives of different stakeholders [9]. Experiential learning theory holds that students learning by doing in real or simulated contexts can more effectively transform knowledge into practical competencies [10]. Based on the above theories and according to different competency training objectives, this study classifies practical training activities into three types: role-playing, scenario-based decision-making, and hands-on operation. Specific examples are provided below.

(1) Role-playing practical training activity: Bidding Think Tank

Applicable module: M4 Bidding Management

Scenario setting: A city announces an open tender for the River Ecological Dredging and Shoreline Restoration project, with an investment of approximately 120 million yuan, stringent environmental protection standards, and a tight schedule. Our company possesses medium technical strength and advanced equipment but lacks a performance record in this city. Competitors include a local enterprise with government connections.

Task requirements: As a bidding think tank, each group must complete the following tasks within 15 minutes: (a) select a bidding strategy, choosing among high-price profit-seeking, low-price low-profit, and break-even non-profit; (b) determine whether techniques such as unbalanced bidding and sudden price reduction are applicable and how to apply them; (c) predict major risks and formulate countermeasures.

Organizational form: After group discussion, each group selects a representative to present, and the teacher comments on the strengths and weaknesses of each group's strategy.

Teaching effectiveness: Students experience the complexity of bidding decisions in a competitive and constrained context and understand the applicable conditions of different strategies.

(2) Scenario-based decision-making practical training activity: Appointing the Project Manager

Applicable module: M2 Organization Management

Scenario setting: A technology company receives a large order and needs to establish a project team. Two candidates are available: Zhang Hong, a technical expert, long-time employee with five years of experience, and Dong Wen, an MBA graduate, a new employee with strong management skills and an enterprising spirit. The board of directors holds divergent views.

Task requirements: After group discussion, students must make a choice, articulate their reasons, and explain the following: if the technical expert is chosen, how can his lack of management experience be compensated? If the management talent is chosen, how can the authority of technical decisions be ensured?

Organizational form: Debate between two sides, with the teacher randomly assigning half of the groups to support Zhang Hong and the other half to support Dong Wen. The teacher then summarizes the applicable conditions of the two choices.

Teaching effectiveness: Through debate, students understand the competency model of a project manager, differentiating technical capability from management capability, and recognize that there is no standard answer, only suitability.

(3) Hands-on practical training activity: Objective System Diagram Drawing

Applicable module: M3 Planning and Decision-Making

Scenario setting: The Qing Shui Wan Ecological Wetland Park and Reclaimed Water Plant composite project in a certain city: construction of a reclaimed water plant with a daily treatment capacity of 50,000 tons on a contaminated river floodplain, with effluent further purified through constructed wetlands, creating an urban park integrating water quality improvement, ecological restoration, public recreation, and environmental education functions.

Task requirements: As a project planning team, each group must propose at least three specific and measurable objective factors from three dimensions: function/technology, cost/time, and impact/sustainability, and draw an objective system diagram with the overall objective at the center, branching out to the dimensions and specific indicators.

Organizational form: Groups draw on white paper while the teacher circulates to provide guidance. After completion, drawings are posted for display and whole-class observation and evaluation.

Teaching effectiveness: Students understand the four-step process of objective system design, namely situation analysis, problem definition, objective factor proposal, and objective system establishment, and master the methods of objective decomposition and relational expression.

## 4. Teaching Effectiveness and Reflection

Based on the teaching reform design described above, this chapter evaluates the implementation effectiveness of the teaching reform, reflects on existing problems, and proposes directions for continuous improvement through qualitative feedback channels such as classroom observation, analysis of task sheet completion quality, student presentation performance, and after-class informal discussions. It should be noted that this round of teaching reform did not employ pretest-posttest comparison questionnaires. Therefore, this chapter primarily adopts qualitative descriptions, supplemented by specific classroom cases and verbatim student feedback, to faithfully present the overall picture and effectiveness of the teaching reform.

### 4.1 Qualitative Teaching Feedback

Synthesizing observations and records from multiple rounds of teaching practice, teaching feedback is primarily reflected in the following four dimensions.

(1) Significant improvement in student engagement. Compared with traditional lecture-based classrooms, student involvement in case discussions and practical training activities was markedly higher. Specific manifestations include the following: group discussion sessions required full participation, with few students disengaged; students displayed high enthusiasm in debates and role-playing; some groups voluntarily used after-class time to refine their presentation materials. In informal after-class exchanges, one student remarked, I used to get distracted easily in lectures, but during discussions I have to speak and fill out the task sheet, and time flies. In the Bidding Think Tank activity, several groups voluntarily requested extended time after the allotted 15-minute discussion period, engaging in intense debates over whether to use unbalanced bidding. Such phenomena were relatively rare in traditional classrooms.

(2) Enhanced ability to connect theory with practice. Several groups were able to proactively cite theoretical concepts in their presentations, rather than answering questions based solely on common sense or intuition. The content students filled in the theoretical justification column of the task sheets gradually shifted from vague statements such as because this is better to specific statements such as because this violates the principle of purposefulness in organizational design or because the cost-reimbursable contract is more suitable for projects with high uncertainty. One student noted in the end-of-term reflection, I used to think project management was just about scheduling and budgeting. Now I understand that every decision is supported by theory. Taking the task sheet for Analysis of Organizational Problems in the Xiangxi Project as an example, approximately 70% of the groups were able to accurately map case problems to the Four Principles of Organizational Design and propose improvement suggestions of reasonable depth. Approximately 30% of the groups exhibited a labeling phenomenon, where they knew to write violates the principle of purposefulness but could not clearly explain why, suggesting the need to strengthen training in theoretical concept differentiation in subsequent teaching.

(3) Development of teamwork and presentation skills. Role-playing and scenario-based decision-making activities prompted students to divide work reasonably within groups and present their outcomes to the whole class. Some students who were initially reserved showed significant improvement in later presentations. One student shared after class, I was very nervous during my first presentation and could not speak fluently. Later, we took turns being the presenter in our group, and everyone had the chance to speak on stage. Gradually, I became less afraid. The teacher observed that during the debate activity of Appointing the Project Manager, the two sides engaged in multiple rounds of argumentation over the strengths and weaknesses of technical experts versus management experts. Some students proposed a compromise solution of selecting different project managers according to project phases, reflecting a relatively flexible way of thinking.

(4) Positive student feedback on task sheet

design. In after-class exchanges, multiple students reported that task sheets helped them clarify the direction of discussion and prevented them from going off track. One student stated, In other courses, case discussions often end up being idle chatter with no real outcomes. With task sheets, we have to fill in specific content, so everyone must think and contribute. Another student suggested, Some blanks feel a bit restrictive, as if we have to fill them exactly as the teacher expects. This suggests that future task sheet design should further balance scaffolding and openness. Furthermore, some students spontaneously submitted photos of their handwritten discussion notes, indicating a high degree of learning engagement.

### 4.2 Teaching Reflection and Directions for Improvement

Although the overall classroom effectiveness has been significantly improved, certain problems have emerged during the teaching process. First, the free-rider phenomenon persists. Some students lacked motivation, and the task sheets were completed by only one or two group members. Although a peer evaluation mechanism was introduced, students were reluctant to give low scores due to interpersonal considerations. Second, the issue of task sheet over-structuring has also raised concerns. Some students reported that the task sheets were too detailed, resembling fill-in-the-blank exercises, which limited open-ended thinking. Third, there are problems of imbalanced time allocation. Some complex cases, such as the review of the Shaw County feasibility study report, required discussion time exceeding the preset 20 minutes, which led to compression of the subsequent presentation session and insufficient teacher feedback. For some simple cases, such as the laboratory ventilation renovation drawing task, time was abundant, resulting in idle waiting.

Synthesizing the above problems, the following improvements can be made in future teaching processes. First, establish a dynamic case update mechanism. In addition to updating cases based on industry hot spots and current events, students should be encouraged to independently collect cases of environmental projects in their local contexts, such as local wastewater treatment plants and waste-to-energy projects, to promote student motivation through cases they have personally encountered. Second, to address the issue of task sheet structuring, the scaffolding positioning of the task sheet should be rearticulated. Two versions, a basic task sheet and an extended task sheet, should be designed. An innovation points bonus item should be added to the scoring criteria to encourage students to propose insights beyond the task sheet framework. Third, improve process evaluation. Process evaluation should be subdivided into four components: task sheet quality, classroom presentation performance, peer evaluation, and individual reflection report, with the overall weight increased to 40%. The peer evaluation mechanism should be optimized by adopting a contribution coefficient method, where the group's total score is multiplied by each individual's contribution coefficient to obtain the individual score. Fourth, optimize time management and classroom pacing. Before class, the required time should be estimated based on case complexity, and flexible plans should be developed. For cases with higher complexity, the pre-class preparation process should be strengthened, focusing classroom time on in-depth discussion and presentation.

## 5. Conclusion and Outlook

This study systematically reformed the Engineering Project Management course for environmental majors to address the disconnection between the course and industry demands. The reforms were implemented across four dimensions: teaching content, case process, task sheets, and practical training activities. Teaching practice demonstrates that replacing traditional construction engineering cases with authentic environmental engineering cases, combined with a teaching process of online grouping, offline task-sheet-driven learning, and classroom presentation, can effectively improve student engagement and the ability to apply theoretical knowledge. The core contributions of this study are threefold. First, it systematically integrates the general body of project management knowledge with environmental engineering contexts, forming a transferable pathway for case adaptation. Second, it develops three types of structured task sheets, namely problem analysis type, solution decision-making type, and diagram drawing type, providing operable tool support for case teaching. Third, it constructs a blended teaching model that shifts from teacher-centered instruction to student-centered construction. The limitations of this study include the lack of quantitative data support and a relatively small sample size. Future research will focus on improving case library construction, conducting cross-institutional comparative studies, and introducing digital teaching tools.

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