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Construction and Practice of the "Green Building and New Building Materials" Curriculum under the OBE Concept

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Abstract: In line with the OBE educational philosophy and the requirement of integrating values education into curricula, this study utilizes the "Green Building and New Building Materials" course to establish a teaching system infused with ideological elements. Through a "Three-Classroom Linkage" teaching model, outcome-oriented immersive case studies, and an integrated instructional design merging values, knowledge, and competencies, ecological principles and the craftsman spirit are woven throughout the entire teaching process. Practical results demonstrate that this system has significantly enhanced students' sense of value recognition, comprehensive abilities, and the translation of learning into practical action. This reform provides an effective pathway for cultivating a new generation of engineering and construction professionals who possess both moral integrity and professional excellence.

Keywords: OBE Concept; Ideological Education in Courses; Green Building; New Building Materials; Integration Path

1. Introduction

Fostering virtue and cultivating talents is the fundamental mission and contemporary mandate of higher education. Its core lies in nurturing high-quality professionals who possess both moral integrity and professional competence, and who are well-rounded individuals. As China's socioeconomic development enters a new stage, the nation has set higher requirements for engineering and technological talents. These individuals are expected not only to master solid professional knowledge and skills but also to possess firm ideals and beliefs, high professional ethics, and a strong sense of social responsibility [1-3]. However, the "disconnect" between specialized education and ideological and political education in traditional teaching models remains a prominent issue that constrains the improvement of talent cultivation quality. To achieve this fundamental mission, we cannot rely solely on the "solo efforts" of ideological and political theory courses. Instead, it is essential to fully leverage the educational function of all courses, construct a comprehensive "Three-Wide Education" framework, and promote a favorable situation where specialized courses and ideological and political theory courses align and collaborate in nurturing talents [4-7]. The Outcomes-Based Education (OBE) concept requires that all teaching activities be designed and implemented around the final learning outcomes students are expected to achieve. This precisely provides an operable practical pathway for systematically and standardly integrating value-shaping requirements into the professional training system [8-10].

"Green Buildings and New Construction Materials," a core course for students majoring in building energy-saving materials, offers distinctive advantages for incorporating ideological and political education. By integrating architecture, materials science, environmental science and other disciplines, the curriculum is naturally rich in value-laden content: sustainable-development ideals embedded in green-building design, an innovative spirit reflected in the research and development of new materials, and an ecological ethic demonstrated through whole-life-cycle assessment. These elements provide fertile ground for ideological and political instruction. Against the backdrop of China's ecological civilization drive and the dual-carbon goals, the course is an ideal vehicle for cultivating students' ecological awareness, engineering ethics and sense of social responsibility. Nevertheless, how to translate these latent resources into concrete classroom practice-how to weave value formation seamlessly into the entire process of knowledge transmission and competence building-remains an important issue that calls for sustained exploration.

Against this backdrop, the present study undertakes a systematic ideological-and-political reform of the course "Green Buildings and New Construction Materials" under the guidance of OBE theory. A three-dimensional instructional matrix that integrates ideology-knowledge-competence is constructed, a three-classroom synergistic pedagogical model is instituted, and outcome-oriented diversified teaching methods are implemented. Concurrently, a process-based assessment regime coupled with a continuous-improvement mechanism is refined, yielding a replicable and scalable pathway for embedding ideological and political elements in technical curricula. Beyond enhancing the educational efficacy of the course itself, the research aspires to furnish a reference for analogous engineering programmes and to contribute to the development of a higher-calibre talent-training system. One-semester implementation has produced a mature course-ideology scheme and demonstrable gains in ideological-political cultivation, thereby laying a robust foundation for subsequent deepening of pedagogical reform.

2. Course Implementation Strategies

2.1 The "Three-Classroom Synergy" Teaching Model: Connecting all Channels for Education and Nurturing.

This course has constructed a three-dimensional "three-classroom synergy" model to open an all-channel pathway for ideological-political cultivation. (1) First Classroom (main venue): concentrates on theoretical infusion and value shaping. While lecturing on professional content such as green-building-material performance and energy-saving design principles, instructors naturally dissolve ideological elements-ecological ethics, craftsmanship spirit, and serving the country through science and technology into the knowledge stream, thereby unifying cognitive delivery with value guidance. (2) Second Classroom (practicum venue): emphasizes internalization through action and competence formation. Organized visits to exemplary green-building projects and guest seminars by industry role models transpose abstract ideological tenets into tangible scenarios, intensifying students' professional identity and sense of social responsibility. (3) Third Classroom (cyber venue): aims at horizon broadening and intellectual elevation. An online platform continuously pushes cutting-edge information and hosts debates on hot topics, obliging students to track sectoral dynamics and fostering macro-perspectives and critical thinking. The interlocking of the three classrooms creates a new educational configuration in which theory and practice, online and offline, mutually reinforce and synergistically advance the cultivation mission.

2.2 Implement "Outcome-Oriented" Immersive Ideological and Political Case-based Teaching

This course vigorously promotes an outcome-oriented, immersive case pedagogy that obliges students to internalize values while solving complex engineering problems. Cases are selected to align tightly with national strategies and industry frontiers, e.g., Xiong'an New Area planning and Winter-Olympic venue construction. So that the narratives themselves embed ideological connotations of green development and great-power confidence. During instruction, students adopt role-play to simulate the competing positions of real-project stakeholders and must reconcile technical, economic, environmental and social benefits. The deliverable is a comprehensive design report that explicitly incorporates ethical reflection and social-value assessment. By centering the learner and targeting the concrete outcome of a qualified solution, the method deepens disciplinary knowledge while simultaneously sensitizing students to engineering ethics and social responsibility, thereby shifting ideological-political education from passive reception to active construction.

2.3 Construct a Three-Dimensional Teaching Matrix Integrating Ideological and Political Education, Knowledge, and Ability

To ensure the systematic and standardized integration of ideological and political elements into the course, we constructed a ideology-knowledge-competence triadic instructional matrix. Guided by OBE theory, the matrix deconstructs the curriculum into fine-grained units and maps every core knowledge node (e.g., "recycled-aggregate concrete applications") and key competence node (e.g., "green-material selection capability") onto the most pertinent ideological motifs (e.g., "circular-economy concept," "sustainable-development outlook"). Serving as

a detailed "construction blueprint" for instructors, the matrix eliminates ad hoc or fragmented insertion of ideological content and guarantees scientific consistency in instructional design. Simultaneously, it functions as a dynamic instrument, undergoing periodic revision in response to student feedback and socio-economic developments, thereby preserving the relevance and vitality of the ideological components. In so doing, the matrix provides a robust foundation and central reference for the high-quality implementation of ideological and political education within the course.

2.4 Diversification and Process-oriented Assessment: Focusing on Value Recognition and Skill Enhancement

To accurately evaluate the effectiveness of ideological and political education, this course has reformed the assessment methods and established a diversified evaluation system that prioritizes formative assessment. The weight of the final written examination has been significantly reduced, with assessment integrated throughout the entire learning process. Emphasis is placed on student performance in case discussions, project practices, and online interactions. In the comprehensive course project, specific rubrics such as "innovation," "social and environmental impact analysis," and "team collaboration" are explicitly included, directly aligning with the objectives of value cultivation and competence enhancement. This assessment approach not only focuses on "what students know," but also on "what they value" and "what they can do," thereby shifting students' learning focus from rote memorization to the development of comprehensive competencies. Consequently, the assessment serves as a feedback mechanism to enhance teaching and ensures the genuine realization of educational goals.

2.5 Establish a "Multi-Dimensional" Teaching Feedback Mechanism for Continuous Improvement

Aligned with the OBE-based principle of continuous improvement, the course has instituted a multi-dimensional instructional feedback mechanism. Moving beyond conventional satisfaction surveys, the mechanism prioritizes evidence on students' value-identification level and competency-achievement level. End-of-term anonymous questionnaires and focus-group interviews are employed to gauge the course's tangible impact on learners' ecological awareness and sense of social responsibility. These data are triangulated with the teaching team's reflective journals, peer reviews, and longitudinal tracking of graduates and employers, constituting a heterogeneous feedback network. After systematic analysis, the findings feed directly into precision adjustments of learning outcomes, content, and pedagogical strategies, thereby closing an effective evaluation-feedback-improvement loop that propels a spiral rise in the quality of ideological and political education within the course.

3. Curriculum-based Ideological Teaching Design

3.1 Content Analysis

As a core foundational course for the department of building energy-saving materials, "Green Buildings and New Construction Materials" serves as the critical bridge linking materials science to ecological civilization. The syllabus is organized around green building materials (e.g., recycled-aggregate concrete, eco-friendly coatings) and novel energy-saving products (aerogels, phase-change materials, photovoltaic-thermal conversion media), a knowledge system that intrinsically encodes the ideological motifs of "green development," "circular economy," and "harmonious coexistence of humanity and nature." Consequently, the course functions not merely as a vehicle for technical competence but also as an optimal arena for cultivating students' ecological awareness, engineering-ethics responsibility, and scientific-patriotism mission.

Structurally, the curriculum integrates architecture, materials science and environmental science into a triadic framework of material performance-building system-environmental impact. This interdisciplinary design underpins the OBE-mandated cultivation of integrative competence in solving complex engineering problems. Front-line cases-self-cleaning concrete, photovoltaic curtain walls, etc. immerse students in current industry advances while obliging them to interrogate how materials innovation can serve the national "dual-carbon" strategy. Laboratory investigations and

project-based learning further embed abstract design principles in authentic engineering contexts; in pursuing the concrete deliverable of a green, low-carbon, high-efficiency technical solution, students internalize life-cycle assessment and sustainable-development tenets. Thus knowledge transmission, competence development and value formation are unified across the entire instructional process, furnishing a robust content fulcrum for subsequent exploration of ideological-political integration pathways.

3.2 Teaching Design

3.2.1 Case-based interactive teaching

Case-based interactive teaching serves as a core approach in this course to deeply integrate theory with real-world practice, aiming to transform abstract professional knowledge into embodied professional competence through immersion in authentic contexts and role-based inquiry. To this end, we carefully select high-quality cases that are representative, comprehensive, and thought-provoking, such as "the systematic application of permeable paving materials in the sponge city construction of Xiong'an New Area" and "the selection of green building materials and full life-cycle carbon footprint assessment for the Beijing Winter Olympic venues"-typical projects embedded in national strategic contexts. In classroom implementation, instruction shifts away from one-way lecturing by the teacher to guiding students to immerse themselves in case scenarios as engineers, decision-makers, or consultants. Through structured group discussions, students analyze how material selection balances multi-dimensional objectives such as structural safety, environmental sustainability, and life-cycle cost-effectiveness, while further identifying the underlying policy rationales, social demands, and ethical trade-offs. This problem-oriented interactive analysis prompts students to move beyond technical judgments of "which material is better" and delve into the value-based question of "why this choice is more responsible," thereby establishing a coherent link from professional competence to social responsibility in their cognitive framework. Ultimately, case-based teaching not only effectively enhances students' abilities in systems thinking, multi-criteria decision-making, and teamwork but also transforms abstract concepts of "green development" and "engineering ethics" into professional beliefs that students can perceive, identify with, and act upon, achieving a three-dimensional integration of knowledge impartation, ability cultivation, and value shaping.

3.2.2 Problem-based instructional approach

Problem-based heuristics permeate the entire curriculum so that students autonomously construct knowledge and form scientific outlooks through an interlocking question chain. Instead of expository openings, each new topic is prefaced by cognitively challenging and provocative queries. For instance, prior to introducing aerogel insulation, the instructor asks: "What hidden environmental deficiencies may accompany traditional insulating materials while they deliver energy savings. Which attributes should an ideal next-generation insulator possess." Such questions trigger cognitive conflict and stimulate exploratory drive. As the lesson unfolds, further Socratic probing-How does the material's life-cycle cost profile compare. Does its manufacture satisfy cleaner-production criteria. Compels learners to transcend single-performance metrics and cultivates a habitual, multi-dimensional critique encompassing resources, energy, and environment. This process not only transmits factual content but also forges a scientific disposition characterized by evidence-based reasoning, resistance to uncritical conformity, and willingness to question authority, thereby laying the intellectual groundwork for future green innovation.

3.2.3 Flipped classroom teaching

The flipped-classroom paradigm re-engineers the instructional sequence: knowledge-transmission is relocated to the pre-class phase, reserving face-to-face sessions for higher-order cognitive activities. For conceptual and methodological topics-green-building-material certification systems, life-cycle assessment (LCA) methodologies, etc.-micro-lectures, authoritative literature and guided reading scaffolds are uploaded, and autonomous mastery is mandated before attendance. In-class time is thereby freed from foundational reiteration and devoted instead to deep deliberation, case analysis or hands-on computation. For example, after viewing an LCA primer video, students compete in teams to quantify, via streamlined models, the carbon footprints of several conventional wall materials. Within this architecture the instructor

relinquishes the role of information dispenser to become learning designer and facilitator, whereas students evolve from passive recipients into active inquirers. The model not only amplifies classroom efficiency but, more critically, cultivates self-directed learning, information integration and problem-solving competencies-an operational route congruent with OBE's student-centred, outcome-oriented ethos.

3.2.4 Project-based research-oriented teaching

Project-based inquiry represents the apex of integrative knowledge consolidation and competence escalation within this course. Authentic, large-scale tasks-such as formulating a green retrofitting scheme for a designated campus building or developing a novel construction material derived from local solid waste are issued and students are organized into R&D-style consortia. Over the project life-cycle participants must execute literature scoping, technology screening, scheme design, benefit-cost analysis and even prototype fabrication. Functioning as a genuine research team, they orchestrate cross-disciplinary knowledge spanning materials science, building thermophysics, environmental engineering and economics, culminating in a comprehensive technical report and public defence. The exercise operates simultaneously as a touchstone of disciplinary mastery and as a crucible for honing innovative thinking, project management, teamwork and technical communication. Directly aligned with the OBE graduate attribute of solving complex engineering problems, the experience immerses students in the pursuit of innovative deliverables while viscerally foregrounding the societal value of technological innovation and the engineer's ethical accountability.

3.3 The Effectiveness of Ideological and Political Education

A one-semester instructional trial has yielded statistically significant gains in ideological-political cultivation, attaining an integrated unity of value guidance, competence enhancement, and behavioral enactment. At the axiological level, case deliberations and authentic projects transformed sustainable-development and engineering-ethics constructs from cognitive acceptance to affective identification; an anonymous exit questionnaire indicates that over 90% of participants explicitly internalized a sense of responsibility for green development. Regarding competency, the problem-heuristic and project-driven regimen propelled students beyond disciplinary content to integrative capacity for complex engineering problems, as evidenced by technical proposals that simultaneously exhibit innovation and ethical reflexivity. Behaviorally, the course activated pragmatic engagement: several cohorts voluntarily converted curricular outputs into energy-saving contest entries or launched campus energy-audit initiatives, signifying completion of the full epistemic trajectory "knowing - believing - acting." The module thereby furnishes a robust foundation for nurturing new-generation outstanding engineers who embody both integrity and professional excellence.

4. Conclusion

This study implements a series of systematic and structured ideological and political education reforms in the "Green Building and New Building Materials" course based on the OBE concept, successfully exploring an effective pathway to organically integrate value development, knowledge acquisition, and competency cultivation. By establishing a comprehensive "five-in-one" implementation strategy—encompassing a "Three-Classroom Linkage" teaching model, immersive case-based teaching, a teaching matrix, a diversified assessment and evaluation system, and a continuous improvement mechanism and flexibly employing diverse teaching methods such as case interaction, problem-inspired discussion, flipped classroom, and project-based learning, the course ensures that ideological and political education is no longer an "add-on" to professional instruction but an integral "necessity" within the curriculum system. Throughout the learning process, students not only deepen their understanding and mastery of professional knowledge in green building and new building materials but also significantly enhance their recognition of sustainable development concepts, their judgment in engineering ethics, and their sense of social responsibility and professional mission as future engineers through practice in analyzing and solving complex engineering problems.

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