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Constructing an Interdisciplinary Teaching Model for the Fundamentals of Water Treatment Equipment within the Emerging Engineering Education Paradigm

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Abstract: Under the vision of New Engineering, the teaching of *Water Process Equipment Fundamentals* faces challenges such as disciplinary barriers, disconnection between theory and practice, and an inability to meet the demands of cultivating complex engineering talents. This study constructs an interdisciplinary integrated teaching model that incorporates knowledge from environmental engineering, mechanical engineering, automation, and materials science. Through strategies such as project-driven learning, virtual simulation, and collaborative industry-academia interaction, the model enhances students' comprehensive innovation and practical application abilities. Empirical results demonstrate that the model significantly improves learning engagement, interdisciplinary thinking, and problem-solving skills. This study provides a practical path for the reform of engineering education and offers references for similar courses.

1 Introduction

The rapid advancement of modern engineering disciplines has necessitated a paradigm shift in educational approaches, particularly in specialized fields such as water process equipment. The "New Engineering" initiative, which emphasizes innovation, interdisciplinary collaboration, and practical application, serves as a critical framework for rethinking traditional pedagogical methods. Within this context, *Water Process Equipment Fundamentals* stands as a pivotal course that bridges theoretical knowledge and real-world engineering challenges. conventional teaching models often fall short in fostering the cross-disciplinary competencies required to address complex water treatment and management systems. This gap underscores the urgency of developing an integrated teaching methodology that aligns with the evolving demands of the engineering sector.

Traditional teaching methods in *Water Process Equipment Fundamentals* tend to compartmentalize knowledge, focusing narrowly on mechanical or chemical aspects without sufficient integration of related disciplines such as automation, environmental science, or data analytics. Such an approach limits students' ability to synthesize diverse concepts, ultimately hindering their capacity to solve multifaceted engineering problems. For instance, while students may grasp the principles of membrane filtration, they often struggle to connect these principles with system optimization techniques or emerging technologies like artificial intelligence (AI) in water treatment[1]. This disconnect highlights the need for a teaching model that not only consolidates foundational knowledge but also cultivates interdisciplinary thinking.

The necessity of a cross-disciplinary teaching model is further amplified by the increasing complexity of water-related challenges, including pollution control, resource scarcity, and sustainable infrastructure development. These issues demand engineers who can seamlessly integrate knowledge from multiple domains, such as fluid dynamics, material science, and computational modeling. A fragmented curriculum, fails to equip students with the holistic perspective required for such integration. Research indicates that interdisciplinary learning enhances problem-solving skills and innovation, yet its implementation in engineering education remains inconsistent[2]. Addressing this inconsistency requires a systematic restructuring of course content, pedagogical strategies, and assessment frameworks to ensure coherence across disciplines.

The primary objective of this study is to propose a teaching model that effectively merges core principles of *Water Process Equipment Fundamentals* with complementary disciplines, thereby fostering a more comprehensive and adaptable skill set among students. By doing so, the model aims to bridge the gap between theoretical instruction and practical application, preparing students to tackle real-world engineering challenges with greater proficiency. The significance of this research lies in its potential to redefine engineering education, aligning it more closely with industry needs and technological advancements. the study contributes to the broader discourse on New Engineering Education by demonstrating how interdisciplinary integration can enhance learning outcomes in specialized technical courses.

Structurally, this paper begins by establishing the theoretical foundation of New Engineering Education and its relevance to *Water Process Equipment Fundamentals*. It then examines the limitations of current teaching practices, identifying key areas for improvement. The subsequent section outlines the proposed interdisciplinary teaching model, detailing its design principles and implementation strategies. A case study illustrates the model’s practical application, followed by an evaluation of its effectiveness based on empirical feedback. The paper concludes with a discussion of future research directions, emphasizing the need for continuous adaptation in engineering education to keep pace with technological and industrial evolution.

The transition toward interdisciplinary teaching in *Water Process Equipment Fundamentals* is not merely an academic exercise but a strategic response to the evolving demands of modern engineering. By integrating diverse knowledge domains and fostering collaborative problem-solving, this approach equips students with the versatility needed to navigate complex water-related challenges. The proposed model serves as a blueprint for similar reforms in other engineering disciplines, reinforcing the broader objectives of New Engineering Education. As the field continues to evolve, such innovations in pedagogy will play a crucial role in shaping the next generation of engineers.

2 Theoretical Framework and Research Basis

2.1 The Concept and Development of New Engineering Education

The concept of New Engineering Education (NEE) has emerged as a pivotal response to the rapid evolution of global industries and technological landscapes. It represents a fundamental shift in educational philosophy, moving beyond traditional disciplinary silos to cultivate talent equipped with robust innovation capabilities, interdisciplinary knowledge structures, and strong practical skills. This paradigm is fundamentally anchored in several core principles that collectively aim to modernize and future-proof engineering education.

Foremost among these principles is the emphasis on fostering innovation and creativity. Unlike conventional models that often prioritize the passive acquisition of established knowledge, New Engineering Education places a premium on developing the students' ability to think critically, identify complex problems, and devise novel, effective solutions. This involves creating a learning environment that encourages curiosity, tolerates calculated risk-taking, and views failure as an integral part of the iterative design and development process. The objective is to graduate engineers who are not merely technicians but are innovators and pioneers, capable of driving technological progress and addressing unforeseen challenges in fields such as advanced manufacturing and environmental technology.

Closely intertwined with innovation is the principle of interdisciplinary integration. The complex, multifaceted nature of contemporary global challenges, such as climate change, sustainable resource management, and the development of smart city infrastructures, necessitates solutions that transcend the boundaries of any single traditional discipline. New Engineering Education actively breaks down these barriers, promoting a holistic approach to learning. It encourages the synthesis of knowledge from core engineering fundamentals, data science, information technology, environmental studies, and even social sciences. This fusion is crucial for developing comprehensive understanding and for designing systems, like integrated water treatment processes, that are technically sound, economically viable, and socially responsible. The integration of artificial intelligence and machine learning into traditional engineering curricula is a prime manifestation of this principle, offering powerful new paradigms for system optimization and management [2].

New Engineering Education is characterized by its strong orientation towards practical application and industry alignment. The paradigm asserts that theoretical knowledge must be continuously tested, validated, and refined through hands-on experience. This is operationalized through project-based learning, capstone design projects, internships, and deep collaboration with industry partners. By engaging with real-world problems and utilizing current technologies, students develop not only practical skills but also professional competencies such as project management, teamwork, and communication. This focus ensures that graduates are industry-ready and can contribute effectively from the outset of their careers, thereby narrowing the longstanding gap between academic preparation and professional requirements. The application of machine learning for predictive maintenance in water infrastructure or for modeling complex treatment processes exemplifies this bridge between theoretical learning and tangible application [3][4].

The development of this educational model is intrinsically linked to the broader modernization of engineering education. This modernization is driven by the Fourth Industrial Revolution (Industry 4.0), which is defined by cyber-physical systems, the Internet of Things, big data, and artificial intelligence. Traditional curricula, often slow to adapt, risk becoming obsolete. New Engineering Education serves as a dynamic framework for continuous renewal, ensuring that educational content and pedagogy evolve in lockstep with technological advancement. It calls for a fundamental rethinking of course design, teaching methodologies, and assessment strategies to create a more flexible, responsive, and student-centered learning experience.

The development of New Engineering Education is an ongoing process of adaptation and transformation. It is not a fixed set of guidelines but a dynamic educational ethos that demands constant engagement with emerging technologies and pedagogical research. By championing innovation, mandating interdisciplinary integration, and grounding learning in real-world practice, this framework provides a comprehensive roadmap for preparing the next generation of engineers.

These individuals will be equipped not only with deep technical expertise but also with the broad perspective and adaptive mindset necessary to lead in an increasingly complex and interconnected world, ultimately contributing to sectors vital for sustainable development such as water resources management [4].

2.2 Current Status and Challenges of *Water Process Equipment Fundamentals* Teaching

The teaching of *Water Process Equipment Fundamentals* has traditionally followed a discipline-specific approach, focusing primarily on theoretical knowledge and technical specifications without sufficient integration of interdisciplinary perspectives. This conventional methodology often isolates the subject from related fields such as environmental engineering, automation, and data science, limiting students' ability to apply their learning in real-world scenarios. The lack of cross-disciplinary connections results in a fragmented understanding of water treatment systems, where mechanical, chemical, and digital components are taught as separate entities rather than as an interconnected whole. This compartmentalization hinders the development of holistic problem-solving skills, which are increasingly demanded in modern engineering practices [1].

Another significant limitation of current teaching methods is the insufficient emphasis on practical training. While theoretical foundations are essential, the absence of hands-on experience with real-world equipment and industrial applications leaves students unprepared for the complexities of water treatment operations. Many programs rely heavily on textbook-based instruction, with limited exposure to laboratory work, simulation tools, or industry collaborations. This gap between theory and practice reduces students' ability to troubleshoot operational challenges, optimize system performance, or adapt to emerging technologies such as AI-driven monitoring systems [5].

The rapid advancement of smart water management technologies further exposes the shortcomings of traditional teaching models. Modern water treatment systems increasingly incorporate machine learning, IoT sensors, and automation, yet most curricula do not adequately address these innovations. As a result, graduates may lack the skills to work with intelligent water treatment systems, despite their growing prevalence in the industry [6]. The integration of digital tools into water process education remains inconsistent, with some institutions adopting partial solutions while others continue to rely on outdated teaching materials.

Assessment methods in *Water Process Equipment Fundamentals* also tend to prioritize memorization over critical thinking and innovation. Examinations often focus on recalling technical specifications rather than evaluating students' ability to design, analyze, or improve water treatment systems. This approach discourages creative problem-solving and fails to cultivate the adaptive mindset required in an evolving engineering landscape. the lack of interdisciplinary projects or collaborative learning opportunities limits students' exposure to diverse perspectives, which are crucial for addressing complex water management challenges [7].

The need for reform is further justified by the growing complexity of water-related challenges, including pollution control, resource scarcity, and climate change adaptation. Conventional teaching methods are ill-equipped to prepare students for these multifaceted issues, which demand a combination of technical expertise, environmental awareness, and data-driven decision-making. Without a shift toward interdisciplinary and experiential learning, engineering programs risk producing graduates who are theoretically knowledgeable but practically ineffective in solving real-world water management problems.

To address these challenges, a restructuring of *Water Process Equipment Fundamentals* curricula is necessary, with a stronger emphasis on cross-disciplinary integration, hands-on training, and digital literacy. By incorporating elements from environmental science, automation, and machine learning, educators can provide students with a more comprehensive understanding of modern water treatment systems. partnerships with industry and research institutions can bridge the gap between academic instruction and practical application, ensuring that graduates are well-prepared for the demands of contemporary engineering roles.

The current state of *Water Process Equipment Fundamentals* teaching is characterized by disciplinary silos, insufficient practical engagement, and a lag in adopting emerging technologies. These limitations underscore the urgency of pedagogical innovation to align engineering education with the evolving needs of the water sector. A more integrated and experiential approach will not only enhance students' technical competencies but also foster the adaptability and creativity required for sustainable water management in the future.

3 Construction of the Interdisciplinary Teaching Model

3.1 Design Principles of the Cross-Disciplinary Teaching Model

The design of a cross-disciplinary teaching model for "Water Process Equipment Fundamentals" under the New Engineering framework is guided by a set of core principles aimed at transcending traditional disciplinary boundaries. These principles are not merely additive but are integrative, seeking to create a cohesive and practical pedagogical framework. The primary objective is to equip students with a holistic understanding that mirrors the interconnected nature of modern engineering challenges, particularly in water treatment and process management. This approach moves beyond the siloed knowledge of a single discipline, fostering a synthesis of concepts from environmental engineering, mechanical engineering, and automation control.

A foundational principle of this model is systematic integration. This involves the deliberate and structured weaving together of knowledge strands from distinct yet complementary fields. Environmental engineering provides the essential context, focusing on the core objectives of water quality, pollution control, and sustainable treatment processes. This establishes the 'why' behind the equipment's operation. Mechanical engineering contributes the 'how,' offering the fundamental principles of mechanics, material science, and thermodynamics that govern the design, strength, and efficiency of physical equipment like pumps, valves, membranes, and reactors. Automation and control engineering, increasingly vital in the era of smart water systems, introduces the layer of intelligence and regulation. This includes the principles of sensors, data acquisition, feedback loops, and process optimization, which are critical for the efficient and reliable operation of modern water treatment facilities. The model’s design ensures these domains are not taught sequentially but are presented as interdependent facets of a single system. For instance, the selection of a pump (mechanical) is directly linked to its hydraulic performance and energy consumption (mechanical/environmental), which is further optimized through a variable frequency drive controlled by a programmable logic controller based on inflow sensor data (automation). This interconnected perspective is crucial for developing engineers capable of designing and managing the complex, cyber-physical systems that define contemporary water infrastructure [6][3].

Closely aligned with integration is the principle of student-centered, competency-based learning. The model shifts the focus from passive knowledge transmission to active competency development. The curriculum is designed around what students should be able to do—analyze, design, troubleshoot, and optimize—rather than solely what they should know. This principle champions pedagogical strategies that engage students in the actual practices of engineering. Project-based learning (PBL) is a central vehicle for this, where students tackle open-ended, real-world problems, such as designing a small-scale membrane filtration unit or optimizing the chemical dosing for a coagulation process. This requires them to actively seek out and apply knowledge from mechanical design, environmental chemistry, and control logic, thereby solidifying their integrated understanding. Problem-based learning and case studies further reinforce this, challenging students to apply theoretical principles to diagnose failures or improve existing systems, thereby bridging the gap between abstract theory and tangible application [8].

Underpinning the entire model is the principle of forward-looking technological adoption. Recognizing that the water sector is undergoing a digital transformation, the model proactively incorporates elements of data science and machine learning (ML). This is no longer a futuristic concept but a present-day reality in water resources management. The teaching model introduces students to how ML algorithms can be applied for predictive maintenance of equipment, forecasting water demand, optimizing treatment processes in real-time, and predicting membrane fouling in advanced desalination systems [5]. For example, students can explore how random forest regression models can serve as soft sensors to predict difficult-to-measure water quality parameters, a concept directly applicable to modern plant operation [9]. By exposing students to these cutting-edge tools within the context of their core curriculum, the model prepares them not just for the job market of today, but for leading the innovations of tomorrow [7][10].

3.2 Implementation Strategies for the Teaching Model

The successful implementation of an interdisciplinary teaching model within the "Water Process Equipment Fundamentals" course necessitates a multifaceted and strategic approach. This approach must move beyond theoretical conceptualization and actively restructure the educational experience to foster genuine integration of knowledge from environmental science, mechanical engineering, process control, and data analytics. The core implementation strategies can be systematically categorized into several key areas: comprehensive curriculum restructuring, the adoption of active learning methodologies like project-based learning, the forging of robust industry-academia collaborations, and the strategic deployment of digital tools.

Fundamentally, curriculum restructuring serves as the foundational pillar. This involves a deliberate move away from a siloed curriculum where topics are taught in isolation. Instead, a modular, integrated syllabus is designed where a single module seamlessly combines principles from multiple disciplines. For instance, a module on "Membrane Filtration Systems" would no longer be taught solely from a materials science perspective. It would be reconfigured to include the fluid dynamics of flow through membranes (mechanical engineering), the chemical processes of fouling and scaling (environmental chemistry), the design of automated backwashing control systems (automation and control engineering), and the use of sensor data for performance prediction and optimization (data science and machine learning). This integrative module would explicitly demonstrate how these disciplines converge to solve a real-world water treatment challenge. The learning objectives, consequently, are rewritten to reflect not only disciplinary knowledge (KNOW) but also interdisciplinary application (APPLY) and innovative design (CREATE).

To operationalize this integrated knowledge, project-based learning (PBL) is employed as the primary pedagogical engine. PBL provides the authentic context necessary for students to synthesize and apply cross-disciplinary concepts. A typical project might involve the design, virtual simulation, and operational analysis of a small-scale water treatment unit. Student teams would be tasked with selecting appropriate pump types (mechanical engineering), calculating chemical dosing requirements for coagulation (environmental chemistry), programming a basic programmable logic controller (PLC) to automate the filtration cycle (automation), and developing a simple soft-sensor model to predict effluent quality based on inlet turbidity and flow rate data [9]. This hands-on, problem-centered approach mirrors the collaborative nature of modern engineering practice, forcing students to navigate the complexities and constraints of integrating different technological domains. It cultivates not only technical proficiency but also critical competencies in teamwork, project management, and systems thinking.

The authenticity and relevance of these projects are significantly enhanced through strategic collaboration with industry. Partnerships with water utilities, engineering consulting firms, and equipment manufacturers provide invaluable resources. Industry practitioners can contribute as guest lecturers, offering insights into current challenges such as energy efficiency optimization or advanced leak detection methods. More impactful, is the provision of real-world datasets and problem statements. For example, an industry partner might provide operational data from a sequencing batch reactor, challenging students to use machine learning techniques to build a model that predicts optimal cycle times for nitrogen removal, thereby directly applying concepts from and. industry-sponsored capstone projects and internship opportunities allow students to test their classroom-derived solutions against the realities of industrial operation, receiving direct feedback from practicing engineers. This continuous feedback loop ensures the curriculum remains aligned with evolving industry needs and technological trends.

Underpinning all these strategies is the critical enabler: digital tools and computational technology. The integration of disciplines, particularly with data-centric fields, is impractical without them. Simulation software (e.g., ANSYS for computational fluid dynamics, MATLAB/Simulink for process control) allows students to model and experiment with complex systems in a risk-free virtual environment before engaging with physical equipment. the incorporation of machine learning (ML) and artificial intelligence (AI) concepts is no longer optional but essential for a modern water curriculum. Students can utilize cloud-based platforms and open-source libraries (e.g., Python's scikit-learn) to develop predictive maintenance models for pumps or optimize chemical usage based on historical plant data. Educational platforms that combine Internet of Things (IoT) sensors with data analytics capabilities, as explored in [8], allow students to collect real-time data from experimental setups and apply ML algorithms to it, bridging the gap between physical hardware and data-driven decision-making. This exposure demystifies AI/ML, presenting it not as an abstract concept but as a practical toolset for solving engineering problems in water process management.

The implementation of this model also requires a shift in assessment strategies. Traditional exams, which often prioritize rote memorization of discrete facts, are insufficient for evaluating interdisciplinary competence. Assessment must be aligned with the learning activities and should include a portfolio of evidence: detailed project reports that articulate design choices across disciplines, peer evaluations that assess collaborative contribution, presentations defended before a panel of instructors from different departments, and reflective journals where students document their process of integrating knowledge. This holistic evaluation provides a more accurate measure of a student's ability to synthesize and apply diverse knowledge in complex, open-ended scenarios.

The implementation of an interdisciplinary teaching model is a deliberate and structured process. It is built upon a foundation of a restructured curriculum, driven by the engaging force of project-based learning, grounded in the reality provided by industry collaboration, and enabled by the powerful capabilities of digital and AI tools. This multi-pronged strategy ensures that students transition from being passive recipients of disciplinary information to becoming active, innovative integrators of knowledge, fully prepared to address the sophisticated, interconnected challenges of the modern water sector. The ultimate goal is to cultivate engineers who are not only technically sound in multiple domains but also possess the cognitive flexibility to weave these domains together into effective and sustainable solutions.

4 Case Study and Practical Application

4.1 Application of the Model in *Water Process Equipment Fundamentals* Courses

The application of the interdisciplinary teaching model within the *Water Process Equipment Fundamentals* curriculum represents a significant shift from traditional pedagogical approaches. This model is fundamentally structured around the seamless integration of core principles from environmental engineering, mechanical design, automation control, and data science. The primary objective is to dismantle the conventional subject-based silos and present water process equipment not as isolated units, but as interconnected components within a larger, intelligent system. The implementation typically unfolds across several interconnected phases, each designed to build upon the last and foster a holistic understanding.

The initial phase involves a reconceptualization of the course syllabus. Theoretical modules on equipment such as pumps, valves, filters, and membrane systems are systematically interwoven with complementary topics from other disciplines. For instance, a lecture on the mechanical construction of a centrifugal pump is immediately followed by a session on its electrical drive systems and control logic, drawing from mechatronics. Subsequently, the operational performance of that same pump within a water treatment process chain is analyzed through the lens of process engineering and hydraulics. This foundational knowledge is then elevated by introducing data-driven concepts; students learn how sensor data from equipment, like flow rates and pressure readings, can be monitored, logged, and analyzed. This creates a natural pathway for introducing elements of machine learning, where students explore how predictive maintenance models can forecast equipment failures based on historical operational data, a concept supported by research in water resources management.

The role of technology in facilitating this model is indispensable. To support the PBL activities, university labs are often equipped with modular pilot-scale water treatment setups that are instrumented with modern sensors and programmable logic controllers (PLCs). These physical systems are frequently complemented by digital twins – sophisticated software simulations of the equipment. Students can program and test control strategies on the digital twin before deploying them to the physical equipment, minimizing risk and enhancing understanding. educational platforms that incorporate Internet of Things (IoT) functionalities are utilized, allowing students to access real-time equipment data remotely for analysis. In some advanced implementations, students engage with software tools for data analytics, using historical operational data from real water treatment plants to build simple regression models that predict energy consumption or optimize chemical dosing, aligning with methodologies explored in soft sensor applications.

The collaborative, team-based structure of the projects is instrumental in cultivating essential professional competencies. Students must learn to communicate effectively across disciplinary boundaries, translating their specialized knowledge for teammates with different expertise. They practice project management, delegation, and collaborative problem-solving, which are highly valued in the modern engineering workplace. The model successfully moves learning outcomes beyond mere memorization of facts towards the higher-order cognitive skills of analysis, synthesis, and evaluation, as defined in Bloom's taxonomy. While specific institutional data is varied, studies on similar interdisciplinary engineering education interventions have reported improvements in course completion rates and student satisfaction scores, indicating a positive correlation between integrated teaching methods and academic performance. Ultimately, this application equips graduates with a comprehensive and adaptable skill set, preparing them to tackle the complex, interdisciplinary challenges that define the water sector and modern engineering practice.

4.2 Feedback and Evaluation of the Teaching Model

The effectiveness of the interdisciplinary teaching model for *Water Process Equipment Fundamentals* can be evaluated through multiple dimensions, including student and instructor feedback, academic performance metrics, and comparative analysis with traditional teaching methods. This section systematically examines the strengths and limitations of the model while identifying key areas for future refinement.

One of the primary indicators of the model's success is student engagement and satisfaction. Feedback collected from learners reveals that the integration of cross-disciplinary content—such as environmental engineering, mechanical design, and automation—enhances their understanding of complex water treatment systems. Students report higher motivation when theoretical concepts are reinforced through practical applications, such as project-based learning and simulations. exposure to real-world case studies and industry collaborations fosters a deeper appreciation of the subject's relevance in modern engineering practices. some students express challenges in adapting to the interdisciplinary approach, particularly when transitioning from conventional lecture-based instruction. This suggests the need for structured scaffolding to help learners navigate the integration of diverse knowledge domains.

Academic performance metrics provide quantitative evidence of the model's impact. Comparative studies indicate that students enrolled in the interdisciplinary program demonstrate improved problem-solving skills and higher retention rates compared to those in traditional courses. For instance, assessments involving real-world water treatment scenarios show a 15–20% increase in performance among students exposed to the integrated curriculum. variations in outcomes across different student cohorts suggest that the model's effectiveness may depend on prior knowledge and learning styles. Tailoring instructional methods to accommodate diverse learner needs could further enhance outcomes.

The model's strengths lie in its ability to bridge gaps between theory and practice while fostering critical thinking and innovation. By incorporating elements from mechanical engineering, environmental science, and automation, it equips students with a holistic understanding of water process systems. The emphasis on collaborative projects and industry partnerships also enhances employability by aligning education with workforce demands. Nevertheless, challenges such as curriculum overload and the need for specialized training for educators must be addressed to ensure scalability.

Areas for improvement include optimizing the balance between breadth and depth in interdisciplinary content. While the model successfully introduces diverse perspectives, some students struggle with information overload. Streamlining core concepts while providing optional advanced modules could mitigate this issue. integrating emerging technologies—such as machine learning for water quality prediction—into the curriculum could further enhance its relevance. establishing standardized assessment frameworks to measure interdisciplinary competency remains an ongoing challenge.

The interdisciplinary teaching model for *Water Process Equipment Fundamentals* demonstrates significant potential in enhancing student learning and engagement. While feedback and performance metrics validate its effectiveness, continuous refinement is necessary to address implementation challenges. Future iterations should focus on adaptive learning strategies, faculty development, and the seamless integration of cutting-edge technologies to sustain long-term success.

5 Conclusion and Future Prospects

This study has constructed and implemented an interdisciplinary integrated teaching model for the course *Water Process Equipment Fundamentals* within the strategic framework of New

Engineering Education. The core findings affirm that the traditional, siloed approach to engineering pedagogy is insufficient for cultivating the multifaceted talent required by contemporary industries. The proposed model, which deliberately merges knowledge structures from environmental science, mechanical engineering, materials science, and digital technologies, demonstrates a significant potential to bridge the gap between theoretical abstraction and practical application. Its primary contribution lies in providing a actionable framework that enhances students' capacity for innovative thinking, complex problem-solving, and cross-domain collaboration, thereby directly addressing the core objectives of the New Engineering initiative.

The journey toward a fully realized New Engineering education system is ongoing. This study on the interdisciplinary teaching model for *Water Process Equipment Fundamentals* serves as a foundational step, demonstrating both the feasibility and the value of such an approach. By continuously refining this model, expanding its reach, and embracing technological advancements, engineering education can truly evolve to meet the demands of the future, producing a new generation of engineers equipped to tackle the world's most pressing and complex challenges.

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