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REVIEW ARTICLE

Innovating Environmental Education: Building Interdisciplinary Talent through Virtual Classrooms

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ABSTRACT

In the modern era, the ecological complexity and environmental crises possesses significant challenges in cultivating talents within environmental disciplines. Traditional training models at local universities inadequate in meeting the industry's demand for interdisciplinary and versatile professionals amidst industrial advancements. This study proposes several educational reform strategies, including developing virtual classroom platforms, restructuring curriculum systems, designing interdisciplinary talent cultivation models, and enhancing teaching evaluation and feedback mechanisms. These approaches aim to transcend the temporal and spatial limitations of conventional teaching, facilitate the effective sharing of educational resources, improve teacher-student interactions, and ultimately cultivate environmental experts with comprehensive skills and innovative capabilities.

Contribution/Originality: This study originates new educational reform strategies, such as developing virtual classroom platforms, restructuring curriculum systems, designing interdisciplinary talent cultivation models, and enhancing teaching evaluation and feedback mechanisms. These strategies aim to cultivate environmental talents with comprehensive skills and innovative capabilities to fulfil the demands of the modern era.

1. Introduction

In the modern era, rapid technological advancements and industrial transformations present society with unprecedented opportunities and challenges (Acemoglu & Restrepo, 2019). As the economy grows, the complexity and global nature of ecological and environmental issues become increasingly prominent (Cheng et al., 2024; Wang et al., 2024). Issues such as environmental pollution, resource scarcity, and ecological imbalance have garnered global attention, posing serious threats to sustainable development. The intricate, systematic, transitory, and long-term nature of these ecological issues necessitates that environmental education cultivate interdisciplinary and versatile talents capable of adapting to industrial advancements. Students must not only possess fundamental theories of environmental engineering but also acquire knowledge and skills in fields such as engineering technology, information technology, and management science to address increasingly complex environmental challenges (Huang et al., 2024).

However, traditional training models for environmental disciplines at local universities struggle to meet the demand for versatile professionals, making educational reform essential. Virtual classrooms, as innovative platforms based on information technology, offer advantages such as overcoming temporal and spatial limitations, integrating multidisciplinary resources, and improving teacher-student interaction (Remacle et al., 2023; Stenberdt & Makransky, 2023). The use of virtual classrooms can facilitate efficient sharing of teaching resources, promote interdisciplinary integration, and address the shortcomings of traditional teaching models. Therefore, exploring educational reform paths based on virtual classrooms is expected to resolve current issues in training environmental professionals and improve the quality of talent cultivation.

This study aims to explore the reform pathways of environmental professional education through virtual classrooms and construct an interdisciplinary talent training model to meet the needs of the modern era. It will investigate models for cultivating environmental professionals with comprehensive qualities and innovative abilities, and analyze educational reform strategies, including curriculum system reconstruction, innovative teaching methods, and optimization of teaching evaluation mechanisms. The goal of this study is to enrich the theoretical framework of higher education teaching reform in environmental disciplines and provide reference and inspiration for the educational reform of other disciplines, thereby promoting overall innovation and development in higher education.

2. Literature Review

2.1. The Importance of Reforming Environmental Professional Education Based on Virtual Classrooms

With the increasingly severe global environmental problems, the importance of environmental education has become more prominent. Some universities are gradually optimizing their curriculum systems and adding interdisciplinary courses, such as environmental policy and environmental management. However, issues remain, including insufficient interdisciplinary integration and limited innovation in teaching methods. Current education in environmental disciplines often lacks the cultivation of students' comprehensive qualities and practical abilities, making it difficult to meet society's demand for high-level environmental talents (Hu et al., 2023; Wu et al., 2023). Therefore, exploring effective pathways for educational reform and cultivating environmental professionals who can meet the needs of the new era has become a consensus in both academia and education.

Interdisciplinary talent cultivation is crucial for addressing complex social issues and technological challenges, emphasizing the interconnection and integration between different disciplines. Gardner's (1983) theory of multiple intelligences suggests that individuals possess multiple forms of intelligence, and education should promote the comprehensive development of these intelligences (Niroo et al., 2012; Starbuck, 2013). Interdisciplinary education fosters students' comprehensive thinking and innovation abilities by integrating knowledge and methods from different fields. This approach is particularly important in environmental education, where issues are complex and multifaceted, involving natural sciences, engineering technology, and social sciences. Through interdisciplinary education, students can understand and solve environmental problems from multiple perspectives, enhancing their comprehensive qualities and practical abilities.

How can we break through the limitations of traditional classrooms and achieve boundaryless interdisciplinary training in higher education? The emergence of virtual classrooms provides an effective solution to overcome the time and space limitations of traditional teaching and research environments (Remacle et al., 2021). Virtual classrooms are virtual spaces constructed using information technology and network platforms, integrating teaching, research, and communication to achieve efficient resource sharing and collaborative innovation. Many universities have successfully applied virtual classrooms in actual teaching practice and achieved significant outcomes. For example, Beijing Jiaotong University has developed a virtual classroom "Double Training Program" for a signal processing course series, fully utilizing the high-quality teaching and reform achievements of the educator team. By using digital signal processing massive open online courses (MOOCs) and textbooks as carriers, they have explored teaching activities and exchange mechanisms within the virtual classroom to further improve the teaching quality of the signal processing course series (Senevirathne et al., 2022). Similarly, Shenyang University of Technology has built a virtual teaching and research office platform across enterprises, universities, and colleges through the "Internet plus University Teaching and Research Office" model. This platform meets the needs of multiple personnel to jointly carry out teaching and research activities online, achieving interdisciplinary integration and providing more effective support for training high-quality, application-oriented, and innovative talents in the vehicle engineering specialty of the Automotive Engineering Industry College. Anhui Medical University primarily adopts virtual simulation teaching as the main form and uses intelligent teaching methods, such as MOOCs and Rain Classroom for theoretical instruction (Zhang et al., 2021). They have established a multidimensional teaching mode that combines virtual and actual theory and practice in both online and

offline classes, facilitating the early establishment of clinical thinking in medical students and promoting the improvement of medical teaching levels. However, there are relatively few reports on the specific application of virtual classrooms in the reform of environmental professional education, and there is a lack of systematic theoretical exploration and practical guidance. The existing research mostly focuses on specific aspects and lacks comprehensive studies that combine virtual classrooms, educational reform, and interdisciplinary talent cultivation.

3. Methods

This work focuses on developing educational reform strategies and systematically analyzes related research materials. The authors utilize the SCOPUS database and China National Knowledge Infrastructure (CNKI), employing keywords such as "educational reform strategy" and "environmental discipline" to conduct a rigorous literature search. Key literature reports are selected based on principles for constructing a conceptual framework, following extensive screening and inclusion of relevant topics.

The article first reviews the importance of reforming environmental professional education. It then explores various educational reform strategies, including the development of virtual classroom platforms, the restructuring of curriculum systems, the design of interdisciplinary talent cultivation models, and the enhancement of teaching evaluation and feedback mechanisms. Finally, the article discusses the extension of virtual classrooms and their roles in higher education, aiming to construct an environmental and interdisciplinary talent training model suited to the needs of the modern era.

4. Reforming Pathways of Higher Education for Environmental disciplines-based on Virtual Classrooms

Interdisciplinary education is essential for addressing complex environmental issues, which are systematic and multifaceted, involving natural sciences, engineering technology, and social sciences. Solving these issues requires knowledge from multiple disciplines. Building an interdisciplinary talent cultivation model involves overcoming traditional disciplinary boundaries and designing courses that integrate multidisciplinary knowledge. It also requires establishing a team of educators with diverse disciplinary backgrounds to provide guidance and support from multiple perspectives as well as creating a diversified evaluation system that focuses on students' comprehensive and practical abilities. Leveraging virtual classrooms, integrating interdisciplinary education theories, and new engineering education concepts to reform higher education in environmental disciplines is an effective way to enhance the quality of talent cultivation (Dai et al., 2023). This approach not only overcomes the limitations of traditional education models but also cultivates students' comprehensive qualities and innovative abilities to meet the demand for environmental professionals in the new era.

4.1. Development of Virtual Classrooms

The primary task in building a virtual classroom is to select and establish a suitable technology platform (Liu, 2023). The platform should support multimedia teaching, real-time interaction, and resource sharing to meet the specific needs of environmental professional teaching. The prioritize mature virtual technology platforms, such as

WeChat or DingTalk can customize platforms based on actual conditions to ensure system stability and scalability.

High-quality and diversified teaching resources are core elements of virtual teaching and research rooms. To achieve effective integration and sharing of resources, it is necessary to collect and organize high-quality textbooks, courseware, cases, and experimental data in related fields, such as environmental science, engineering technology, information technology, and management science, building a resourceful library. The scientific classification and labeling of teaching resources will facilitate quick retrieval and access for lecturers and students. Moreover, teaching materials should be updated regularly, the latest scientific research achievements and industry trends should be introduced promptly to maintain the progressiveness and timeliness of teaching content.

An excellent educator is crucial for the successful operation of virtual classrooms (Zou & Hyland, 2020). To improve teaching quality, it is necessary to invite lecturers and experts with diverse disciplinary backgrounds to participate in curriculum design and teaching, which promote the interdisciplinary integration. Regular training on information technology applications, online teaching methods, and other relevant areas should be organized to enhance lecturers' ability to utilize virtual classrooms and their awareness of teaching innovation. Additionally, experts from industries and other institutions should be invited to participate in teaching, providing practical guidance and enhancing the applicability and effectiveness of the instruction.

4.2. Design of Interdisciplinary Talent Cultivation Model

To cultivate environmental experts with interdisciplinary knowledge and comprehensive abilities, it is essential to comprehensively reconstruct the curriculum system. This involves developing interdisciplinary course modules and designing comprehensive courses that cover environmental science, engineering technology, information science, management, and other fields. For examples, "Environmental Big Data Analysis" and "Intelligent Environmental Protection Technology," which help to promote the cross-integration of knowledge. Establishing a flexible curriculum structure allows students to choose different course modules based on their interests and career plans, thereby meeting personalized training needs. Additionally, increasing practical courses, such as experiments, internships, and research training, is crucial for cultivating students' hands-on abilities and innovative thinking. Collaborating with overseas universities to introduce advanced international courses and textbooks can further expand students' global perspectives.

4.3. Teaching Evaluation and Feedback Mechanism

Constructing a scientific and fair evaluation system that comprehensively reflects students' learning outcomes and ability development is imperative. This system should focus on students' performance throughout the learning process, including classroom participation, quality of homework completion, and project progress. Emphasizing the importance of learning attitude and process, while also considering students' comprehensive qualities, including innovation ability, cooperation spirit, and sense of responsibility, is essential for cultivating well-rounded and outstanding talents. Evaluating students' knowledge through exams, project reports, and work exhibitions can provide a holistic assessment of their capabilities.

5. Extension of Virtual Classrooms and Their Roles in Higher Education

5.1. Impact of Virtual Classrooms on Educational Models

The advent of virtual classrooms has transcended the temporal and spatial constraints inherent in traditional education. By harnessing the advantages of the Internet and information technologies, educators and learners can participate in educational activities ubiquitously, fostering continuous learning and interaction. This expansion of the educational landscape facilitates the unrestricted access to educational resources, thereby benefiting educators and learners across diverse regions and time zones. Learners can tailor their educational contents according to their individual progress and interests, thereby enhancing the flexibility of learning and diversifying pedagogical approaches. Furthermore, the interactive recording and data analysis capabilities of virtual teaching environments enable educators to gain insights into students' learning behaviours and patterns, allowing for timely pedagogical adjustments and enhancing instructional efficacy.

5.2. Implementation Pathways of Interdisciplinary Integration

Virtual classrooms serve as an optimal platform for interdisciplinary education and research. By amalgamating teaching resources and faculty from various disciplines and interlinking knowledge points across different subjects, students can cultivate a comprehensive knowledge framework. This interdisciplinary integration facilitates the synthesis of knowledge from diverse fields, fostering novel insights and creativity, and supporting innovative solutions to complex environmental challenges.

5.3. Mechanisms for Improving the Quality of Talent Cultivation

The extensive digital resources and information channels available in virtual classrooms have expanded students' opportunities for knowledge acquisition and stimulated their curiosity in exploring new domains. Additionally, the open learning environment and autonomous learning model promote critical thinking and active inquiry, thereby nurturing critical thinking skills.

6. Conclusion

The reform of environmental professional education through the implementation of virtual classrooms presents a novel approach to cultivating interdisciplinary and versatile talents. The establishment of virtual classrooms mitigates the temporal and spatial limitations of traditional education, facilitates the efficient sharing of educational resources, and enhances teacher-student interactions. By restructuring the curriculum, innovating pedagogical methods, and refining evaluation and feedback mechanisms, students' self-directed learning abilities, innovative thinking, and practical skills are significantly enhanced. The integration of virtual classrooms has enriched the theoretical framework of higher education reform in environmental disciplines, underscoring their positive impact on innovative educational models, interdisciplinary integration, and the enhancement of talent cultivation quality.

Ethics Approval and Consent to Participate

The study did not involve human or animal subjects, and therefore, no ethical approval was needed.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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