Teaching Innovation and Practice Exploration of Interdisciplinary Integration Courses: A Case Study of "Talk to the Plants"

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Abstract The "Talk to the Plants" course, as an interdisciplinary integrated teaching innovation practice course, aims to break through the knowledge-imparting model of traditional botany education. It establishes a profound interactive bridge between humans and plants, cultivating students' ecological awareness, scientific literacy, and humanistic values. With life education at its core, the course integrates multidisciplinary knowledge from botany, ecology, psychology, and arts. Leveraging modern technologies including VR/AR and sensor monitoring, it creates immersive learning environments that guide students to engage with plants through scientific inquiry, emotional empathy, and artistic expression. This exploration establishes a new paradigm for developing well-rounded talents in ecological civilization while offering both theoretical insights and practical models for interdisciplinary curriculum reform in the new era, demonstrating significant value in educational innovation.

Key words Talk to the Plants; Interdisciplinary integrated teaching; Scientific literacy

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In contemporary society, as ecological awareness intensifies and educational philosophies progress, the innovative 'Talk to the Plants' program has emerged as a novel initiative. This innovative curriculum model breaks through the limitations of traditional botany education which focuses solely on knowledge impartation, aiming to build a bridge of communication between humans and plants. It guides students to deeply explore the mysteries of plants, thereby fostering a profound appreciation for the wonders of nature. The rise of plant dialogue courses is no coincidence. It is closely linked with the development of the times. On one hand, as environmental issues grow increasingly severe and ecological conservation becomes urgent, fostering students' ecological awareness has become a vital mission in education. Students can personally experience the significance of plants as key components of ecosystems by "conversing" with them, inspiring their enthusiasm to actively engage in environmental protection. On the other hand, the rapid advancement of modern technology has provided us with new tools to deepen our understanding of plants, making the implementation of plant dialogue courses feasible.

The exploration of plant dialogue courses began earlier in foreign countries, characterized by interdisciplinary integration and extensive technological applications[1]. In some developed nations in Europe and America, educational institutions and research teams collaborate closely to deeply integrate botany with disciplines such as ecology and psychology, and have developed a series of innovative plant dialogue courses. For example, some schools in the U.S. offer the course "Plant Perception and Communication", which allows students to monitor real-time physiological changes in plants under varying environmental conditions with the help of advanced sensor technology[2]. Meanwhile, these courses incorporate psychological concepts of empathy, encouraging students to think from the perspective of plants and fostering respect and care for plant life. Although plant dialogue courses started relatively later in China, it has developed rapidly in recent years with distinct local characteristics. On one hand, leveraging the country's rich botanical resources and long-standing agricultural heritage, many schools have introduced curriculum activities centered on native plants. For instance, in schools located in rural areas, under the guidance by teachers, students get to know local crops and wild plants, and explore their growth habits, ecological functions, and adaptive relationships with regional climate and soil, thus inheriting agricultural wisdom[3]. On the other hand, with the comprehensive advancement of quality-oriented education, urban schools are increasingly integrating plant dialogue courses into comprehensive practical activities.

However, there are still some shortcomings in the research and practice of plant dialogue courses both domestically and internationally. Theoretically, the definition of the connotation and extension of talk to the plants remains unclear, and there is no systematic theoretical framework to support in-depth curriculum development. In practice, the evaluation systems for such courses are inadequate, with most focusing solely on students' acquisition of knowledge and skills while neglecting comprehensive assessments of emotional attitudes, values and practical innovation abilities. Additionally, the integration and sharing of curriculum resources remain insufficient, making it difficult to widely disseminate and learn from high-quality teaching experiences across

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different regions and schools. This limitation hinders the comprehensive promotion and continuous optimization of plant dialogue courses. Future research should address these issues through in-depth exploration to advance such courses to a higher developmental stage.

The "Talk to the Plants" course employs a comprehensive range of research methods to conduct an in-depth multidimensional exploration of the talk to the plants course. First, it innovates the curriculum design concept by breaking through the limitations of traditional botany's single-subject knowledge transmission. Adopting an interdisciplinary perspective, it constructs a curriculum framework that organically integrates knowledge from botany, ecology, psychology, art studies, and other disciplines. This approach guides students to "dialogue" with plants from various dimensions, holistically enhancing their comprehensive quality. Second, it pioneers innovative teaching methods by fully utilizing modern information technologies[4], such as virtual reality (VR), augmented reality (AR), and sensor technology. These tools create an immersive and interactive learning environment, which allows students to experience plants' growth conditions and physiological changes firsthand, thereby enhancing both engagement and effectiveness. The course encourages students to apply scientific methods including observation, experimentation, and analysis to study plant growth habits and environmental adaptability, significantly strengthening their scientific inquiry and innovation capabilities. Through the process of "dialoguing" with plants, students learn to care for and respect life. They develop perseverance by witnessing the struggles and resilience of plant growth. Meanwhile, through collaborative team-based inquiry activities, they enhance their communication and teamwork skills, laying a solid foundation for future social integration[5].

The Connotation and Objectives of the Course

The "Talk to the Plants" course is not merely an improved version of traditional botany courses but represents an entirely new educational philosophy and practice model. Traditional botany courses focus on the systematic transmission of plant knowledge, employing teacher-led instruction and student memorization as the primary teaching methods. They emphasize the imparting of theoretical knowledge such as plant classification, morphology, and physiology, placing students in a relatively passive learning state. In contrast, the "Talk to the Plants" course centers on "dialogue," emphasizing two-way interaction between students and plants. It encompasses knowledge exchange, emotional connection, and joint exploration on life's mysteries. Through diverse teaching activities, it guides students to ponder the scientific principles behind phenomena and organize group discussions, and encourages bold hypotheses with careful verification. This approach ignites students' enthusiasm for active learning, cultivates their comprehensive quality, and opens the door to exploring the wonders of plant life. The objectives of the "Talk to the Plants" course are carefully designed in alignment with educational standards, taking full account of students' cognitive development needs and interests. It aims to foster holistic growth across multiple dimensions including knowledge, skills, and emotional attitudes, cultivating students to become a new generation of talents with profound scientific literacy, exceptional practical abilities and a strong sense of ecological responsibility.

Current Teaching Status and Problem Analysis

Leading by traditional teaching: limited student participation

In the "Talk to the Plants" course in some universities, the traditional teaching method still occupies a dominant position. Teachers spend considerable class time explaining theoretical knowledge such as plant classification, morphological structures, and growth cycles, primarily relying on textbooks and PPT for one-way knowledge transmission. This approach maintains students in a passive information-receiving mode. Classroom interactions predominantly follow a teacher-question and student-answer pattern with predetermined questions, creating a rigid format that leaves little room for student-initiated inquiries or exploration. Rare opportunities exist for hands-on experiences of microscopic cellular worlds through experiments or specimen observations. This approach fails to transform abstract knowledge into tangible understanding, dampening learning motivation and resulting in superficial comprehension. Consequently, students struggle to deeply explore the mysteries of plant life, and it is difficult to achieve the goal of cultivating students' autonomous learning and scientific inquiry ability[6].

Singular evaluation methods: inadequate comprehensive assessment

Current evaluation systems for the "Talk to the Plants" course predominantly focus on knowledge memory and understanding. Most institutions organize regular exams to assess students' grasp of plant names, characteristics, physiological processes, and similar knowledge points, primarily relying on exam scores as the key evaluation basis. Many institutions overlook students' demonstrated practical skills including experimental design logic and technical equipment proficiency. They fail to consider the change of students' emotional attitude in course learning, such as caring for plants and teamwork spirit. Furthermore, they lack mechanisms to measure students' creative thinking, particularly the ability to formulate original botanical inquiries and design innovative investigation protocols from novel perspectives. Such single evaluation methods fail to comprehensively reflect students' learning outcomes, easily misguide teaching direction, and lead teachers to emphasize knowledge indoctrination while neglecting the cultivation of students' comprehensive quality, which is detrimental to the long-term development of the course and the alignment with students' growth needs.

Teaching Reform Strategies for the Course

Situational teaching method: immersive learning experience

The situational teaching method creates authentic or virtual

scenarios closely related to the teaching content, immersing students in specific environments where they can experience plant growth firsthand. This approach stimulates students' enthusiasm for learning and their desire to explore. On one hand, schools can fully utilize on-campus resources to establish real-world teaching spaces such as botanical gardens and greenhouses. These areas can be zoned based on plant classification and ecological habits, creating diverse natural settings. On the other hand, leveraging virtual reality (VR) and augmented reality (AR) technologies can create virtual scenarios that break through spatial and temporal constraints, allowing students to explore plant habitats worldwide[7]. For instance, students can be instantly "transported" to Yellowstone National Park in the U.S. by wearing VR headsets, and they can observe the unique "colorful pools" formed by heat-resistant algae and bacteria around geothermal springs closely. This immersive experience enables them to investigate the survival mechanisms of microorganisms in extreme environments, broadens their ecological perspectives, and deepens their appreciation for the fascinating co-evolution of plants and nature, significantly enhancing their enthusiasm and proactivity in learning[8].

Group collaboration exploration: sparks of collision thinking

Group collaboration exploration involves organizing students into well-structured teams to investigate plant-related topics together, fostering the collision of ideas and stimulating innovative thinking. Each group follows a clear division of tasks and conducts in-depth research through methods such as field investigations, literature reviews, and experimental design. Teams regularly convene for discussions to share discoveries and resolve doubts through questioning, and with teachers' timely guidance, students can break through cognitive limitations while developing teamwork skills and critical thinking. This approach unlocks multiple perspectives for exploring botanical mysteries and enhances comprehensive quality.

Incorporating cutting-edge knowledge: keeping up with the pace of science

As life sciences and ecology rapidly evolve, plant biology courses should promptly integrate the latest research findings to broaden students' scientific horizons and inspire their passion for exploration. In the chapter of gene-editing technology, teachers should comprehensively explain the principles of CRISPR-Cas9 and its applications in plant breeding such as genetically modifying rice to enhance pest resistance and stress tolerance and ultimately improve crop yield and quality. This approach guides students to explore technical ethics and cultivate their scientific thinking ability. In the field of intelligent plant research, scientists have discovered that plants can "communicate" through chemical signals, perceive environmental changes, and respond accordingly. For example, when attacked by pests, they release volatile compounds to attract natural predators of the pests, which make students wonder the astonishing intelligence of plants. Organizing group discussions on the potential applications and research directions of plant intelligence can inspire innovative thinking, keeping students engaged with cutting-edge science and allowing them to appreciate the charm and boundless possibilities of botany.

Interdisciplinary integration: expanding knowledge boundaries

Breaking down disciplinary barriers and incorporating multidisciplinary knowledge can bring new vitality to plant dialogue courses. Taking the "Plants and Cyanotype Art" course as an example, it organically integrates botany with art, history, and chemistry. From an artistic perspective, teachers showcase plant cyanotype works, guiding students to appreciate the beauty of plant morphology and light-shadow interplay while inspiring creative expression. Historically, the course traces the origins and evolution of cyanotype technology from early photographic processes to contemporary artistic applications, enabling students to understand the memory of the times it carries. In the chemistry component, the course provides in-depth explanation of cyanotype principles, including the photosensitive reaction of iron salts to ultraviolet light and the effects of plant sap on image development. Students engage in hands-on practice by creating cyanotype artworks using local plants and observing the distinctive textures and colors produced by different species, while documenting their experimental processes and reflections. Through this interdisciplinary learning, students gain comprehensive understanding of plants, enhance their comprehensive quality, and develop their ability to explore and solve problems from multiple perspectives, ultimately appreciating the beauty of integrated knowledge.

Prospects for Curriculum Reform

With growing societal emphasis on ecological education and rapid advancements in educational technology, the "Talk to the Plants" course is poised for expansive development. To fully leverage their unique potential in cultivating students' ecological awareness, scientific literacy, and humanistic values, interdisciplinary integration should be further strengthened across multiple fields, so as to establish a comprehensive multi-level ecological education curriculum system by breaking down disciplinary barriers. On the one hand, we should continue to deepen cooperation with natural science disciplines such as ecology, biology and geography, and guide students to explore the relationship between plants and the environment from different disciplines. For instance, combined with ecological principles, the succession law of plant communities and its influence on ecosystem stability should be analyzed. With the help of biological knowledge, the application of plant gene editing technology in endangered plant protection and crop improvement should be deeply studied. Using geographical methods, the relationship between plant distribution and geographical elements such as topography, climate and soil should be discussed, so that students can fully understand the key position and mechanism of plants in the earth's ecosystem. On the other hand, it is necessary to actively introduce elements of humanities and social sciences such as history, culture and sociology and

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significantly enhanced the teaching quality of the course and fostered continuous growth and advancement within the teaching team. Beyond jointly delivering theoretical instruction, laboratory experiments, and practical internships for Chinese Materia Medica Identification, the team regularly conducts in-depth discussions on the course's limitations and the evolution of talent development models in the discipline. By collecting data through questionnaires, student feedback, and teaching evaluations, they identify pedagogical gaps and collaboratively develop actionable strategies and recommendations for optimization. These measures not only promote standardized management and sustainable development of the teaching team but also provide robust support for the long-term advancement of the curriculum[9]. Consequently, Identification of Chinese Materia Medica has achieved notable progress in both teaching quality and team capacity building.

Conclusions

In conclusion, this study on the blended "online + offline" teaching reform of Chinese Materia Medica Identification based on the TfU framework effectively addressed the limitations of traditional teaching methods, such as overemphasis on theoretical knowledge while neglecting practical application and low student engagement. Constructing a four-phase closed-loop teaching model-generative topics, comprehension-oriented objectives, understanding-focused activities, and sustained assessment-established a reusable paradigm for reforming pharmaceutical education curricula. The reform not only significantly enhanced students' learning outcomes and cultivated their scientific research and practical thinking skills, but also promoted the standardized management and scientific development of the teaching team. These achievements have accumulated valuable experience for the advancement of Chinese Materia Medica Identification and provided practical references for similar courses seeking to integrate innovative pedagogical models with blended learning strategies.

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tap the rich humanistic connotation behind plants. The role changes of plants in the long river of human history should be described, from the important source of food, medicinal materials and building materials in ancient farming civilization to the embodiment of aesthetic value in modern garden landscape design and eco-tourism development. The symbolic meaning and folk customs carried by plants in different regional cultures can be explored. The promoting effect of plant industry development on social economy and employment structure should be analyzed. Ultimately, these efforts will cultivate students' ability to solve practical problems through multidisciplinary knowledge integration, students' holistic ecological values and social responsibility, and establish a widely influential brand course in ecological education.

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