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Exploration and Practice of Practical Teaching Pathways for Industry-Education Integration in Environmental Protection in the Context of the Rural Revitalization Strategy

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Abstract In the context of the rural revitalization strategy and the "High-Quality Development Project for Hundreds of Counties, Thousands of Towns, and Myriads of Villages", the integration of industry and education in environmental protection majors at universities needs to focus on "demand orientation, technology drive, and collaborative education" as its core. Through curriculum restructuring, joint platform construction, technology empowerment, and policy support, it should form a virtuous cycle of "education chain-industry chain-innovation chain". Under the background of rural revitalization strategy, the present explores practical teaching paths for industry-education integration, including: establishing moral education as the fundamental task for talent cultivation under the rural revitalization strategy; strengthening innovation in curriculum systems and teaching models; implementing a dual-mentor guidance system combining enterprise and academic instructors; adopting comprehensive evaluation systems that integrate theory and practice; improving practical teaching monitoring systems to steadily enhance teaching quality; and effectively strengthening the construction of university-enterprise cooperative bases.

Key words Rural revitalization, Integration of industry and education, Practice-oriented education

0 Introduction

The "High-Quality Development Project for Hundreds of Counties, Thousands of Towns, and Myriads of Villages" is the Top-Priority Project of Guangdong's high-quality development[1]. This project is centered on advancing high-quality development, driven by the rural revitalization strategy, the regional coordinated development strategy, the major functional zones strategy, and the new urbanization Strategy. With integrated urban-rural development as the primary pathway and the goal of building a new pattern of coordinated urban-rural and regional development, it aims to strengthen the comprehensive capabilities of counties and comprehensively advance rural revitalization.

Rural revitalization takes talent revitalization as its prerequisite and foundation. In the cultivation of environmental protection professionals in higher education institutions, practical teaching constitutes the most crucial component. It serves as a vital link to strengthen students' comprehension of theoretical knowledge, cultivate their practical capabilities, innovation and entrepreneurship skills, while also enhancing their professional social competence and employability[2-3]. The rural revitalization strategy and the context of emerging engineering disciplines endow higher education with unprecedented missions. Regarding the training of environmental protection talents, how to place greater emphasis on strengthening practical teaching to improve the quality of talent cultivation and graduates' social competitiveness undoubtedly poses new considerations for universities, enterprises and society at large.

1 Necessities of strengthening practice-oriented education in the context of rural revitalization strategy

In the context of the rural revitalization strategy, high-quality talent cultivation in engineering disciplines at higher education institutions holds significant importance. The core of rural revitalization lies in talent development, yet rural areas currently face widespread challenges such as shortages of specialized professionals and brain drain of skilled workers. practice-oriented education, through an integrated "classroom-fieldwork" model, cultivates interdisciplinary professionals equipped with agricultural technology, ecological governance, and industrial management capabilities, directly addressing the needs of rural industrial upgrading and ecological conservation. For instance, the agricultural and forestry economic management discipline has implemented practical teaching reforms to specifically enhance students' operational competencies in rural economic planning and resource management, effec-

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tively compensating for the limitations of traditional theoretical instruction[4-5].

1.1 Necessities for cultivating new talents for rural development under the strategy of rural revitalization Rural education has long been plagued by weak teaching capacities and insufficient educational resources. Practical teaching initiatives, through school-enterprise collaborations and school-local government partnerships, have introduced high-quality urban educational resources to rural areas. For instance, volunteer teaching programs provide rural students with skills training and career guidance, narrowing the urban-rural education gap. Meanwhile, vocational colleges adopt a "customized training model" to precisely align with rural industrial demands. A notable example is the Guangdong Polytechnic of Environmental Protection Engineering, which collaborates with local enterprises to cultivate and supply environmental technology professionals tailored to regional needs.

At present, the status of grassroots agricultural and rural professionals remains concerning, manifesting in three key aspects: (i) inadequate mastery of modern agricultural knowledge and technology, leaving frontline workers ill-equipped to guide agricultural production effectively; (ii) limited understanding of modern agricultural information technology, resulting in information asymmetry between production practices and societal demands; (iii) traditional and conservative working methods that lag behind the developmental needs of society in the new era[6]. In view of these challenges, there is an urgent need to cultivate a large cohort of professionals with broad perspectives, technical expertise, and proficiency in production management. However, current students often lack exposure to real-world production processes and practical skills. Compounding this issue, the flawed evaluation mechanisms under existing educational models obscure the cultivation of practical competencies, leading to deficiencies in applying theoretical knowledge and fostering innovation and entrepreneurship[7]. Therefore, it is imperative for relevant disciplines, particularly agriculture-related programs, to reform talent development strategies. Through prioritizing and strengthening practical teaching in curricula, educational institutions can better meet the changing societal demands for skilled professionals in the new era.

1.2 Necessities for improving the level of school running and the teaching ability of teachers Higher education institutions serve as vital platforms for cultivating high-quality talent, conducting scientific research, and delivering social services. A robust research ecosystem and a well-developed environment for social engagement form the foundation of top-tier universities. In the talent development process, the institution, faculty, and students act as core educational subjects. Continuous improvement in institutional capabilities fosters the growth of both faculty and students, while the enhanced competencies of individuals reciprocally elevate the institution's overall standing and influence[8]. Practice teaching bridges scientific research outcomes with rural revitalization. For instance, Donghua University relocated its ideological and political courses to the Shuiyu Village in Shanghai's Jinshan District, where students engaged in practice projects such as river remediation and ecotourism planning, driving the transformation of "green mountains and clear waters" into golden mountains (economic prosperity). Similarly, the application of environmental technologies, such as microbial mineralization carbon sequestration and intelligent water quality monitoring systems, depends on practice-oriented education to cultivate professional talents capable of technological transformation.

2 Main problems in the practice teaching

2.1 Improper content setting of practice teaching and the implementation not in place The design of practice teaching content must align with theoretical course knowledge and maintain logical coherence, continuity, and progression across related disciplines. Its aim is to enable students to systematically navigate the "learning-practicing-applying" cycle within their specialized fields. In reality, however, constraints such as curriculum modularization, instructor assignments, and evaluation frameworks frequently result in poorly coordinated content design and inconsistent implementation.

Taking the discipline of the Environmental and Resource Science at Zhaoqing University as an example, its practice courses on cleaner production and environmental impact assessment (EIA) training are delivered by separate instructors. While some teachers, although equipped with rich practical teaching experience, meticulously design and rigorously execute course content, others adopt a perfunctory approach to curriculum design, either due to inadequate pedagogical expertise or a mere focus on fulfilling workload quotas. This discrepancy leads to fragmented content and lax implementation standards. Furthermore, insufficient collaboration among instructors exacerbates disconnections between practical modules, ultimately compromising the quality of practice teaching.

2.2 Weak base construction of the practice teaching Practice teaching bases are critical places for conducting practice teaching. The primary issue in the development of practice teaching bases lies in the institution's emphasis on the quantity of bases, while neglecting the quality of their development and evaluation. When a new base is established or officially inaugurated, leaders and faculty actively participate, posing for photos and compiling documentation, but subsequent phases, including ongoing development, utilization rates, and the presence of faculty or students, receive minimal attention. Such base development largely becomes a formality. Furthermore, the lack of substantive financial investment during base construction remains a key factor undermining the quality of practice teaching base development.

2.3 Insufficient investment in practice funds and teachers Although colleges and universities have repeatedly stressed the importance of practice teaching, and some teachers have called for increased funding, the funding for practice teaching is still

seriously inadequate. In addition, due to the lack of effective incentive mechanism, the school's assessment of teachers is not focused on practice teaching, so many teachers are always reluctant to engage in practice teaching on the grounds of various arguments, resulting in very limited available teachers, affecting the improvement of the effect of practice teaching.

3 Exploration and practice of practical teaching pathways for industry-education integration in environmental protection in the context of the rural revitalization strategy

3.1 Taking moral education as the fundamental task of talent cultivation in the context of the rural revitalization strategy The 20th National Congress of the Communist Party of China in 2022 proposed "building a livable, industry-friendly and beautiful countryside". In the process of practice teaching, taking into account China's national conditions and the actual socio-economic development, guided by Xi Jinping's socialist thought with Chinese characteristics in the new era, strengthen the ideological and political construction of the curriculum, firmly grasp the Party's educational purposes, reinforce the development of curriculum-based ideological and political education, firmly adhere to the Party's educational principles, prioritize fostering virtue through education as the fundamental task of talent cultivation, standardize the implementation of the "Three Comprehensives" education mechanism (whole-staff, whole-process, and all-round education), and enhance quality education and ideological awareness among students. The training of environmental protection students in colleges and universities must not only pay attention to results, but also strengthen the process; it must be based not only in the classroom, but also deeply rooted in the practice base and in the countryside, clarify the role of practice teaching in the overall development of students, recognize the importance and urgency of practice teaching reform, and strengthen the concept of practical education. It is necessary to adhere to the combination of practice teaching with theoretical teaching, scientific research, social services, employment and entrepreneurship, and take school-enterprise cooperation, industry-education integration, and collaborative education as the main line through the practice teaching system[9].

3.2 Strengthening the innovation of curriculum system and teaching mode Practice teaching must be based on course theory as its guiding principle, emphasizing skill and competency development as its core focus. Firstly, there is professional foundational training centered on disciplinary cognition and experimental coursework, such as cognitive internships in specific majors. These courses are typically arranged at the beginning of freshmen year to deepen students' understanding of their chosen fields through practical engagement. Secondly, curricular internship-based practice teaching serves as a crucial bridge connecting theoretical knowledge with real-world application. Thirdly, graduation internships, scientific research practices, and holiday social practices constitute another vital component of practice teaching for cultivating applied innovative talents. Examples include introducing practical courses like rural ecological planning, agricultural pollution control, and green packaging design that integrate environmental technologies with rural industrial needs. For instance, Hebei University of Environmental Engineering combines agricultural product packaging design with intangible cultural heritage preservation through its "Cultural Creativity Workshop," enhancing cultural value-added of products. Additionally, incorporating case teaching and interdisciplinary integration, as demonstrated by Northwest University's "New Engineering Disciplines" initiative, strengthens the practical application of environmental science in ecological revitalization[10].

3.3 Implementing the comprehensive evaluation system of school-enterprise dual mentor guidance and the combination of theory and practice A strong faculty team is the foundation for improving the quality of internship/practice teaching for students. Schools should intensify the cultivation of young faculty members, focusing on guiding, nurturing, and enhancing their professional capabilities. Efforts should be made to transform teaching philosophies, broaden perspectives, and build a high-quality teaching force that possesses both theoretical knowledge and practical skills in entrepreneurship management. Through school-enterprise collaborations, institutions can provide practical training for faculty advisors to align with curriculum requirements and integrate into daily teaching, while corporate mentors can elevate their theoretical expertise through mutual exchanges. Establishing joint internship bases and technology R&D centers with enterprises promotes the "dual mentorship system." For example, Guangdong Polytechnic of Environmental Protection Engineering has partnered with municipal ecological environment bureaus and industry associations to create an integrated "industrial chain-professional chain-talent chain" system, cultivating environmentally-focused professionals. Practices like on-the-job internships and targeted training programs, such as Hebei University of Environmental Engineering's collaboration with Hongdu Industrial Group allows students to participate in agricultural product packaging design, demonstrating seamless integration of teaching and production[11].

3.4 Improving the monitoring system of practice teaching and steadily improving the quality of practice teaching In the assessment of internship and practical training, beyond mandating participating students to submit detailed practice reports, efforts should focus on motivating students to shift their learning approaches through diverse evaluations spanning classroom and extracurricular activities, online and offline platforms. This aims to cultivate an environment conducive to self-directed learning and proactive practical engagement. Institutions should establish

structured mechanisms such as regular reporting systems between interns and their corporate or academic mentors, consistent communication channels linking corporate mentors with academic supervisors, periodic dialogues with practice base administrators, and scheduled evaluations of interns. Concurrently, comprehensive guidance, continuous monitoring, and routine assessments should be reinforced throughout the internship period to ensure systematic oversight and sustained support for student development.

3.5 Effectively strengthening the construction of school-enterprise cooperation base The practice teaching base focuses on construction, management, and operation, including laying a solid foundation of industry-university-research collaboration with the school, providing teachers with a conducive research environment and space for achievement transformation, offering practice teaching content and venues aligned with students' professional internships, assigning corporate mentors to students, and providing necessary financial support. Taking the Environmental Engineering program at Zhaoqing University as an example, one of its partnered practice teaching bases, Guangdong Xijiang Environmental Protection Technology Co., Ltd., has been established as a provincial-level university student practice teaching base. It is recommended to collaborate with local governments to implement ecological governance projects, such as Guangdong Environmental Protection College dispatching cadres to rural areas for resident assignments to carry out environmental science outreach, green industry cultivation projects, and promote technology achievement transformation. A "science and technology commissioner" system could be established to channel university research capabilities into rural areas, addressing practical issues like agricultural non-point source pollution and solid waste treatment.

4 Conclusions

In the context of the rural revitalization strategy, practice teaching is not only an inevitable choice for educational reform but also the core driving force to break through rural development bottlenecks. Through curriculum innovation, industry-education integration, and policy guarantees, practice teaching can deliver "ready-to-use and locally-retained" high-quality talents to rural areas, driving the transformation of villages from "blood transfusion" to "blood creation." It is projected that by 2030, such models will cover more than 60% of agriculture-related universities in the whole country, significantly enhancing rural industrial competitiveness and sustainable development capacity.

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