

INTERDISCIPLINARY INTEGRATION CULTIVATION MODE OF ENVIRONMENTAL DESIGN MAJOR IN THE CONTEXT OF RURAL REVITALIZATION

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Abstract: Rural Revitalization is an important part of the national strategy in the new era. Environmental Design serves as the core technical support for improving rural living environments, reshaping industrial spaces, and passing down local culture. The quality of talent training directly affects the scientific nature and sustainability of rural construction. At present, there is a shortage of high-quality compound talents, and the single-discipline training model cannot handle the complex problems of rural areas. This has become a key bottleneck that limits industry services. This article is based on Complex Systems Theory and Constructivist Learning Theory. By analyzing the needs of Rural Revitalization and the existing shortcomings in training, it proposes a modular matrix cultivation mode of "problem-oriented, interdisciplinary core, multi-scene practice, and diverse evaluation". It focuses on key aspects such as training objectives, core competencies, curriculum system, teaching mode, and evaluation mechanism. It systematically explains the theoretical foundation, core structure, implementation path, and support mechanisms. The results show that this mode can effectively improve students' comprehensive ability to solve complex rural problems. It provides solutions and ideas for the transformation and upgrading of university Environmental Design majors. It helps cultivate compound innovative talents who "understand rural areas, know design, are good at coordination, can implement, and know operation". The innovation of this research lies in building a theoretical model for interdisciplinary integration cultivation of Environmental Design oriented to Rural Revitalization. It proposes an implementation path that combines a modular matrix curriculum system with progressive practical teaching. It emphasizes the construction of a school-local collaborative education community. It has strong theoretical value and practical guidance significance.

Keywords: Rural revitalization; Environmental design talent; Interdisciplinary cultivation; Modular matrix cultivation mode; Curriculum system; Core competencies; Practical teaching

1 INTRODUCTION

The deep and comprehensive promotion of the Rural Revitalization strategy has shaped the path of rural development in China. It puts forward diverse demands in areas such as improving rural living environments, reshaping industrial spaces, and creating cultural scenes. Environmental Design is the core technical support for shaping rural physical space forms and passing down regional cultural genes. The quality of its talent training directly relates to the effectiveness and sustainability of rural construction. The rural environmental system has compound attributes of nature, society, economy, and culture. It involves multiple dimensions such as ecological protection, cultural inheritance, industrial development, and social governance. Therefore, Environmental Design talents need not only solid professional design skills but also interdisciplinary knowledge perspectives, systems thinking abilities, and comprehensive practical abilities. However, current Environmental Design professional education in China shows significant mismatch: the knowledge structure is single and rigid, the curriculum system still focuses on traditional aesthetic training and space form design, and lacks systematic integration of related knowledge such as rural ecology, agricultural production, and local culture; there is a serious disconnect between theory and practice, teaching content is misaligned with real rural needs, and students often know design but not rural areas, can draw but hard to implement, and have weak overall design; interdisciplinary collaboration ability is weak, the training process is limited to a closed loop within design discipline, failing to effectively link key disciplines for rural development such as agronomy, ecology, and sociology, making it difficult for students to handle complex rural system problems.

Although domestic and international research has paid attention to the necessity of design education reform and interdisciplinary integration, there is still a significant gap in systematic and localized interdisciplinary integration cultivation mode research for the Rural Revitalization strategy. Existing explorations mostly stay at the macro-concept level or partial course adjustments, lacking systematic reconstruction of key aspects such as training objectives, core competencies, and curriculum systems. In the broad context of Rural Revitalization, Environmental Design practice research mostly focuses on specific projects or technical methods, with insufficient systematic research on education mode reform for talent support systems; Environmental Design education reform research involves concepts such as interdisciplinary integration and local service, but research specifically exploring interdisciplinary integration cultivation modes oriented to Rural Revitalization is rare and lacks operational plans. Developed countries have experience in community design and participatory design, but direct transplantation faces challenges from differences in

culture and social governance systems[1-3].

Therefore, building a new paradigm for interdisciplinary cultivation of Environmental Design talents that fits China's Rural Revitalization needs is not only the key to solving the current disconnect between design education and practice but also an inevitable requirement to serve major national strategic needs. This article stands on the complex needs of Rural Revitalization, systematically analyzes the ability demands and training shortcomings of Environmental Design talents, and explores the theoretical foundation, core structure, and implementation path of interdisciplinary integration cultivation mode. It provides systematic solutions and preliminary plans for the reform of Environmental Design professional education.

2 ABILITY DEMANDS AND CULTIVATION CHALLENGES FOR ENVIRONMENTAL DESIGN TALENTS DRIVEN BY RURAL REVITALIZATION

2.1 Deconstruction of Ability Demands Driven by the Five Major Tasks of Rural Revitalization

The five major tasks of the Rural Revitalization strategy—"thriving industries, livable ecology, civilized rural styles, effective governance, and affluent life"—form an organic whole. They put forward multi-dimensional and compound ability demands on Environmental Design talents[4]. Under the guidance of thriving industries, environmental designers need to have industrial space design and integration planning abilities. They should understand the laws of rural industry integration and turn the needs of industries such as agricultural production, agricultural product processing, and rural tourism into specific space carriers, such as agricultural landscape layout, characteristic homestay design, and rural tourism service point planning. Under the guidance of livable ecology, they need to master ecological priority design and comprehensive technical integration abilities suited to local conditions. They should use ecological principles to assess environmental carrying capacity, adopt local materials and ecological restoration technologies such as rainwater-flood management and biodiversity protection to create harmonious living environments, achieving unity between improving rural landscape styles and ensuring ecological functions. Under the guidance of civilized rural styles, they need to have cultural sensitivity and regional inheritance literacy. They should deeply explore regional genes such as traditional villages, ancient architecture, and folk customs, and use design methods such as protective renovation and cultural scene creation to revitalize the spiritual home of rural areas, avoiding homogenized designs of "one thousand villages with the same face". Under the guidance of effective governance, they need to have social collaboration and community participation abilities. They should shift from "top-down" design thinking to become collaborators and enablers in rural environmental governance, organize and guide villagers to participate in the design process, coordinate the demands of multiple interest parties, and promote co-building, co-governance, and sharing of rural environments. Under the guidance of affluent life, they need to have comprehensive benefit improvement and operation planning abilities. They should consider environmental benefits, social benefits, and economic benefits together, incorporate considerations such as cost control and industrial operation in design, and ensure the economic feasibility and sustainability of design plans.

2.2 Diagnosis of Shortcomings in the Current Environmental Design Professional Talent Cultivation Mode

Facing the complex demands of Rural Revitalization, the current Environmental Design professional talent cultivation mode has many structural shortcomings. First, the training objectives are vague in positioning, mostly following urban design standards and ignoring the local characteristics of rural areas, failing to clarify the differentiated training direction of "serving rural areas", leading to weak student cognition of rural social culture, ecological environment, and industrial laws. Second, the knowledge system is single and closed. Course settings focus on core design courses such as design principles, expression techniques, and space form design, lacking organic integration with key disciplines for rural development such as agricultural landscape and industrial layout in agronomy, environmental carrying capacity assessment in ecology, community creation in sociology, and industrial planning in economics. Students find it hard to form a knowledge framework for systematically solving complex rural problems. Third, teaching methods are disconnected from practice. Classroom teaching focuses on theoretical lectures and virtual topics, lacking long-term localized practice links. Students' cognition of rural areas stays at "superficial survey" level, failing to deeply understand the real needs of rural residents, leading to design plans that are "all talk no action" and hard to implement. Fourth, the faculty structure is single, with most teachers from design backgrounds, lacking interdisciplinary teaching abilities and rural practice experience, making it difficult to guide students in integrating multi-disciplinary knowledge to solve real problems. Fifth, the evaluation system is one-sided and rigid, focusing on aesthetic expression and drawing standards of design plans, ignoring the assessment of students' interdisciplinary knowledge integration abilities, problem-solving abilities, and other comprehensive competencies, unable to fully measure training quality. These shortcomings together lead to Environmental Design talents who cannot adapt to the actual needs of Rural Revitalization. When participating in rural construction projects, they often feel powerless due to limited knowledge structure and insufficient practice experience.

3 THEORETICAL FOUNDATION AND CONSTRUCTION IDEAS FOR THE INTERDISCIPLINARY INTEGRATION CULTIVATION MODE OF ENVIRONMENTAL DESIGN MAJOR

3.1 Theoretical Foundation

The construction of the interdisciplinary integration cultivation mode for Environmental Design major in the context of Rural Revitalization needs to rely on multi-disciplinary theoretical support to form a systematic theoretical framework. Complex Systems Theory views rural areas as dynamic composite systems where nature, society, economy, and culture interact. It emphasizes the connections and wholeness between systems, requiring the cultivation mode to break single-discipline thinking and guide students to analyze rural environmental problems from a systems perspective, forming holistic dynamic design thinking. Constructivist Learning Theory holds that knowledge is constructed by learners through active exploration and collaborative interaction in real contexts, rather than passive acceptance. This provides methodological guidance for interdisciplinary course design, that is, using real rural problem contexts to motivate students to autonomously integrate multi-disciplinary knowledge. Project-Based Learning (PBL) theory drives with real projects, guiding students to conduct interdisciplinary collaboration around problems, achieving knowledge integration and ability improvement in the process of solving problems, fitting the demand for practical talents in Rural Revitalization. Collaborative Education Theory emphasizes breaking barriers between disciplines, universities, and localities, integrating resources from government, universities, rural areas, enterprises, and others to form educational synergy. It provides theoretical basis for interdisciplinary faculty construction and practice platform building[5]. Local Knowledge Theory emphasizes respecting rural local wisdom and traditional experience, opposing "elite" design thinking. It requires the cultivation mode to incorporate rural surveys and villager interviews, guiding students to shift from "external designers" to "local learners", improving the suitability and locality of design plans.

3.2 Overall Construction Ideas

Based on the above theoretical foundation and analysis of Rural Revitalization needs, this research proposes the overall construction ideas for a modular and matrix cultivation mode of "problem-oriented, interdisciplinary core, multi-scene practice, and diverse evaluation"[6]. "Problem-oriented" starts from real environmental problems in Rural Revitalization practice, such as traditional village revitalization, ecological restoration, and community creation. It decomposes complex problems into specific topics, such as material selection in farmhouse renovation and villager demand coordination in public space design, guiding students to integrate multi-disciplinary knowledge with problems as clues. "Interdisciplinary core" is based on Environmental Design professional abilities, dynamically integrating core concepts and methods from related disciplines such as agronomy, ecology, sociology, and management to form an open multi-dimensional knowledge system. For example, in the topic of "rural ecological restoration design", it needs to integrate knowledge modules such as "biodiversity protection" in ecology, "local plant application" in agronomy, and "landscape creation" in Environmental Design. "Multi-scene practice" builds progressive practice scenes in classrooms, campuses, rural areas, enterprises, and others, strengthening students' immersive experience and localized learning through case studies, field investigations, village-based projects, and other links, gradually improving practice abilities from "cognition, skills, comprehensive". "Diverse evaluation" breaks the traditional single evaluation mode, building a comprehensive evaluation system with multi-party participation and multi-dimensional consideration of knowledge mastery, ability improvement, competency development, and social contribution, emphasizing the locality, feasibility, and social value of design plans. This idea organically integrates elements such as training objectives, core competencies, curriculum system, teaching mode, practice platform, and evaluation mechanism, forming a talent cultivation system with clear objectives, clear structure, and efficient operation[7].

4 CORE STRUCTURE AND IMPLEMENTATION PATH OF THE INTERDISCIPLINARY INTEGRATION TALENT CULTIVATION MODE FOR ENVIRONMENTAL DESIGN MAJOR

4.1 Core Structure

4.1.1 Training objective positioning

The interdisciplinary integration talent cultivation objective for Environmental Design major serving Rural Revitalization should focus on compound specialized talents who "understand rural areas, know design, are good at coordination, can implement, and know operation". Specifically, they master the basic theory and skills of Environmental Design profession, have systems thinking, interdisciplinary integration, and lifelong learning abilities, are familiar with rural social culture, ecological environment, and industrial development laws, and can independently engage in design, research, and management work in areas such as rural living environment improvement, cultural heritage protection, ecological restoration, and industrial space planning. This objective emphasizes not only professional abilities in Environmental Design but also differentiated competencies such as rural cognition, interdisciplinary collaboration, and practical implementation, forming a significant distinction from urban design talent cultivation.

4.1.2 Core competency system construction

Around the training objectives, build a system of six major core competencies. In terms of systems thinking and complex problem-solving competency, students are required to use systems theory methods to analyze the causes and connections of rural environmental problems, such as the impact of "industrial hollowing out" on village styles, and propose sustainable solutions that balance ecology, culture, and economy; cultural sensitivity and local inheritance competency emphasizes respecting rural cultural diversity, excavating local knowledge through field investigations and oral history records, and turning it into design language; ecological ethics and green design competency requires mastering ecological design principles, being familiar with local material characteristics and ecological restoration

technologies, and avoiding "high-input, high-consumption" design plans; social collaboration and community participation competency cultivates students' organizational coordination abilities, enabling them to effectively guide villagers in participating in the design process and balance various interest demands; local technology application and practice innovation competency encourages students to integrate modern appropriate technologies such as low-cost energy-saving technologies on the basis of traditional crafts such as wooden structures and stone masonry, improving the operability of design plans; industrial integration and operation planning competency requires students to understand the logic of rural characteristic industries, incorporate industrial planning, cost control, and operation management considerations in design, ensuring the economic sustainability of design results.

4.1.3 Curriculum system reconstruction: modular matrix design

To adapt to the demand for compound Environmental Design talents in the Rural Revitalization strategy, this research breaks the shackles of traditional linear curriculum structure and builds a modular and matrix curriculum system of "professional foundation module + interdisciplinary crossover module + rural practice module + personalized development module". This system takes students' different grades and cultivation stages as the vertical axis, and the four major course modules as the horizontal axis. Through cross-penetration of module courses in each stage, it achieves spiral upward of knowledge and abilities. The professional foundation module focuses on three major directions: "rural living environment design", "rural cultural heritage and place creation", and "rural industrial space planning". They respectively integrate core knowledge such as space planning, local technology, microclimate design; cultural heritage protection, social design, community participation; and industrial planning, experience economy, sustainable tourism design, forming clear directional course clusters; the interdisciplinary crossover module relies on cross-college elective courses and workshops, adopting a mode of "thematic lectures + interdisciplinary workshops + case discussions". For example, the "rural community creation" workshop is co-taught by mentors from sociology, Environmental Design, and rural practice, guiding interdisciplinary collaboration; the rural practice module implements progressive teaching, with lower grades conducting rural cognition internships and traditional village surveys, middle grades doing environmental mapping and local material experiments, and higher grades participating in village-based projects and rural-themed graduation designs, supported by courses such as "Rural Environmental Design Practice" and "Rural Workshops"; the personalized development module sets elective courses in digital technologies and characteristic cultures such as rural digital twin design and intangible cultural heritage inheritance to meet personalized development needs.

Adopt diversified collaborative education teaching modes to promote integration of "teaching, learning, and doing". Project-Based Learning (PBL) uses real rural projects such as public space renovation in a certain village as carriers, organizing interdisciplinary learning groups including students from Environmental Design, ecology, sociology, and others. It simulates the full process from survey, planning, design, construction, to feedback. Teachers only act as guides, and students independently complete problem analysis, scheme design, multi-party coordination, and other links. Participatory workshop teaching invites villager representatives, rural craftsmen, government officials, enterprise mentors, and other parties around specific themes such as "village entrance square design" to conduct design co-creation through seminars, brainstorming, model building, and other ways, guiding students to understand diverse rural demands. The school-local dual-mentor system assigns each student a school professional mentor for theoretical and design method guidance and a rural practice mentor such as a senior rural designer for local knowledge and practical skill guidance. Dual mentors jointly participate in topic guidance and result evaluation. Case teaching and scenario simulation analyzes excellent rural design cases such as ancient village revitalization in Songyang, Zhejiang, and Echigo-Tsumari Art Triennale in Japan, combined with VR/AR virtual simulation technology to restore rural scenes, improving teaching intuitiveness. Flipped classroom and blended learning combine online resources such as rural survey databases and interdisciplinary MOOCs with offline interactions such as group discussions and design reviews, guiding students to learn theoretical knowledge autonomously before class, and focusing on problem-solving and ability improvement in class.

4.1.4 Practice platform construction and evaluation mechanism optimization

Build a "school-local collaborative education community" practice platform: cooperate with local governments to jointly build rural practice teaching bases, providing real project resources and localized practice scenes; set up rural design workstations/institutes as bases for teachers and students' village-based practice, result transformation, and long-term tracking services; integrate school resources to build interdisciplinary labs such as rural ecological design lab and local material research center, providing technical support; establish school-enterprise cooperation platforms with rural construction enterprises and cultural tourism companies, introducing real industry projects and mentor resources; use internet technology to build virtual learning communities, sharing rural survey data, design cases, interdisciplinary courses, and other resources to achieve remote collaboration and knowledge sharing[8]. In terms of evaluation mechanism, establish a multi-dimensional comprehensive evaluation system: diversified evaluation subjects, absorbing villager representatives, practice mentors, enterprise experts, etc., to participate, avoiding limitations of single teacher evaluation; multi-dimensional evaluation content, focusing on knowledge integration ability (interdisciplinary knowledge application), problem-solving ability (targetedness of design plans), competency development (cultural respect, social responsibility), and social contribution (villager satisfaction, project implementation effect); diversified evaluation methods, process evaluation through learning portfolios recording students' full-process growth trajectory from rural surveys, scheme conception, to result display, summative evaluation using design defenses, result exhibitions, village-based work reports, etc., and social value evaluation introducing quantitative indicators such as community satisfaction surveys and project economic benefit analysis; contextualized evaluation standards, emphasizing rural

design characteristics such as locality (whether it fits rural culture), suitability (whether it matches rural economic level), and sustainability (whether it is easy for later maintenance), rather than pure aesthetic expression[9].

4.2 Implementation Path and Support Mechanisms

The implementation path adopts a "pilot first, gradual promotion" strategy. Select grades or classes with certain conditions for pilot operation, optimize the cultivation plan through student feedback, teacher discussions, and practice tests, and promote it to the whole college after maturity. Progressive cultivation in stages: lower grades (cognition and foundation stage) focus on professional foundation learning and rural cognition, initially establishing rural cognition framework through courses such as "Introduction to Rural Environmental Design" and "Traditional Village Survey"; middle grades (integration and skills stage) deeply learn interdisciplinary crossover module courses, conduct small and medium rural design topic practices such as farmhouse renovation design and village entrance landscape improvement, strengthening professional skills and interdisciplinary collaboration abilities; higher grades (comprehensive and innovation stage) participate in real rural construction projects such as village-based design and Rural Revitalization demonstration village planning, completing rural-themed graduation designs, achieving a "from theory to practice" closed loop. Projects drive courses, and courses serve projects, turning local government and enterprise Rural Revitalization projects such as "cultural-tourism integration space design" in a certain village into teaching content. Students work in groups to complete design plans and connect to actual construction, achieving "integration of teaching, learning, and doing".

Support mechanisms need multi-dimensional collaboration: in organizational support, establish a talent cultivation guidance committee composed of university leaders, department heads, interdisciplinary teachers, local government representatives, and enterprise mentors to coordinate cultivation plan formulation, resource integration, and quality monitoring; in faculty support, implement "school faculty interdisciplinary training plan" to send design teachers to agronomy, sociology, and other departments for further study, "external expert flexible introduction plan" to hire rural planners, ecologists, village cadres, etc., as part-time mentors, and regularly organize interdisciplinary teaching seminars and rural practice ability training; in resource integration support, break department barriers to achieve school resource sharing such as courses, labs, and research projects, seek local government policy support such as practice base construction subsidies and project docking priority, expand school-enterprise cooperation resources such as enterprise scholarships and internship positions, and set up special funds to support interdisciplinary course construction, rural practice subsidies, etc.; in institutional support, innovate interdisciplinary elective and credit recognition systems to allow students to take rural-related courses across departments and count them into total credits, establish teacher teaching reform reward mechanisms to include interdisciplinary teaching and rural practice guidance in assessment and excellence evaluation indicators, and student practice achievement incentive mechanisms to prioritize excellent rural design plans for competitions and docking implementation projects, and implement routine teaching quality monitoring to regularly assess cultivation effects and dynamically adjust plans through student feedback, peer review, and social evaluation.

5 CONCLUSION

The comprehensive promotion of the Rural Revitalization strategy puts forward compound demands on Environmental Design talents for "understand rural areas, know design, are good at coordination, can implement, and know operation". The current single-discipline cultivation mode cannot meet this demand. This article is based on Complex Systems Theory, Constructivist Learning Theory, and others, building a modular matrix cultivation mode of "problem-oriented, interdisciplinary core, multi-scene practice, and diverse evaluation". It systematically explains its theoretical foundation, core structure, implementation path, and support mechanisms. This mode clarifies the cultivation objectives serving Rural Revitalization, builds a system of six major core competencies, reconstructs modular matrix courses, innovates diversified collaborative teaching modes, builds school-local collaborative practice platforms, and optimizes multi-dimensional comprehensive evaluation mechanisms, forming a set of logical, specific, and operable interdisciplinary integration talent cultivation plan for Environmental Design major.

The innovative value of the research lies in: for the first time, systematically building a theoretical model for interdisciplinary integration cultivation of Environmental Design oriented to Rural Revitalization, breaking the limitations of traditional design education's "single-discipline closed loop"; proposing specific paths combining "modular matrix curriculum system" and "progressive practical teaching", solving the problem of how to systematically embed interdisciplinary knowledge into the cultivation process; emphasizing the construction of "school-local collaborative education community", promoting synergy among universities, governments, rural communities, and enterprises to form educational forces, improving the practical feasibility of the cultivation mode. The implementation of this mode helps improve students' comprehensive design abilities, systems thinking abilities, and practice innovation abilities to solve complex rural problems, providing systematic solutions for the transformation and upgrading of university Environmental Design majors, and injecting continuous intellectual support into the comprehensive promotion of the Rural Revitalization strategy.

Future research can further deepen the application of digital technologies such as rural environmental gene databases and digital twin design platforms in interdisciplinary cultivation to improve teaching intuitiveness and interactivity; explore adaptive promotion strategies for this mode in different types and levels of universities, forming differentiated

implementation paths; conduct long-term tracking evaluations of the mode implementation effects such as graduate career development and rural project implementation effects, and continuously optimize the cultivation system; deepen the long-term mechanism for "university-rural" collaborative development, explore sustainable business models for design services in Rural Revitalization and talent return mechanisms, and promote the true formation of endogenous development power in rural areas.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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