Reform and Reflection of Graduate Landscape Design Courses Based on "Nature-based Solutions"

Shidong TANG, Meihong ZHAO*

Zhongyuan University of Technology, Zhengzhou 450000, China

Abstract With the intensification of climate change and ecological environmental degradation, the role of postgraduate landscape design disciplines in achieving sustainable development goals has become increasingly prominent. Nature-based Solutions (NbS), as an emerging concept, emphasize addressing social and environmental challenges through natural processes, offering a new direction for landscape design education. This study explored the reform of and reflections on landscape design courses for postgraduates guided by Nature-based Solutions. In response to the issues of disconnection between theory and practice and insufficient interdisciplinary integration in current graduate education in landscape design, this paper proposed a curriculum reform pathway oriented towards nature-based solutions. A new model for cultivating postgraduates in landscape design was explored by reconstructing the curriculum system, innovating teaching methods, and improving evaluation mechanisms. Moreover, drawing on the practical case of graduate teaching at Zhongyuan University of Technology, specific implementation strategies and outcomes of the curriculum reform were analyzed. This paper also reflected on the challenges encountered during the reform process and proposed corresponding optimization suggestions, aiming to provide a reference for the innovative development of graduate education in landscape design in China.

Key words Nature-based Solutions; Landscape design; Graduate education; Curriculum reform

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Nature-based Solutions, as an emerging design concept and framework, have attracted widespread attention in the field of landscape planning and design in recent years. In this context, graduate education in landscape design, as a crucial stage for cultivating advanced professionals, urgently needs to systematically integrate this cutting-edge concept into the curriculum system. This will enable future designers to master nature-based design languages and methods.

Integration Status of Nature-based Solutions and Landscape Design Education

Since introduction, Nature-based Solutions have demonstrated broad application prospects globally in fields such as ecological conservation, urban planning, and water resource management. At its core, Nature-based Solutions represent a "nature-based" way of thinking, emphasizing respect for natural laws, leveraging ecological processes to address social challenges, while simultaneously preserving and enhancing biodiversity and ecosystem services. Currently, the integration of Nature-based Solutions into China's graduate education in landscape design remains in its preliminary stages. Indeed, the response of most universities' curriculum systems to this cutting-edge concept has been relatively slow, failing to systematically incorporate it into their core courses. Taking typical landscape design course for postgraduates as an example, traditional course structures are primarily focused on conventional knowledge modules such as design theory, history and theory, engineering and technology, and plants and applications. In contrast, content related to Nature-based Solutions is often limited to scattered case studies, lacking a systematic theoretical framework and methodological instruction. The lack of a systematic theoretical framework makes it difficult to establish a complete knowledge system and methodology for Nature-based Solutions (Table 1). Furthermore, existing teaching approaches are often inadequate for cultivating the comprehensive competencies required by Nature-based Solutions, which emphasize a deep understanding of specific environmental and social contexts, as well as collaborative efforts among multiple stakeholders. This poses a challenge to traditional teaching models, which are predominantly teacher-centered and focus primarily on skill training. Graduate education at Zhongyuan University of Technology has begun actively exploring pathways to integrate Nature-based Solutions with landscape design education. In its graduate course *Landscape Design* and *Environmental Protection*, topics such as "sponge city construction" have been introduced. By embedding industry experts into the classroom, the course helps students understand the practical application of Nature-based Solutions in urban environmental design[1-2].

Core Pathways for Curriculum Reform Guided by "Nature-based Solutions"

Restructuring and integration of the curriculum system

Given the complexity and interdisciplinary nature of Nature-based Solutions, the primary task of curriculum reform is to systematically restructure the existing course framework. It involves breaking down traditional disciplinary boundaries and constructing

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Shidong TANG (1968 –), male, P. R. China, professor, PhD, devoted to research about architectural environmental space and its planning and design.

* Corresponding author. Meihong ZHAO, professor, PhD, devoted to research about environmental space and its planning and design.

a three-tiered course module centered on the sequence of "ecological process understanding, design strategy generation, and implementation management and evaluation". Through this approach, the concepts and methods of Nature-based Solutions can be organically integrated into the entire process of graduate education.

In the "ecological process understanding" module, it is essential to strengthen the scientific understanding of the operational mechanisms of natural systems. This will help students grasp key ecological processes such as biogeochemical cycles, species flow, and energy transformation, thereby laying a scientific foundation for nature-based design. Teaching in this module should particularly emphasize the close integration of theory and practice. For instance, through practical components such as site monitoring and ecological process simulation, students can deepen their understanding of abstract ecological concepts. In the "design strategy generation" module, the focus should be on the core principles of Nature-based Solutions, cultivating students' ability to translate ecological knowledge into concrete design strategies. In this module, special emphasis should be placed on analyzing and simulating real-world cases. Through design exercises for different types of sites such as urban built-up areas, rural regions and ecologically sensitive zones, students should learn to develop nature-based solutions tailored to local conditions. In the "implementation management and evaluation" module, focus should be placed on the full lifecycle management of nature-based solutions, covering aspects such as project planning, implementation oversight, and performance assessment. This will help students understand the entire process from design to execution. This module can draw on the CDIO (Conceive – Design – Implement – Operate) engineering education model, emphasizing the implementability and long-term operation and maintenance of designs. By incorporating post-assessment of actual engineering cases, students are encouraged to reflect on the impact of design decisions on project sustainability[3] (Table 2).

Table 1 Current status and challenges in integrating Nature-based Solutions into landscape design courses for postgraduates

Aspects	Current characteristics	Existing problems
Course content	Based on traditional design theory and skills	Insufficient coverage of cutting-edge concepts such as Nature-based Solutions
Teaching method	Teacher-led instruction supplemented with design exercises	Lack of practical experience in real-world contexts
Interdisciplinary integration	Limited interdisciplinary content	Evident disciplinary barriers, inadequate integration depth
Competency development	Emphasis on design presentation and skill training	Insufficient cultivation of systems thinking and critical thinking

Table 2 Design of curriculum modules guided by Nature-based Solutions

Curriculum modules	Core curriculum examples	Key points of competence cultivation	Characteristics of teaching methods
Ecological process understanding	Landscape ecology, ecosystem services, biodiversity conservation	Ecological cognition, system analysis, environmental diagnosis	Site monitoring, process simulation, data analysis
Design strategy generation	Nature-based design, climate-adaptive design, ecological restoration technology	Problem-solving, innovative design, interdisciplinary integration	Case study, project simulation, design workshop
Implementation management and evaluation	Landscape project management, design performance evaluation, community engagement	Project management, collaborative governance, performance evaluation	Case debriefing, role simulation, field study

Innovation and practice in teaching methods

Curriculum reform guided by Nature-based Solutions requires not only content updates, but also innovations in teaching methods to cultivate students' comprehensive abilities to tackle complex problems. To cultivate these abilities, several effective teaching approaches have been developed and implemented.

Project-driven teaching as a vital bridge between theory and professional practice Students apply the principles and methods of Nature-based Solutions throughout the complete design process by introducing real or simulated design projects. For example, in the *Landscape Design* and *Environmental Protection* course at Zhongyuan University of Technology, real-world contexts such as the ecological restoration of abandoned mines in urban fringe areas are used. Students are guided to conduct mountain ecological restoration and landscape design based on the specific characteristics of these abandoned mines. This design task, grounded in real-world scenarios, not only strengthens students' understanding of theoretical knowledge, but also cultivates their ability to solve practical problems. In project-driven teaching, special emphasis should be placed on the iterative nature of the design process. Students should be encouraged to engage in multiple rounds of design revisions to gain a deeper understanding of the adaptability and context-dependent nature of Nature-based Solutions.

Cultivating critical thinking as a key component for enhancing students' professional judgment At Zhongyuan University of Technology, the *Landscape Design* and *Environmental Protection* course fosters critical thinking by integrating three key elements: theoretical instruction, case analysis, and thematic seminars. This approach guides students to deeply examine both classic and failed design cases, question the underlying assumptions of designs, and evaluate their ecological and social benefits, so as to cultivate their critical thinking ability. Particularly in the case analysis segment, by comparing the application of Nature-based Solutions across different cultural backgrounds and scales, students are helped to understand the requirements of locality and adaptability in design.

Interdisciplinary collaborative teaching as an inevitable choice to address the complexity of nature-based solutions In the graduate course *Landscape Design* and *Environmental Protection* at

Zhongyuan University of Technology, the teaching reform integrates faculty from multiple disciplines such as ecology, geography, sociology, and computer science to jointly form the teaching team. For example, when discussing urban flood management issues, hydrology experts can be invited to explain hydrological processes, ecologists to analyze habitat impacts, and sociologists to introduce community engagement methods, thereby helping students develop a multidimensional perspective. This teaching model not only breaks down disciplinary barriers, but also simulates the real-world working approach of multi-professional collaboration.

Integration of cutting-edge technologies as a key direction for teaching method innovation With the advancement of digital technologies, tools such as Geographic Information Systems (GIS), environmental sensing and monitoring, and ecological process simulation provide robust support for the design and evaluation of Nature-based Solutions. In the teaching process, students should be guided to master the application of these technological tools to enhance the scientific rigor and precision of their designs[4].

Reform and innovation of the evaluation system

The traditional practice of relying primarily on final drawings and presentations as evaluation criteria is inadequate for meeting the teaching demands oriented toward Nature-based Solutions. The reformed evaluation system should place greater emphasis on process assessment, diverse competency evaluation, and multi-stakeholder participation.

Process assessment requires instructors to focus on students' performance throughout the entire design process, rather than merely on the final outcome. It includes evaluating the accuracy of problem definition, the comprehensiveness of data collection, the logical reasoning in concept generation, and the depth of solution iteration, among other aspects. Methods such as design journals, staged presentations, and peer reviews can be used to document students' cognitive development throughout the design process. This enables a more objective evaluation of their learning attitude and professional growth. Particularly for complex issues such as Nature-based Solutions, the systematic and scientific nature of the design process often holds greater importance than the final formal presentation.

Diverse competency evaluation means that assessment criteria should extend beyond traditional aesthetic and functional dimensions to incorporate multiple indicators such as ecological performance, social adaptability, and economic feasibility. Drawing on the multi-faceted evaluation mechanisms of the CDIO teaching model, attention should be paid not only to students' learning outcomes, but also to their learning processes, innovation ability, teamwork ability, and other aspects. For example, when evaluating a Nature-based Solutions design, in addition to considering spatial layout and formal language, factors such as its potential in enhancing ecosystem services, community acceptance, and life-cycle costs should also be assessed. This approach guides students in developing a comprehensive design value system.

Multi-stakeholder participation in evaluation serves as an effective approach to enhancing the objectivity and practicality of assessments. In addition to instructor evaluations, perspectives from industry experts, community representatives and peer reviews should be incorporated[5].

Teaching Implementation Challenges and Reflections

In the process of advancing curriculum reform oriented towards Nature-based Solutions, universities face several common challenges that require in-depth reflection and the exploration of coping strategies.

The contradiction between disciplinary barriers and a homogeneous faculty structure represents the primary obstacle

The inherent nature of Nature-based Solutions requires interdisciplinary knowledge integration. However, current university faculty predominantly come from single-disciplinary backgrounds, lacking experience in interdisciplinary teaching and research. Furthermore, the internal organizational structure and management systems within universities often hinder the development and implementation of interdisciplinary courses. To address this issue, interdisciplinary teaching teams can be formed by integrating faculty resources from relevant disciplines to collaboratively develop comprehensive courses. Additionally, actively involving industry experts as supplementary instructors can effectively compensate for the lack of practical experience among academic faculty.

The challenge of balancing theory and practice is equally significant

Nature-based Solutions emphasize science-based design, yet an overemphasis on ecological theory may lead to an excessive scientification of design courses, potentially weakening their artistic and creative dimensions. Conversely, an excessive focus on formal creation may deviate from ecological principles, falling into the pitfall of "ecological formalism". In the curriculum reform, careful consideration must be given to balancing theory and practice, as well as science and art. On one hand, a spiral instructional design of "theory-case-practice" can be employed to foster interaction between abstract theory and concrete practice. On the other hand, the case study methodology can be adopted to guide students in analyzing the ecological mechanisms and design strategies underlying successful projects, thereby cultivating their ability to connect science with design.

Insufficient teaching resources and conditional support also constitute a widespread issue

Teaching oriented towards Nature-based Solutions often requires more site monitoring equipment, analytical software, and experimental facilities, placing higher demands on institutional resources. Meanwhile, highly interactive teaching models also necessitate corresponding faculty and spatial support. To address these limitations, universities can leverage information technology tools such as virtual simulations and online platforms to compensate for the lack of physical resources. They can also enhance resource utilization efficiency through inter-school collaboration and resource sharing. Furthermore, actively seeking support from national and provincial-level teaching reform projects can not only secure essential resource investment, but also help elevate the recognition and impact of the curriculum reform.

The effectiveness evaluation of curriculum reform requires in-depth reflection

Current assessments of the effectiveness of teaching reforms in universities often remain limited to short-term indicators such as course satisfaction and student project presentations. There is a lack of longitudinal studies tracking the long-term impact on graduates' career development and design practices. In the future, it is necessary to establish more scientific and long-term evaluation mechanisms. Through methods such as alumni interviews, employer feedback, and case studies, a comprehensive assessment of the actual impact of curriculum reform on students' professional competencies and industry development should be conducted. This will provide a basis for the continuous optimization of the reform.

Conclusions and Prospects

The Nature-based Solutions-oriented reform of landscape design courses for postgraduate represents an active response to current ecological and environmental challenges as well as industry talent demands. Through systematic reform measures including restructuring the curriculum system, innovating teaching methods, and refining evaluation mechanisms, the effective cultivation of advanced landscape design professionals capable of meeting future challenges can be achieved. The curriculum reform framework proposed in this paper emphasizes the deep integration of ecological knowledge and design practice, the balanced development of scientific thinking and artistic expression, and the equal importance of system analysis and innovative problem-solving ability. It offers a new direction for the development of graduate education in landscape design.

Reflecting on the reform practice of the course *Landscape Design* and *Environmental Protection* at Zhongyuan University of Technology, some successful experiences are gradually taking shape. For example, the "experts in the classroom" model has effectively bridged academia and industry, and the introduction of the CDIO educational philosophy has provided a framework for cultivating project management skills throughout the entire process. These diverse explorations collectively enrich the content of graduate education in landscape design and offer varied reference options for universities with different foundations and characteristics.

Looking ahead, Nature-based Solutions-oriented landscape design education still needs continuous deepening in several aspects. It is essential to further strengthen interaction with the forefront of scientific research, promptly integrating new discoveries from fields such as ecology and geography into teaching content. Active exploration is needed for the application methods of digital technologies throughout the entire process of Nature-based Solutions design to enhance the precision and adaptability of designs. Attention must be paid to issues of design justice and inclusivity, ensuring that Nature-based Solutions benefit all social groups, particularly vulnerable communities and environmental justice areas.

The fundamental goal of landscape design education is to cultivate professional forces capable of leading industry transformation and promoting sustainable development. Through curriculum reform based on Nature-based Solutions, a new generation of landscape designers is being nurtured. They not only has solid design skills and ecological knowledge, but also possess system thinking, interdisciplinary collaboration, and innovative problem-solving abilities. These professionals are poised to play a significant role in the great journey of China's ecological civilization construction.

References

[1] LIU L. The Promoting role of environmental design teaching reform on landscape architecture discipline competition achievements[J]. Modern Horticulture, 2025, 48(20): 193 – 194, 197, 200. (in Chinese).

[2] XING K. The Teaching reform of the course on principles of landscape planning and design based on task-driven approaches[J]. Journal of Qiqihar University (Philosophy & Social Science Edition), 2025(5): 151 – 154, 163. (in Chinese).

[3] LIN SP, WANG P, MA YC. Exploring interdisciplinary "design competition-based" teaching reform in environmental design majors: A case study of landscape design courses[J]. Art Education Research, 2025(1): 136 – 138. (in Chinese).

[4] ZHANG JX, JIANG X, CHEN SF. "Participatory" teaching reform of graduate landscape design courses oriented towards serving rural revitalization[J]. Art Education Research, 2024(24): 136 – 138, 166. (in Chinese).

[5] HUANG DX. Dual integration of "humanistic literacy cultivation + design innovation ability cultivation" in the "landscape design" course[J]. Journal of Hubei University of Education, 2024, 41(9): 94 – 103. (in Chinese).

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(Continued from page 75)

[18] QI SY, LIU SB, TIAN BK, *et al.* The ultrasonic-assisted extraction of rutin from the leaves of *Camellia longituba* Chang[J]. Journal of Hubei Minzu University: Natural Sciences Edition, 2024, 42(4): 559 – 564. (in Chinese).

[19] ZENG SQ. Optimization of extraction process of total flavonoids from *Gynura cusimbua* and its antioxidant activity[J]. Journal of Hubei Minzu University: Natural Sciences Edition, 2023, 41(4): 440 – 447. (in Chinese).

[20] FU XZ, LIN SQ, LUO PX. Optimization of ultrasonic-assisted acid-enzymatic preparation of water chestnut resistant starch by response surface methodology[J]. Journal of Hubei Minzu University: Natural Sciences Edition, 2024, 42(4): 551 – 558. (in Chinese).

[21] XU LL, YAN MM, LIU YY, *et al.* Research of loganin alleviates retinopathy in diabetic retinopathy rats[J]. The Chinese Journal of Clinical Pharmacology, 2025, 41(3): 366 – 371. (in Chinese).

[22] ZHANG Y. Study on preparation technology of high purity morroniside and loganin from *Cornus officinalis* L.[D]. Zunyi: Zunyi Medical University, 2023. (in Chinese).

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