

Exploring Blended Teaching Reform in Plant Landscape Planning and Design Courses in the Context of Digital Intelligence

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Abstract: Digital intelligence education transformation imposes new requirements on plant landscape teaching. Traditional teaching has obvious limitations in plant cognition, scheme design and assessment. This study adopts VR virtual simulation and intelligent plant databases to build a three-stage blended teaching system including online intelligent autonomous learning, offline on-site project training, and virtual-real iterative evaluation. A full-process multidimensional quantitative assessment mechanism is established to evaluate student competencies objectively. Three-year teaching practice shows that the experimental class achieves 43.8% higher plant identification accuracy and 94.7% design drawing compliance than the control class. The model effectively breaks spatiotemporal constraints in traditional teaching and improves students' plant recognition, ecological design thinking and digital design abilities.

Keywords: digital intelligence; plant landscape planning and design; blended teaching; virtual simulation

1. Problems in Traditional Plant Landscape Planning and Design Teaching

Based on three-year teaching data, questionnaires and student works of environmental design majors, traditional teaching presents three key problems that restrict professional competency cultivation.

1.1 Spatiotemporal Barriers in Plant Cognition

The course is offered in autumn, making it impossible for students to observe spring flowering plants, winter ornamental branches and bark-featured trees. Outdoor practical training is often suspended in extreme weather. Students can only learn through textbook images and verbal explanations, resulting in poor understanding of seasonal plant variation and community succession. Traditional teaching resources update slowly and lack dynamic videos and 3D models. Test data show that the average plant identification accuracy of students is only 62%, while the error rate of seasonally distinctive plants reaches 45%.

1.2 Insufficient Dynamic Simulation in Scheme Planning

Traditional teaching mainly relies on 2D CAD plans and hand-drawn renderings for plant layout. Two-dimensional drawings fail to reflect canopy density, light conditions and long-term spatial changes of plant growth. Without dynamic simulation tools, student designs often suffer from unreasonable arbor-shrub collocation, mismatched sun-shade plant arrangement and inadequate seasonal landscape planning. Frequent design revisions reduce student confidence and fail to cultivate ecological spatial planning capabilities.

1.3 Monolithic Result-Oriented Assessment

Traditional assessment consists of theoretical tests and final design drawings, ignoring pre-class preparation, field investigation, group collaboration and scheme iteration. Some students obtain high scores by rote memorization or case copying. The result-oriented evaluation lacks objectivity and cannot support progressive learning or digital talent cultivation.

2. Construction and Implementation of the Blended Teaching Model

2.1 Overall Model Framework

To solve traditional teaching defects, this study constructs a “three-stage, six-link” digital intelligence blended teaching model. Supported by the SPOC platform, VR laboratory and self-built plant digital database, the model integrates online preview, offline field training and virtual-real evaluation. Real PBL projects including campus green space and community pocket park renovation are applied to achieve OBE-based competency training[1].

Pre-class autonomous learning accounts for 20% of total class hours, focusing on knowledge consolidation and project preparation. In-class virtual-real training accounts for 60%, improving practical and digital design abilities through field teaching and VR simulation. Post-class iteration and extended learning account for 20%, optimizing design outcomes and

connecting students with industry practice.

2.2 Digital Intelligence Teaching Resource Database Construction

A course-specific digital resource library compatible with mobile and desktop devices is built on the Chaoxing SPOC platform, following systematic, visualized and iterable principles[2]. The plant cognition module covers over 300 common native landscape plants with HD images, seasonal growth videos, 3D models, ecological parameters and application guidelines. It supports intelligent image identification and automatic error sorting for targeted learning.

The micro-lecture module includes 12 thematic units covering plant collocation, seasonal landscape design, ecological restoration and rural green space planning. The digital tool module provides complete tutorials for SketchUp modeling, Lumion rendering and Ladybug ecological simulation to improve students' digital operation skills[3]. The case library collects excellent student and industry projects to support online discussion and collaborative learning[4].

2.3 Three-Stage Teaching Implementation Path

2.3.1 Pre-Class Online Autonomous Learning

Diagnostic tests are used to assign differentiated learning resources to students at different levels. The system generates error logs to identify common learning difficulties for targeted offline teaching. Students form four-person groups to complete literature review and preliminary plant selection based on released digital twin site data, laying a foundation for in-class project training.

2.3.2 In-Class Virtual-Real Integrated Training

Offline teaching combines outdoor field investigation and indoor virtual simulation. In field courses, students collect plant data, complete site sketching and upload materials for teacher guidance. In bad weather, VR simulation replaces outdoor training. Students import site models to arrange plant communities, simulate long-term growth changes, and calculate solar radiation and runoff via the Ladybug plug-in[5]. AIGC tools generate alternative schemes for comparative optimization. Real-time self, peer and teacher evaluation ensures traceable learning progress.

2.3.3 Post-Class Online Iteration and Extended Learning

Students submit multiple revised design versions online with personalized teacher guidance. Extended practices include AI-assisted scheme generation and modular landscape design. Industry cases and enterprise lectures are regularly updated to narrow the gap between classroom learning and professional practice.

2.4 Multidimensional Digital Teaching Assessment System

A dual assessment system combining 50% process evaluation and 50% outcome evaluation is established based on SPOC learning data[6]. Process evaluation includes micro-lecture completion, plant test accuracy, online discussion, pre-class investigation quality and scheme iteration performance. Outcome evaluation covers field performance, virtual simulation results, group presentation and final design drawings, scored comprehensively by teachers, enterprise mentors and peers.

3. Teaching Practice Outcomes and Reflections

3.1 Teaching Practice Outcomes

This model was applied to 2023–2025 environmental design majors, with 86 students in both the experimental blended teaching class and the traditional control class. Teaching effects are verified through tests, questionnaires and design works.

First, student professional competencies are significantly improved. The experimental class achieves an average plant identification score of 89.3, compared with 62.1 in the control class, representing a 43.8% accuracy improvement. The identification accuracy of seasonally variable plants increases from 47% to 92%, and design drawing compliance reaches 94.7%. Multiple student designs are adopted for campus greening renovation. Most students report improved understanding of plant spatial changes and reduced design revision frequency.

Second, student learning initiative is greatly enhanced. Over 90% of students recognize the value of online preview and AIGC-assisted design. Weekly autonomous learning duration and classroom interaction of the experimental class increase significantly, with higher platform login frequency compared with the control group.

Third, teaching resources achieve sustainable accumulation. Three years of practice forms a complete and updatable resource library covering hundreds of plant resources, micro-lectures and site digital twin models. Teachers' lesson preparation workload is reduced by 40%, and resources are shared across multiple related courses to form a preliminary digital teaching ecosystem.

3.2 Existing Implementation Challenges

First, students show uneven adaptability to digital tools. Foundation-weak students require repeated guidance on VR and simulation operations, increasing teachers' tutoring burden. Second, digital resource updating requires continuous time and labor investment, while high-quality industry cases are limited. Third, unreasonable class hour allocation may overemphasize virtual simulation and weaken students' field observation ability.

3.3 Optimization Strategies

Introductory micro-lectures and layered tasks are added to lower technical thresholds, and a peer tutoring mechanism is established for ability balancing. University-enterprise cooperation is introduced to enrich updated industry cases and technical resources. Standard class hour ratios are formulated to balance field investigation, virtual simulation and theoretical teaching, with supervision mechanisms to ensure stable implementation.

4. Conclusion

This study constructs a three-stage blended teaching system integrating online autonomous learning, offline project training and virtual-real iterative evaluation for plant landscape courses. Supported by SPOC and VR technology, the model breaks traditional spatiotemporal limitations, compensates dynamic simulation deficiencies, and realizes scientific multidimensional competency assessment.

Teaching practice verifies that the model effectively improves students' plant identification and digital design abilities, optimizes teaching efficiency and reduces teacher workload. Digital intelligence teaching reform represents systematic educational innovation rather than simple technical superposition. Future research will further integrate AI automatic evaluation and immersive VR/AR teaching, and promote inter-university resource sharing to support the digital transformation of landscape design education.

References

- [1] Bao Z Y, Shen Y M. Exploring the construction path of first-class plant landscape courses with virtual-real symbiosis[J]. *Chinese Landscape Architecture*, 2026, 42(2): 112-117.
- [2] Li J, Kang X K. Application of BOPPPS+SPOC blended teaching in the landscape direction of environmental design[J]. *Art Education Research*, 2025(18): 134-136.
- [3] Xia Y. Reform of digital teaching system for environmental design based on OBE concept[J]. *Shaanxi Education (Higher Education)*, 2026(4): 67-69.
- [4] Chen T. Application of PBL teaching method in blended teaching[J]. *Education and Teaching Forum*, 2023(28): 163-167.
- [5] Gao H X, Wang J. Teaching reform integrated with virtual simulation technology[J]. *Journal of Anhui Agricultural Sciences*, 2024, 52(20): 265-269.
- [6] Huang Y, Liu S Y. Application value of VR virtual simulation in landscape design teaching[J]. *Computer Simulation*, 2023, 40(7): 412-416.