Construction and Practice of the "1+X" Digital Integration Model in the Teaching of Territorial Spatial Planning

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Abstract

To meet the compound demands for talents in the urban and rural planning major arising from the digital transformation of territorial spatial planning, and to address the issues in traditional teaching such as "disconnection between theory and technology, fragmented interdisciplinary content, and lack of practical scenarios", this study, based on the urban and rural planning major, carries out the "1+X" digital integration teaching reform for the course General Territorial Spatial Planning, realizing the all-round integration of digital technology and the core content of planning. The reform is promoted through the reconstruction of curriculum content, industry-education integration, and practical empowerment. Eventually, it achieves transformations in the curriculum system, students' abilities, and teaching models, winning 1 Second Prize in the "Challenge Cup" of Yunnan Province, 2 provincial-level innovative training projects (including 1 key project), and publishing 1 paper on teaching reform. This study verifies the feasibility of the "1+X" digital integration model and provides a reference for the cultivation of digital talents in the urban and rural planning major of similar colleges and universities.

Keywords

Territorial Spatial Planning, "1+X" Digital Integration Model, Interdisciplinary Curriculum System, Teaching Reform.

1. Introduction

With the full advancement of the Reform Plan for the Territorial Spatial Planning System, "digital empowerment for territorial spatial governance" has become the core orientation of the industry. [1] From the accurate delineation of the "Three Zones and Three Lines" to the data modeling of "Dual Evaluation", and from smart planning to the application of digital twin scenarios, all these put forward rigid demands on the core capabilities of territorial spatial planning and interdisciplinary digital technology literacy for talents in the urban and rural planning major.

However, there are significant shortcomings in the traditional teaching of the urban and rural planning major: First, the curriculum system focuses on the theoretical teaching of General Territorial Spatial Planning, lacking the systematic integration of digital technologies such as GIS, remote sensing, and big data analysis, resulting in the "disconnection between theory and technology"; [2] Second, the teaching model is dominated by classroom lectures, failing to connect with the digital practical scenarios of the industry, making it difficult for students to master full-chain planning skills; Third, interdisciplinary content is fragmented, failing to form a collaborative system supporting digital territorial spatial planning, leading to a mismatch between talent cultivation and industry needs.

To resolve the above contradictions, this study, relying on the teaching reform project of the urban and rural planning major in the university, launches the "1+X" digital integration construction reform for General Territorial Spatial Planning. [3-5] Among them, "1" anchors the

core course of General Territorial Spatial Planning and strengthens its disciplinary foundation of "policy connection and spatial coordination"; "X" constructs an interdisciplinary digital course cluster covering geographic information, management information, planning information, and other fields, realizing the in-depth integration of core theories, technical tools, and practical applications.

2. Construction of the "1+X" Digital Integration Model

2.1. Positioning of the "1" Core Course

In the education of the urban and rural planning major, General Territorial Spatial Planning is a core course that undertakes the important task of cultivating students' basic theories and practical abilities. This course is positioned as the "1" core course and serves as the core pillar of the entire teaching system. As a core hub course in the urban and rural planning major, General Territorial Spatial Planning undertakes three strategic orientations:

2.1.1. Disciplinary Foundation Orientation

It closely follows the technical main line of "Dual Evaluation - Three Zones and Three Lines - Spatial Layout", systematically cultivates students' abilities in territorial spatial resource identification, carrying capacity assessment, and spatial structure optimization, and lays the foundation for the core literacy of planners.

2.1.2. Technology Integration Orientation

It integrates digital tools such as GIS spatial analysis, remote sensing monitoring, and CIM modeling to reconstruct the traditional planning process. For example, in the module of "suitability evaluation of territorial development", students are required to use GIS multi-factor overlay technology to complete the diagnosis of ecological-agricultural-urban spatial conflicts, promoting the transformation of planning from experience-based judgment to data-driven decision-making.

2.1.3. Policy Connection Orientation

Combined with the new "Five Levels and Three Types" system of territorial spatial planning, it strengthens the teaching of policy tools such as the control of "Three Zones and Three Lines" and land use control, enabling students to master the collaborative logic between spatial planning, land management, and ecological protection.

2.2. Integration Path of "X" Interdisciplinary Courses: All-Round Integration of Curriculum Content

Based on the informatization reform of general territorial spatial planning and focusing on the digital capability requirements of urban and rural planners, the project constructs a three-tier "X" course support system and carries out the informatization teaching reform of 1 (General Territorial Spatial Planning) + X (interdisciplinary multiple courses):

Table 1. Teaching Framework of 1 (General Territorial Spatial Planning) + X (Interdisciplinary Multiple Courses)

Core Course (1)	Type of Interdisciplinary Courses (X)	Interdisciplinary Courses
General Territorial Spatial Planning	Management Information Courses	Urban Systems Engineering
		Operations Research
		Management Information Systems
	Geographic Information Courses	Remote Sensing Image Interpretation
		Oblique Photogrammetry Technology
		Application of Geographic Information Systems
		Aerial Photogrammetry
	Interdisciplinary Application Courses of Urban and Rural Planning Information	Technology and Application of "Dual Evaluation"
		Comprehensive Urban and Rural Social Survey (Big Data)
		Introduction to Urban Information Modeling and Smart Cities

3. Practice and Effects of Teaching Reform

3.1. Practice of Curriculum Content Reconstruction

Figure 1. Industry Collaboration (Yunnan Land and Resources Vocational College, Yunnan University Diandun College)

In accordance with the requirements of the teaching reform plan, detailed reform plans were formulated through discussions with domestic and foreign institutions engaged in territorial spatial digitalization, informatization, and intellectualization, well-known enterprises and public institutions in territorial spatial informatization, and relevant universities in the industry, such as Kunming Planning and Information Center, Information Center of Yunnan Institute of Geology, Mineral Resources and Surveying, and School of Territorial Spatial Information of Yunnan Land and Resources Vocational College.

3.2. Practice of Integrating and Consolidating Interdisciplinary Content

Courses such as Urban Systems Engineering, Operations Research, Management Information Systems and Digital Urban Management, Remote Sensing Image Interpretation, Oblique Photogrammetry Technology, and Introduction to Urban Information Modeling and Smart Cities (focusing on digital transformation and smart urban-rural planning) have been offered.

3.2.1. Teaching Reform Method: Integrating Courses in the Planning Data Acquisition and Processing Stage

Courses were integrated through a dual-path approach of introduction and optimization. Among them, the courses Remote Sensing Image Interpretation and Oblique Photogrammetry were introduced, which rely on remote sensing technology and high-resolution oblique photogrammetry technology respectively to obtain current data of urban and rural areas and

detailed data such as buildings and terrain; the Comprehensive Urban and Rural Social Survey Course was optimized, with the addition of internet data mining methods to obtain diversified data such as semantic data from social platforms and traffic data, providing comprehensive data support for planning.

Table 2. Integration of Courses in the Planning Data Acquisition and Processing Stage

Type of Course Offering	Course Name	Content Integrated into the Teaching Reform of General Territorial Spatial Planning
Introduction	Remote Sensing Image Interpretation	Acquisition and interpretation of remote sensing image data for obtaining current data of urban and rural areas.
	Oblique Photogrammetry	Acquisition of high-resolution urban data (including buildings, terrain, etc.) using oblique photogrammetry technology.
Optimization	Comprehensive Urban and Rural Social Survey Course	Acquisition of rich data resources (including semantic data from social platforms, traffic data, etc.) through internet data mining and analysis.

3.2.2. Teaching Reform Method: Integrating Courses in the Planning Data Management and Analysis Stage

With the goal of "processing data efficiently and supporting planning logic", a data processing system was built through course integration. The Management Information Systems course was introduced to teach methods for integrating, managing, and analyzing urban data using digital tools; the Application of Geographic Information Systems course was optimized to strengthen the application of GIS technology in data management and spatial analysis, facilitating the scientificity of data processing and analysis in territorial spatial planning.

Table 3. Integration of Courses in the Planning Data Management and Analysis Stage

Type of Course Offering	Course Name	Content Integrated into the Teaching Reform of General Territorial Spatial Planning
Introduction	Management Information Systems	Teaching how to use management information systems and digital urban management tools to integrate, manage, and analyze urban data, providing support for planning decisions.
Optimization	Application of Geographic Information Systems	Application technologies of Geographic Information Systems (GIS), including data management and spatial analysis, to support the data processing and analysis work of general territorial spatial planning.

3.2.3. Teaching Reform Method: Integrating Courses in the Planning Decision-Making and Implementation Stage

Focusing on "empowering planning implementation with technology", connection was achieved through the introduction of 3 courses. The Application of "Dual Evaluation" course teaches data integration and analysis methods to provide a basis for planning decisions; the Urban Systems Engineering course analyzes the correlation of urban systems and the coordination logic of infrastructure to assist in decision-making; the Introduction to Smart Cities course teaches urban information modeling and smart technologies to support the formulation and implementation of planning decisions.

Table 4. Integration of Courses in the Planning Decision-Making and Implementation Stage

Type of Course Offering	Course Name	Content Integrated into the Teaching Reform of General Territorial Spatial Planning
Introduction	Application of "Dual Evaluation"	Teaching how to use management information systems and digital urban management tools to integrate, manage, and analyze urban data, providing support for planning decisions.
	Urban Systems Engineering	Introducing the composition and interaction of urban systems, helping students understand the coordinated development of urban planning and urban infrastructure, and providing support for the planning decisions of general territorial spatial planning.
	Introduction to Smart Cities	Teaching urban information modeling and smart city content, and discussing how to apply smart city technologies and urban information modeling to support the decision-making and implementation process of general territorial spatial planning.

3.3. Guiding Competitions, Reports, and Papers, Winning Provincial Awards, and Publishing Teaching Reform Papers

Practical achievements were participated in corresponding competitions or used to write practical project reports and research papers, demonstrating students' achievements and research findings in practical projects. Students were guided to formulate competition plans, provided with professional knowledge guidance, helped students solve problems and optimize design schemes, and offered necessary resource support. A teaching reform paper was published to summarize the practical experience and achievements of the project, emphasizing the application of digital transformation and smart cities in general territorial spatial planning, and the impact of the teaching reform project on the improvement of students' abilities.

Table 5. Awards Won in Guided Competitions

Time	Name	Award Level	Contribution of the Project Team
June 2025	The 13th "Challenge Cup" Yunnan Provincial College Students' Extracurricular Academic and Technological Festival: Investigation and Research on Ecological Wisdom Empowering Aging-Adaptable Construction in Villages on the Red Earth Plateau	Second Prize of Yunnan Province	First Supervisor

Table 6. Approved Guided Projects

Time	Name	Level	Contribution of the Project Team
September 2025	Tourist Perceived Image and Improvement Path of Internet-Famous Ethnic Villages in Yunnan Based on New Media Data	Yunnan Provincial Innovative Training Project in Key Support Areas	First Supervisor
September 2025	Investigation and Research on Ecological Wisdom Empowering Aging-Adaptable Construction and Spatial Reconstruction Path in Villages on the Red Earth Plateau	Yunnan Provincial Innovative Training Project	First Supervisor

Table 7. Published Papers on Teaching Reform

Time	Name (Title)	Publication Unit (Published Journal/Conference)	Contribution of the Project Team
May 2025	Multi-Source Big Data-Driven Coupling Study of Spatial Quality and Vitality in Historic Districts: A Case Study of Nangiang District, Kunming	7th International Symposium on Economic Development and Management Innovation (EDMI 2025)	Independent Author

4. Summary and Outlook of Teaching Reform Effects

4.1. Summary of Teaching Reform Effects

This "1+X" digital integration construction reform for General Territorial Spatial Planning closely aligns with the informatization reform needs of territorial spatial planning and the talent cultivation goals of the urban and rural planning major. Through the construction and practical implementation of the system of "core course anchoring + interdisciplinary course support", it has achieved multi-dimensional and verifiable reform effects, which can be summarized from the following four aspects:

4.1.1. The Curriculum System Has Realized the Reconstruction from "Singularization" to "Integration", Consolidating the Foundation for Digital Teaching

With the positioning of General Territorial Spatial Planning as the "1" core course, the reform clarifies its three strategic functions of "disciplinary foundation, technology integration, and policy connection". At the same time, it constructs a three-tier "X" interdisciplinary curriculum system covering "management information, geographic information, and interdisciplinary application of urban and rural planning information", realizing the all-round integration of digital technology and the core content of planning.

4.1.2. Students' Abilities Have Realized the Leap from "Theoretical Cognition" to "Practical Innovation", Matching the Development Needs of the Industry

Through the cultivation path of promoting competition guidance and project practice via course integration, the reform has significantly improved students' comprehensive abilities. In terms of digital skills, students can proficiently use tools such as GIS multi-factor overlay, remote sensing interpretation, and oblique photogrammetry to complete practical tasks such as "suitability evaluation of territorial development" and "village spatial reconstruction"; in terms of innovation and practical abilities, the reform achievements have been verified through provincial competitions and projects —— in 2025, students under guidance won the Second Prize in the 13th "Challenge Cup" Yunnan Provincial College Students' Extracurricular Academic and Technological Festival, and 2 Yunnan Provincial Innovative Training Projects (including 1 project in key support areas) were approved.

4.1.3. The Teaching Model Has Realized the Breakthrough from "Classroom-Oriented" to "Industry-Education Integration", Enhancing the Targeted Nature of Teaching

During the reform process, the project team collaborated with enterprises, public institutions, and universities such as Kunming Planning and Information Center, Information Center of Yunnan Institute of Geology, Mineral Resources and Surveying, and Yunnan Land and Resources Vocational College to jointly formulate reform plans, design curriculum content, and participate in teaching through lectures and practical guidance. This provides students with cutting-edge industry perspectives, helps students adapt in advance to the digital and intelligent work requirements of territorial spatial planning, and significantly enhances the industry relevance and job adaptability of teaching.

4.1.4. The Reform Achievements Have Realized "Academic + Practical" Dual Outputs, Verifying the Feasibility of the Model

This reform not only forms an implementable teaching system but also produces rich academic and practical achievements, providing empirical support for the effectiveness of the reform. In terms of academic outputs, teaching reform papers such as Multi-Source Big Data-Driven Coupling Study of Spatial Quality and Vitality in Historic Districts: A Case Study of Nangiang District, Kunming have been published. Overall, the "1+X" digital integration model has passed practical verification and is feasible for promotion in the urban and rural planning major of similar colleges and universities.

4.2. Outlook of Teaching Reform

Although this reform has achieved phased results, combined with the development trend of "intellectualization, precision, and collaboration" in territorial spatial planning (such as new requirements for digital twins, AI-assisted planning, and spatial optimization under the goal of carbon neutrality) and potential issues in the current reform (such as insufficient in-depth integration of interdisciplinary courses and limited coverage of practical scenarios), future efforts need to deepen the reform from the following aspects to further improve teaching quality:

4.2.1. Deepen the Dynamic Adjustment of "X" Courses to Connect with New Industry Technologies

The technology of territorial spatial planning is developing rapidly towards "digital twin", "artificial intelligence", and "real-time big data analysis". In the future, a dynamic adjustment mechanism for "X" courses needs to be established: On the one hand, new technologies and contents such as "digital twin urban planning" should be promptly incorporated into the interdisciplinary curriculum system to avoid the lag between curriculum content and industry practice; On the other hand, the logical coherence between "X" courses should be strengthened. For example, the Application of Geographic Information Systems should be connected with Introduction to Urban Information Modeling and Smart Cities to cultivate students' planning capabilities for multi-technology integration.

4.2.2. Expand the Dimensions of Practical Platforms to Construct "Virtual-Real Integration" Practical Scenarios

Current practical teaching still relies on traditional university-enterprise cooperation bases, with limited scenario coverage. In the future, expansion should be carried out from two aspects: First, strengthen the depth of "physical practice", establish long-term cooperation with provincial territorial spatial planning institutes, smart city construction enterprises, etc., and jointly build a "Territorial Spatial Digital Planning Practice Base" to enable students to participate in the full process of formulating real project plans; Second, build a "virtual simulation" platform, and develop virtual simulation experiment projects for scenarios that are difficult to operate on-site (such as the delineation of "Three Zones and Three Lines" and the protection of ecologically sensitive areas) to improve the safety and comprehensiveness of practical teaching.

4.2.3. Strengthen the "Interdisciplinary Literacy" of Teachers to Break Through the Bottleneck of Teaching Capabilities

The "1+X" model places high demands on teachers' comprehensive literacy in interdisciplinary knowledge. In the future, two measures need to be taken to improve the quality of teachers: First, carry out "interdisciplinary teacher training", organize teachers to participate in special training on advanced GIS applications, remote sensing big data analysis, and smart city planning, and encourage teachers to obtain relevant industry certificates; Second, establish an "interdisciplinary teaching team", consisting of teachers from urban and rural planning,

geographic information, management science, and other majors, to jointly design curriculum content and practical projects, avoiding the impact of individual teachers' "knowledge blind spots" on teaching effects.

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