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Rooted in the Land of Bagui, Integrating Ideological and Political Innovation: A Teaching Reform of the "Principles of Geographic Information Systems" Course Serving Guangxi's "Two Mountains" Practice

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Abstract

To meet the pressing demand of higher education in the new era for cultivating innovative and application-oriented talent, and to address the core problems commonly found in teaching the "Principles of Geographic Information Systems" course—namely, a disconnect from regional development needs, an overemphasis on operation at the expense of thinking, and a single, narrow mode of assessment—this study designs and proposes a teaching reform that deeply integrates curriculum-based ideological and political education with the cultivation of innovative ability. The reform is closely aligned with Guangxi's strategic positioning as a hub of the Belt and Road Initiative, a national demonstration zone for ecological civilization, and a leading province for culture and tourism. Guided by the values of the "Two Mountains" theory (the principle that "lucid waters and lush mountains are invaluable assets"), the study systematically builds a four-in-one teaching model of "ideological-political guidance—content restructuring—system innovation—assessment reform". Specific measures include: developing modular, locally grounded cases under the theme of "GIS + Guangxi's characteristic industries" to embed ideological and political elements into concrete scenarios; designing a three-tier progressive practical teaching system of "basic operation—comprehensive application—innovative decision-making" to systematically train students' ability to solve complex spatial problems; and establishing a diversified assessment mechanism that combines process-based and innovation-outcome evaluation. This paper presents the design of the reform together with a planned two-year pilot and an evaluation framework; it aims to establish a replicable and transferable

paradigm for cultivating Geographic Information Science talent in service of regional development and to offer a reference for the reform of specialized courses at local universities. Empirical results of the pilot will be reported in follow-up work.

Keywords

Geographic Information Systems, Curriculum Ideological and Political Education, The "Two Mountains" Theory, Teaching Reform, Cultivation of Innovative Ability, Localized Teaching, Instructional Design

1. Introduction

In the new era, China's higher education has entered a critical stage of connotative development. The Ministry of Education is vigorously advancing the construction of "New Engineering" and "New Liberal Arts", with the core aim of cultivating high-caliber, interdisciplinary talent who possess strong practical, innovative, and competitive abilities and who can adapt to and lead the development of future industries (Ministry of Education, 2017). At the same time, curriculum ideological and political education, as a strategic measure for implementing the fundamental task of fostering virtue through education, calls for the integration of value shaping, knowledge transmission, and ability cultivation (Ministry of Education, 2020). For application-oriented undergraduate programs that are closely tied to regional economic and social development, how to organically incorporate national strategic needs and local industrial characteristics into specialized course teaching—so as to achieve resonance among knowledge transmission, ability enhancement, and value guidance—has become a core issue that current teaching reform urgently needs to resolve.

Geographic Information Systems (GIS), a comprehensive technical discipline integrating spatial data acquisition, management, analysis, visualization, and decision support, is a core foundational course for related programs such as Geographic Information Science, Surveying and Mapping Engineering, Urban and Rural Planning, and Tourism Management (Yan et al., 2023). Its strong practical orientation, cutting-edge nature, and broad applicability make it irreplaceable in developing students' spatial thinking, technological innovation, and capacity to serve society. However, traditional teaching of the GIS Principles course commonly faces three pain points. First, teaching content mostly relies on general-purpose textbooks and cases that are only loosely connected to the actual development needs of the region in which the institution is located; as a result, students experience a separation of knowing and doing, hold vague learning goals, and lack both the aspiration and the motivation to serve their locality. Second, practical teaching is largely confined to procedural exercises on commercial software (such as ArcGIS), emphasizing tool operation while neglecting training in

the complete chain of spatial thinking—from discovering a geographic problem, to modeling spatial data, to comprehensive analysis and decision-making—which leaves students with insufficient innovative ability to solve complex real-world problems. Third, assessment relies mainly on end-of-term written examinations and lab reports, valuing results over process, which makes it difficult to scientifically evaluate and motivate students' innovative practice and integrated application ability.

The Guangxi Zhuang Autonomous Region—an important gateway that organically connects the Belt and Road, a national demonstration zone for ecological civilization, and a leading province for culture and tourism—has an enormous and urgent demand for geographic information technology talent in fields such as ecological civilization construction, tourism resource development, territorial spatial planning, and rural revitalization (People's Government of the Guangxi Zhuang Autonomous Region, 2021). In particular, the "Two Mountains" theory—that "lucid waters and lush mountains are invaluable assets"—carries profound practical significance in contexts such as protecting Guangxi's fragile karst regions and pursuing the sustainable development of eco-tourism in the Lijiang River basin. Therefore, organically integrating ideological and political elements such as the "Two Mountains" theory into GIS courses at Guangxi's universities—and using them as a value guide to restructure teaching content and models that serve local strategies—is not only necessary but also urgent.

This study is based on the Geographic Information Science program of the School of Tourism Ecology and Environment at Guilin Tourism University. Taking the "Principles of Geographic Information Systems" course as the object of reform, we design an integrated teaching reform of ideological and political education and innovative-ability cultivation in service of Guangxi's "Two Mountains" practice. The reform seeks to explore a new path for teaching reform that takes ideology and politics as its soul, ability as its foundation, and service to Guangxi as its distinctive feature. Through systematic reform design, it aims to resolve the aforementioned teaching challenges and to cultivate high-caliber, application-oriented, innovative talent who are usable, capable, and committed to regional development. It should be noted that this paper focuses on the design of the reform, its implementation plan, and the framework for evaluating its outcomes; empirical evaluation of the planned two-year pilot is ongoing and will be reported separately.

2. The Core Framework of the Teaching Reform

This teaching reform establishes a systematic reform scheme built on the basic framework of "one core objective, two integration threads, three capability tiers, and four supporting measures".

2.1. Core Objective: Cultivating GIS Innovation Talent to Serve Guangxi's Development

The core objective of the reform is to achieve three shifts in talent cultivation:

from mastering general GIS techniques to solving spatial problems specific to Guangxi; from mechanically operating software to training systematic spatial thinking; and from passing course examinations to producing innovative outcomes that serve the locality. The ultimate goal is to cultivate New Engineering talent who are proficient in GIS technology, well versed in Guangxi's regional conditions, and equipped with both an ethos of ecological civilization and the ability for innovative practice.

2.2. Integration Threads: A Deep Coupling of Ideological-Political Education and Professional Education

The reform abandons the practice of treating ideological-political education and the discipline as two separate layers, or of merely attaching labels, and instead strives to achieve a deep coupling of two threads. Ideological and political elements—such as the "Two Mountains" theory, the philosophy of ecological civilization, patriotism, cultural confidence, and serving the nation through science and technology—serve as the logical starting point and value benchmark for selecting and organizing teaching content. Ideology and politics are no longer pursued for their own sake; rather, they become the intrinsic driving force and natural outcome of professional teaching. The restructuring of content around regional needs is closely aligned with Guangxi's major strategies, including the Belt and Road Initiative, the ecological civilization demonstration zone, the culture-and-tourism province, and rural revitalization. Taking "GIS + Guangxi's characteristic industries" as the main thread, teaching cases and practical projects are thoroughly reconstructed so that the course content takes root in the land of Bagui and is imbued with local character and a sense of the times.

2.3. Capability Ladder: A Three-Tier Progression of "Basic-Comprehensive-Innovative"

Following the laws of cognition and ability formation, a three-tier progressive teaching system is designed to systematically and incrementally enhance students' abilities:

Tier 1: Basic Operation. The objective is to master the fundamental operation of GIS software and cartographic conventions. Through verification experiments such as the cartography of Guangxi's basic geographic data, students develop a rigorous and standardized scientific literacy.

Tier 2: Comprehensive Application. The objective is to cultivate the ability to solve regional problems using spatial methods. Through comprehensive projects such as the spatiotemporal analysis of water quality changes in the Lijiang River basin and the analysis of the spatial pattern of Guangxi's county-level economy, students are trained in data integration, model construction, and comprehensive analysis.

Tier 3: Innovative Decision-Making. The objective is to train the ability to model complex problems and support decision-making. Through open-ended,

interdisciplinary innovation projects such as designing a traffic-congestion relief plan for peak tourist seasons in Yangshuo and assessing the potential for the digital preservation and tourism development of Guangxi's traditional villages, students are guided through the full process from problem definition to decision recommendations, stimulating their innovative potential.

2.4. Theoretical Basis: Industry-Education Integration and the OBE Philosophy

Guided by the educational policy of industry-education integration and collaborative talent cultivation, this reform promotes the organic connection of the education chain and the talent chain with Guangxi's industrial chain and innovation chain (General Office of the State Council, 2017). It also implements the Outcome-Based Education (OBE) philosophy: taking the students' ultimate learning outcomes—namely, the innovative ability to solve complex spatial problems in Guangxi—as the point of departure, it reverse-designs the teaching content, teaching methods, and assessment system (Syeed et al., 2022), ensuring that every teaching component supports the attainment of the final goal.

2.5. Defining the Target Learning Outcomes as Observable Indicators

To make the reform's goals assessable rather than merely aspirational, the three core target outcomes are defined in observable, measurable terms as follows.

Innovative ability refers to a student's demonstrated capacity to independently identify a real geographic problem in Guangxi, formulate an appropriate spatial-data and analysis model, and produce a defensible decision recommendation. It is evidenced by the deliverables of Tier-3 innovation projects—analytical reports, decision plans, and visualization-system prototypes—and, at a higher level, by the transformation of these deliverables into academic-competition entries, projects under the College Students' Innovation and Entrepreneurship Training Program, or academic papers.

Systematic spatial thinking refers to a student's ability to carry a problem through the complete chain of "problem discovery → spatial-data modeling → integrated analysis → decision-making", rather than performing isolated software operations. It is evidenced in the process artifacts of Tier-2 and Tier-3 projects, such as documented analysis workflows, model designs, and the reasoning that links spatial results to conclusions.

Service to locality refers to the orientation and usability of a student's work toward Guangxi's actual regional-development needs—ecological security, culture and tourism, and urban-rural integration. It is measured by the proportion of student projects that address a genuine local problem and by any subsequent recognition or adoption of those outputs.

These definitions provide the criteria against which the assessment mechanism in Section 3.4 and the evaluation design in Section 4.3 are constructed, ensuring

that each teaching component can be traced to an observable outcome.

3. Specific Implementation Pathways

Around the framework above, the reform is advanced collaboratively along four dimensions: course content, teaching system, teaching resources, and assessment mechanism.

3.1. Deepening and Scenario-Based Integration of Curriculum Ideological and Political Education

The key to integrating ideological and political education lies in scenario building. We translate abstract ideological-political concepts into vivid teaching scenarios closely related to Guangxi.

3.1.1. Infusing the "Two Mountains" Theory into Ecological Assessment

In the module on the vulnerability assessment of the karst landform in Guilin, students are taught not only GIS methods for ecological sensitivity assessment (such as overlay analysis and weight setting) but are also guided to explore in depth the ecological baseline value of "lucid waters and lush mountains", as well as how scientific assessment can provide a spatial basis for decision-making in the sustainable transformation into "invaluable assets" (such as eco-tourism and characteristic agriculture)—thereby gaining a profound understanding of the dialectical unity of protection and development.

3.1.2. Strengthening Systems Thinking in Watershed Analysis

In the project on the spatial analysis of tourist flows and the assessment of ecological carrying capacity in the Lijiang River basin, the systemic view that mountains, rivers, forests, farmlands, lakes, grasslands, and deserts form a community of life is emphasized. Students are guided to use GIS techniques such as network analysis, buffer analysis, and raster computation to simulate the spatiotemporal impact of tourism activities on the basin's ecological environment, cultivating a holistic perspective and the scientific thinking needed to coordinate protection with development.

3.1.3. Reinforcing National Awareness in Cartography

A special topic on border geographic information cooperation and the standardized representation of sovereignty on maps is established. While teaching knowledge of map projection, symbolization, and cartographic conventions, the topic focuses on national-territory knowledge, emphasizing the paramount importance of using maps in a standardized manner and of safeguarding national sovereignty and territorial integrity—thus elevating professional-standards education into vivid patriotic education.

3.2. Modular Restructuring of Course Content around "GIS + Guangxi Characteristics"

Breaking free from the chapter constraints of textbooks and adopting a project-

oriented approach, four core teaching modules are constructed.

3.2.1. Module One: Basic Spatial Data and Geographic Cognition of Guangxi

Using Guangxi-wide vector and raster data, digital elevation models (DEMs), and remote-sensing imagery as materials, students are trained in basic skills such as data management, symbolization, and thematic cartography, while simultaneously building an understanding of Guangxi's basic geographic patterns, including terrain, hydrology, and administrative divisions.

3.2.2. Module Two: GIS and Guangxi's Ecological Security Assessment

Focusing on typical ecological problems such as karst rocky desertification, the ecology of the Lijiang River basin, and the Beibu Gulf coastal zone, a series of comprehensive experiments is designed to teach spatial analysis methods such as overlay analysis, hydrological analysis, and the computation of ecological-environmental indices.

3.2.3. Module Three: GIS and the Development of Guangxi's Culture and Tourism Industries

In line with Guangxi's goal of building a world-class tourist destination, projects are designed on the spatial distribution of tourism resources, scenic-area accessibility analysis, the spatiotemporal simulation of tourist flows, and decision support for tourism planning.

3.2.4. Module Four: GIS and Guangxi's Integrated Urban-Rural Development

In service of the rural revitalization strategy, innovative projects are designed on the analysis of the spatial pattern of county-level economic development, the assessment of the preservation and development potential of traditional villages, and the spatial optimization of rural infrastructure.

3.3. Innovation of a "Three-Tier Progressive, Online-Offline Blended" Teaching Model

3.3.1. Building a Foundation with Online Resources

A "digital teaching resource library of GIS with Guangxi characteristics" is systematically developed, comprising: 1) a library of localized cases and datasets (thematic data on Guilin's karst, the Lijiang River basin, and more); 2) micro-lectures on key operations and algorithmic principles (such as GIS hydrological analysis and spatial interpolation); and 3) a package of cutting-edge and ideological-political digital resources (relevant policies, papers, and engineering reports). Students can study independently online, freeing up class time for higher-order teaching.

3.3.2. Advancing in the Offline Classroom

The offline classroom focuses on discussion, collaboration, and innovation. Tier-1 experiments are teacher-led, combining instruction with practice; Tier-2 exper-

iments are task-driven and completed through group collaboration; and Tier-3 experiments place students entirely at the center, engaging them in project-based learning (PBL) grounded in real problems, with the teacher's role shifting to that of mentor and evaluator.

3.3.3. Interdisciplinary Project Collaboration

Students in Geographic Information Science are encouraged to form teams with those in Landscape Architecture and Tourism Management to jointly complete interdisciplinary innovation projects such as the spatial planning of a culture-and-tourism complex and the design of eco-tourism routes, simulating real work scenarios and cultivating teamwork and cross-disciplinary innovation.

3.4. Reform of a Diversified "Process-Based + Innovation-Outcome" Assessment Mechanism

An ability-oriented, diversified assessment system is established to break the situation in which a single examination determines everything.

3.4.1. Process-Based Assessment (50%)

This includes classroom-discussion performance, lab journals and reports, mid-project presentations, and peer evaluation within groups. The emphasis is on students' learning engagement, thinking processes, iteration of solutions, and contributions to the team.

3.4.2. Innovation-Outcome Assessment (30%)

The final outcomes of the three-tier innovation projects (such as analytical reports, decision plans, and visualization-system prototypes) serve as the main basis for evaluation. Students are encouraged to transform project outcomes into entries for academic competitions, projects under the College Students' Innovation and Entrepreneurship Training Program, or academic papers.

3.4.3. Comprehensive Knowledge Assessment (20%)

Through an end-of-term written examination or a course paper, students' mastery of core concepts, principles, and methods is assessed. Using this assessment as a guiding baton, the reform steers students' learning focus away from memorization and reproduction toward application and creation, continuously stimulating their intrinsic drive for innovation.

3.5. Alignment of Teaching Modules with Learning Outcomes and Ideological-Political Objectives

To make explicit how each teaching component contributes to both the professional and the value-oriented goals of the course, Table 1 maps the four teaching modules and their representative projects to the capability tiers, the target learning outcomes defined in Section 2.5, and the corresponding ideological-political objectives.

Table 1. Mapping of teaching modules to capability tiers, target learning outcomes, and ideological-political objectives.

Module/representative project	Capability tier	Target learning outcome	Ideological-political objective
M1—Basic spatial data and geographic cognition of Guangxi (cartography of Guangxi base data)	Tier 1: Basic operation	Standardized GIS operation and cartographic literacy; foundational spatial-data management	Scientific rigor and standardization; awareness of national territory and sovereignty in mapping
M2—GIS and Guangxi's ecological security (karst vulnerability; Lijiang River basin; Beibu Gulf coastal zone)	Tier 2: Comprehensive application	Systematic spatial thinking through full-chain analysis of regional ecological problems	The "Two Mountains" theory; ecological-civilization ethos; the dialectic of protection and development
M3—GIS and Guangxi's culture and tourism (resource distribution; accessibility; tourist-flow simulation; planning support)	Tiers 2-3: Application to innovation	Comprehensive application and innovative decision support for tourism problems	Cultural confidence; service to the local culture-and-tourism strategy
M4—GIS and Guangxi's urban-rural integration (county-economy patterns; traditional-village preservation; rural infrastructure)	Tier 3: Innovative decision-making	Innovative ability: modeling complex problems and producing decision recommendations	Service to locality; the rural-revitalization mission; patriotism through scientific service

4. Anticipated Outcomes, Implementation Plan, and Evaluation Design

Through systematic teaching reform, this study is expected to achieve significant results in the following respects. Because these results are anticipated rather than yet measured, Section 4.3 specifies how the reform is to be implemented and how its effects will be evaluated.

4.1. Teaching Problems Expected to Be Resolved

By restructuring content around "GIS + Guangxi characteristics", course teaching responds directly to regional development needs and is expected to inspire in students a sense of mission and enthusiasm for application, substantially bridging the gap between the course and industry. The three-tier progressive teaching system is designed to overcome the drawback of practical teaching that values tools over thinking; through a complete project chain, it systematically trains students' innovative ability to solve complex spatial problems. By scientifically establishing a benchmark for evaluating innovative literacy, the diversified assessment mechanism is intended to measure students' knowledge application, teamwork, and innovative practice more comprehensively, exerting a positive guiding and motivating effect.

4.2. Reform Achievements Expected to Be Formed

A set of high-quality, distinctive teaching resources—including a series of localized teaching cases, thematic spatial databases, and micro-lecture videos—will be produced, offering a Guangxi model that similar institutions within the region and across the country can draw upon. A GIS course teaching reform model of "value guidance—localized content—tiered capabilities—diversified assessment" will be formed, providing a paradigm reference for the reform of engineering specialty courses at local application-oriented undergraduate universities. Students will be guided to produce a body of innovative project reports or competition entries that address Guangxi's real problems, directly serving the locality and enhancing the social influence of the program.

4.3. Planned Implementation and Evaluation Design

Because the outcomes described above are anticipated rather than yet measured, this subsection specifies how the reform is to be implemented and how its effects will be evaluated, so that the anticipated results can be tested against evidence in subsequent work.

The reform is designed to be piloted in the "Principles of Geographic Information Systems" course of the Geographic Information Science program over two academic years, delivered through the blended, three-tier model described in Section 3.3. Instruction shifts progressively from teacher-led verification experiments (Tier 1) to task-driven group projects (Tier 2) and student-centered, problem-based innovation projects (Tier 3), with the instructor acting as facilitator and evaluator in the higher tiers.

The pilot involved a cohort of first-year undergraduate students majoring in Geographic Information Science. One class section was offered, with an enrollment of 46 students. The pilot was conducted during the 2026 spring semester, spanning Weeks 1 - 16, with three sessions per week. The evaluation is designed around the observable indicators defined in Section 2.5 and combines the following instruments:

1) Outcome-attainment rubrics that score the Tier-1, Tier-2, and Tier-3 deliverables against the defined indicators of operational literacy, systematic spatial thinking, and innovative ability;

2) A pre- and post-course comparison in which students complete a comparable complex-spatial-problem task at the beginning and end of the course, allowing change in problem-solving performance to be quantified;

3) Student questionnaires measuring learning engagement, self-assessed ability gains, and the resonance of the ideological-political elements;

4) Tracking of higher-order outputs—academic-competition entries, Innovation and Entrepreneurship Training Program projects, and papers—as indicators of innovative ability; and

5) Longer-term follow-up of graduates' participation in Guangxi's regional-development work as an indicator of service to locality.

Where sample sizes permit, changes in the performance measures will be examined using appropriate descriptive and inferential statistics, and the full quantitative results of the pilot will be reported in a follow-up study.

5. Conclusion

Serving the regional development strategy is the foundation on which local application-oriented undergraduate universities stand, and cultivating professional talent who possess both patriotic feeling and innovative ability is the mission of higher education in this era. Taking the "Principles of Geographic Information Systems" course as a concrete vehicle, this study explores a teaching reform path that deeply integrates ideological and political elements such as the "Two Mountains" theory into professional teaching, centers on the cultivation of innovative ability, and fully aligns with local industrial needs. Through systematic and integrated design, the reform strives to achieve synergistic gains in value shaping, knowledge transmission, and ability cultivation. The design and exploration in this study aim not only to improve the teaching quality of a single course but also to offer a "Guangxi solution" of reference value for how Geographic Information Science and related programs can better fulfill their responsibilities of serving society and cultivating talent in the context of the new era. Future work will implement the reform, carry out the evaluation described in Section 4.3, and—through long-term tracking of students' learning outcomes—continually optimize the reform scheme, ultimately aiming for a substantive improvement in the quality of talent cultivation.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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