

Instructional Design for Junior High School Local Geography with Deep Integration of AI and the 4F Teaching Model: A Classroom Practice Based on Environment and Development

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Abstract: Local geography teaching serves as an important pathway for developing core geographic competencies and an effective vehicle for cultivating students' affection for their hometown and country. The *Compulsory Education Geography Curriculum Standards (2022 Edition)* explicitly emphasize the strengthening of local geography teaching and guide students to attend to the human–environment relationship and sustainable development of their hometowns. Drawing on the 4F teaching model (Fact, Feel, Find, Future) and integrating AI technologies, this study takes “Environment and Development” from the Grade 8, Volume 2 textbook published by Hunan Education Press as its theme, selects the value divergence between rapid tourism development and ecological environmental protection in Shibanyan Town, Linzhou City, Henan Province as a classroom case, and designs a local geography teaching process with deep AI integration. This paper proposes an actionable teaching model aimed at promoting the digitalized, experiential, and in-depth development of local geography teaching and facilitating the implementation of the concept of human–environment harmony and students' affection for their hometown and country.

Keywords: Local geography; Practical activities; Ecological protection; 4F teaching model; AI technology

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1. Introduction

Local geography teaching is an important component of the junior high school geography curriculum and a key bridge connecting students' life experiences with geographic knowledge. The *Compulsory Education Geography Curriculum Standards (2022 Edition)* explicitly state that students should “understand the geographical environment of their hometown and develop affection for it,” and advocate guiding students to attend to hometown development issues through practical activities ^[1]. The *Compulsory Education*

Curriculum Plan (2022 Edition) further emphasizes interdisciplinary thematic learning and encourages the design of curriculum content around the realities of students' hometowns ^[2]. The *Implementation Opinions on Deepening the Reform of Basic Education Curriculum* also encourage the development of geography courses grounded in local realities ^[3]. It is thus evident that local geography teaching has become an important direction in the current reform of geography education.

At present, the dimensions and perspectives of local geography curriculum design have become increasingly diverse. Researchers have explored dimensions such as resource development, practical pathways, and interdisciplinary integration, aiming to enhance the relevance and appeal of instruction ^[4]. Among these, the 4F teaching model, owing to its structured and reflective characteristics, has been applied in areas such as geography field trips and case-based teaching, guiding students to systematically progress from perception to reflection ^[5]. In the era of artificial intelligence, AI technology, with its powerful capabilities in data processing, scenario simulation, and interaction, has injected new momentum into classroom reform. Existing studies have attempted to apply AI technology to the creation of geographic scenarios, the planning of personalized learning pathways, and the support of inquiry processes, effectively enhancing the interactivity and depth of inquiry in teaching ^[6]. The 4F teaching model offers the advantages of a complete process and strong systematic structure, whereas AI technology can construct immersive contexts, enhance student experience, and improve teaching effectiveness. The integration of the two can not only improve the systematic and theoretical quality of teaching, but also strengthen students' learning experience and depth of inquiry through technological means, thereby holding significant practical value.

On this basis, this study constructs a theoretical framework for empowering junior high school local geography curriculum design through the deep integration of AI technology and the 4F teaching model. Taking the value divergence between tourism development and ecological environmental protection in Shibanyan Town, Linzhou City, Henan Province as a case, it further develops an instructional design for local geography. By embedding the intelligent tools provided by AI technology into the systematic 4F teaching model, this study aims to offer geography educators a more effective roadmap for junior high school local geography curriculum design, and to better transform the abstract concepts of "human–environment harmony" and "affection for hometown and country" into learning experiences characterized by students' personal participation, deep thinking, and creativity, thereby truly realizing the educational value of the geography discipline.

2. Overview of the 4F teaching model

The 4F teaching model is a structured framework widely applied in experiential learning and critical reflection. It was proposed by British educator Roger Greenaway in the 1990s ^[7]. The model comprises four interconnected modules: Fact (objective facts), Feel (feelings and associations), Find (inductive meaning), and Future (decided action). This teaching model follows the logical chain of "perceiving facts—perceptual understanding—rational understanding—taking action," dividing the learning process into four progressive stages that correspond respectively to students' cognitive processes of knowing, feeling, willing, and acting. It is a teaching model consistent with students' cognitive patterns, emphasizing cognitive development from the concrete to the abstract and from the perceptual to the rational ^[8]. Specifically, students first observe and describe objective facts, and then engage in basic perception to acquire perceptual understanding. On this

basis, they proceed to inductive summarization to form rational understanding. Finally, they reflect, take action, apply theory to practice, and transfer what they have learned.

Fact denotes “objective facts,” emphasizing that the surface manifestations of things are multifaceted. Teachers should guide students to observe and describe facts from different perspectives, enabling them to learn methods for recognizing “objective facts,” perceive “objective facts,” and construct a fundamental cognition of “objective facts.” Feel denotes “feelings and associations,” reflecting inner subjective emotions and intuitive perceptions. On the basis of “objective facts,” students engage in “feelings and associations” through personal participation and experience, expressing subjective emotions and intuitive perceptions, thereby acquiring perceptual knowledge. Find denotes “inductive meaning.” At this stage, teachers should guide students to engage in inductive and deductive reasoning on the basis of perceptual understanding, exercise logical thinking, and encourage in-depth reflection, so as to identify the essence of things and summarize geographic principles and patterns. Future denotes “decided action.” Teachers should guide students, on the basis of “experiential meaning,” to look toward the future, transfer and apply what they have learned, and put their learning outcomes into practice in real life and future development.

3. Theoretical analysis of local geography teaching integrating AI technology and the 4F teaching model

The core of integrating AI technology with the 4F teaching model lies in empowering 4F-based teaching through AI, deeply integrating the technological affordances of AI with the content systematicity and progressive thinking of the 4F model. This integration fosters a positive interaction in which “technology adapts to the model, and the model guides technology,” helping students better understand the local geography teaching process and achieve instructional objectives. The theoretical framework of this integration is shown in **Figure 1**.

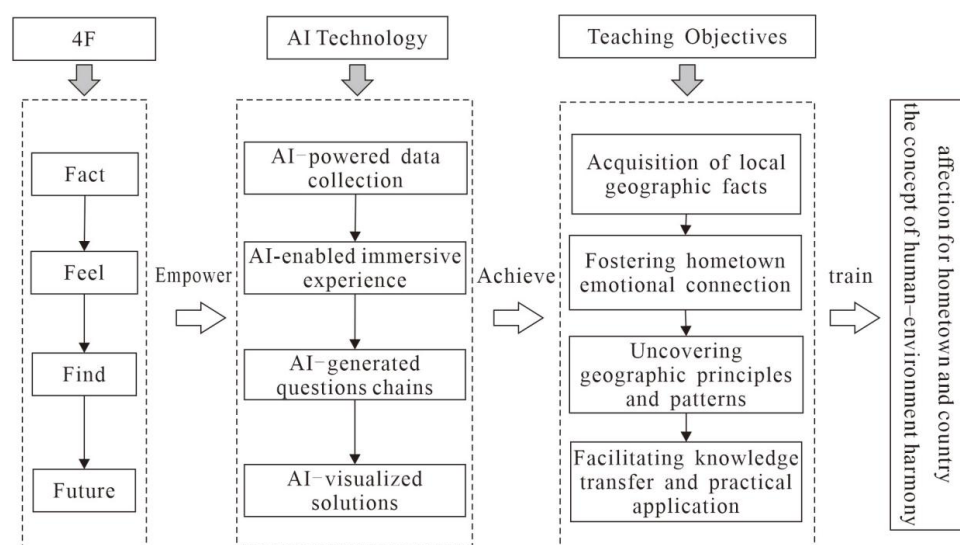


Figure 1. Theoretical framework for the integration of AI and the 4F teaching model

3.1. The “Fact” stage

Grounded in hometown geographic facts, this stage fully leverages AI’s intelligent, systematic, and precise advantages in data collection, classification, and processing to extract key geographic elements of the hometown and generate charts, maps, animations, and other materials suitable for classroom use, thereby enabling more efficient integration and utilization of teaching resources. The application of AI not only significantly reduces teachers’ data-processing burden in pre-class preparation, but also ensures the scientific validity and timeliness of teaching materials. Moreover, AI can establish intelligent pathways that connect local cases with general disciplinary knowledge. For example, when explaining typical regional landforms, the system can automatically link to the corresponding formative principles in the textbook and interpret them in light of local geological and climatic conditions, thereby promoting students’ knowledge transfer “from general patterns to specific manifestations” and effectively strengthening the structural integration between local geography teaching and core disciplinary content.

3.2. The “Feel” stage

Building on a systematic understanding of hometown geographic facts, students are guided to progress from “factual cognition” to “emotional identification,” with AI employed to transform abstract or fragmented local materials into embodied, immersive audiovisual experiences, thereby deepening students’ emotional engagement and value perception ^[9]. Teachers can leverage AI tools to create lightweight virtual reality (VR) or augmented reality (AR) scenes, enabling students to remotely and interactively “roam” the natural landscapes and cultural spaces of their hometown. In teaching contexts constrained by limited space or insufficient conditions for field investigation, this is particularly conducive to filling the gap in cultivating geographic practical competence and promoting the organic integration of emotional experience and geographic cognition.

3.3. The “Find” stage

Within the context of students’ deep emotional identification, this stage aims to cultivate comprehensive geographic thinking and practical competence, guiding students to independently discover and analyze regional geographic issues based on local facts. AI plays the role of an intelligent scaffold by providing structured question chains, data analysis tools, and cognitive support, thereby lowering the threshold of inquiry and enhancing the systematicity and depth of thinking in inquiry activities. The AI system can automatically generate hierarchical and progressive sequences of inquiry questions based on the fact base constructed in the “Fact” stage, in alignment with curriculum standards and learning conditions. Such differentiated question design not only accommodates multiple organizational forms, including whole-class instruction and small-group collaboration, but also more effectively guides students through a complete thinking-training process from phenomenon observation to essence induction and from element analysis to systemic synthesis, thereby deepening their understanding of the geographic patterns and mechanisms of their hometown ^[10].

3.4. The “Future” stage

The junior high school stage focuses on cultivating students’ preliminary geographic decision-making awareness and feasibility-oriented thinking. AI transforms learning outcomes into constructive suggestions for the sustainable development of their hometown, thereby facilitating the transfer, application, and value

internalization of geographic knowledge. Development suggestions proposed by students in textual form can be transformed by AI into visual outputs such as schematic diagrams, planning sketches, or dynamic simulation clips, helping students reflect on the environmental and social impacts of their proposals and providing technical support for the “visualization of ideas” and “simple simulation of plans,” thereby making abstract ideas concrete and perceptible and enhancing students’ sense of learning achievement and motivation for participation.

4. Case design: Environment and Development

The core objective of Chapter 8 of the Hunan Education Press textbook is to guide students to understand that regional development is a comprehensive, coordinated, and sustainable process, with particular emphasis on attending to ecological security and social equity while pursuing economic development. The case of Shibanyan Town serves precisely as a “microcosm” and “realistic projection” of this abstract theme. Meanwhile, the development conflict in Shibanyan Town is not a simple black-and-white issue but a complex “dilemma,” and the 4F model provides a clear and actionable thinking framework for addressing complex real-world problems, as shown in **Figure 2**.

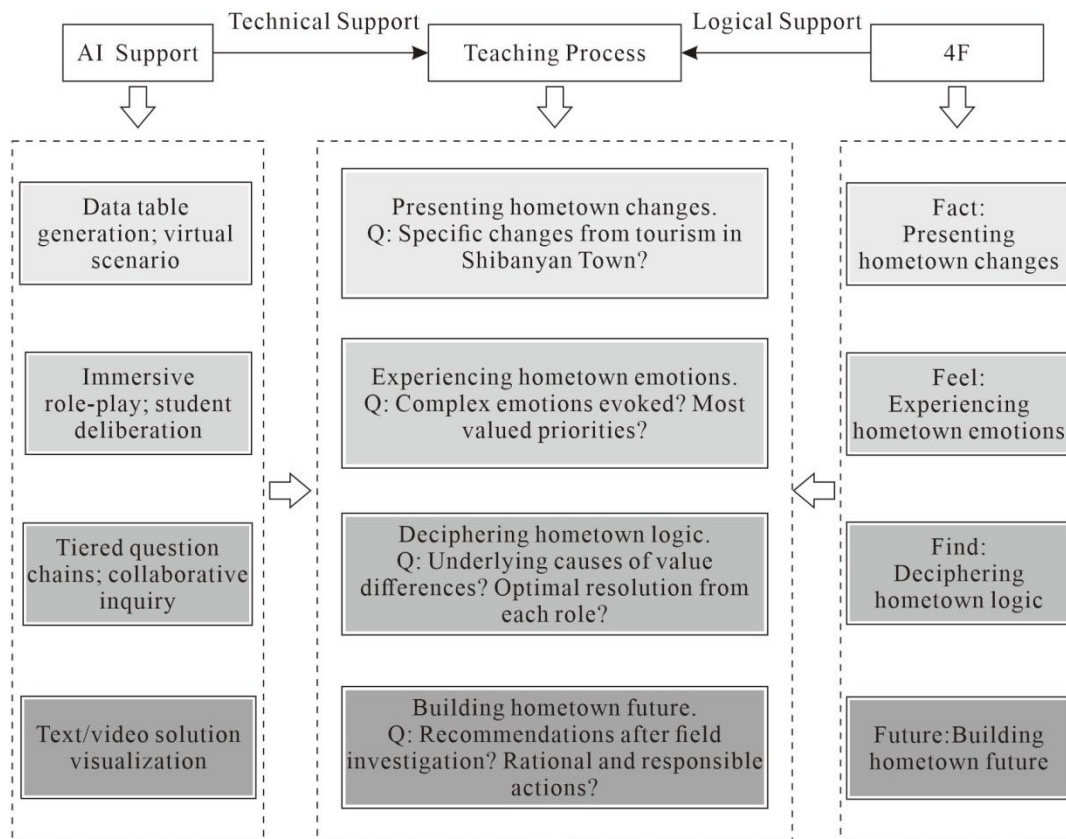


Figure 2. Design Approach for Local Geography Classroom Teaching in Shibanyan Town

4.1. Analysis of textbook content

Chapter 8 of the Hunan Education Press Geography Textbook for Grade 8, Volume 2 centers on the dialectical relationship between regional environment and development, guiding students through case analyses (e.g., rocky desertification control in Guizhou Province and soil erosion on the Loess Plateau) to understand the importance of “human–environment coordination” in regional development ^[11]. As a local geography case, the conflict between rapid tourism development and ecological environmental protection in Shibanyan Town aligns with the textbook’s central theme that regional development must give due consideration to both economic benefits and ecological protection. In teaching, it is necessary to integrate map analysis, role-playing, and practical inquiry to help students extract geographic problems from real-world contexts and develop a concept of sustainable development.

4.2. Analysis of curriculum standards

The Compulsory Education Geography Curriculum Standards require students to: analyze regional locations, characteristics, and problems using maps; understand the interactions between natural and human elements (e.g., the impact of tourism development on ecology); dialectically examine the contradiction between development needs and environmental protection and propose reasonable countermeasures; and enhance problem-solving abilities through field investigation and data collection ^[1].

4.3. Teaching objectives

Concept of Human–Environment Harmony: Through analyzing the conflict between tourism development and ecological protection in Shibanyan Town, students will understand the sustainable development implication that “lucid waters and lush mountains are invaluable assets,” develop a sense of responsibility for protecting the ecological environment of their hometown, and embrace the regional development principle of “protection first and rational development.”

Comprehensive Thinking: Students will comprehensively analyze the dual impacts of tourism development from both natural and human perspectives, and apply systems thinking to propose strategies for coordinating environmental protection and development.

Regional Cognition: Through map interpretation, students will describe the geographical location, distribution of tourism resources, and ecological vulnerability characteristics of Shibanyan Town.

Geographic Practical Competence: Through activities such as simulated public hearings and data/chart analysis, students will enhance their ability to investigate geographic issues and make decisions. They will complete the design task of an “Ecotourism Initiative,” transforming theory into action plans for solving real-world problems.

4.4. Key and difficult points in teaching

Teaching Focus: The manifestations and causes of the conflict between tourism development and environmental protection.

Teaching Difficulty: Proposing sustainable development strategies that balance economic and ecological considerations.

4.5. Teaching methods

Situational teaching method, role-playing method, and small-group discussion method.

4.6. Analysis of student characteristics

Eighth-grade students have acquired preliminary regional analysis skills, yet their understanding of complex human–environment relationships remains relatively superficial, and they lack field investigation experience. In teaching, it is necessary to leverage AI to create scenarios and provide scaffolding, thereby reducing cognitive difficulty and stimulating interest in inquiry.

4.7. Teaching process

4.7.1. “Fact” Stage: Observing the Changes in the Hometown

【Lesson Introduction】

The teacher issues the following instruction to the AI: “Please search for and select high-definition comparative images of the landscape and streetscape of Shibanyan Town, Linzhou City, Henan Province before 2015 and after 2025, highlighting changes in architecture, roads, public facilities, and the natural environment brought about by tourism development. The images should be authentic and representative, with the shooting time and location annotated.” After displaying the images, the teacher asks: “Tourism development has indeed brought substantial income to Shibanyan Town. From the perspective of your daily lives, what other changes has it brought to the local area? Are all of these changes positive?”

Students: After watching the video, students recognize that the development of tourism in Shibanyan Town has increased local residents’ income and improved infrastructure, but it has also produced negative effects, such as aggravated environmental pollution and ecological damage.

【Design Intent】

To stimulate interest and guide students to attend to contradictions and conflicts, laying the groundwork for subsequent inquiry.

4.7.2. “Feel” Stage: Experiencing the Joys and Sorrows of the Hometown

【New Lesson Instruction】

The “Value Balance” Ranking Activity

The teacher presents several core values that compete with one another in the development of Shibanyan Town:

- A. Economic prosperity and household income;
- B. The health and purity of the ecological environment;
- C. Tranquility and convenience of life;
- D. The authenticity of the hometown’s nature and culture;
- E. More development opportunities and choices.

The teacher uses AI to generate virtual effect videos of Shibanyan Town’s development under each option. Task: Assuming you are a decision-maker, rank these five values in order of personal importance (1 being the most important). Then consider: How might your ranking differ from the rankings you would predict for “tourists,” “older-generation residents,” and “young entrepreneurs”? Why?

【Design Intent】

By experiencing the complexity of their own emotions, students establish a foundation for subsequently understanding the markedly different feelings and positions of other stakeholders (residents, tourists, government), thereby lending greater depth to the “simulated public hearing.”

4.7.3. “Find” Stage: Understanding the Logic of the Hometown

Causes of Value Divergence

Teacher: The teacher distributes AI-generated tiered question chains, with different groups receiving corresponding tasks (basic group: the influence of natural factors on divergence; advanced group: the influence of human factors on divergence; extension group: the interaction between natural and human factors), and students conduct inquiry using pre-class material packages and AI data analysis tools.

Students: In small groups, students collaboratively organize materials and use mind maps to summarize problems such as “overdevelopment leading to insufficient arable land” and “tourist overload exacerbating pollution.”

【Design Intent】

To cultivate information integration and problem analysis abilities, and to understand the interaction between natural and human elements.

Problem-Solving Proposals

Teacher: The teacher organizes a simulated public hearing and assigns roles: government officials, tourists, environmental organizations, and local residents.

Students: Students state their positions according to their assigned roles. Government officials propose “limiting daily tourist numbers”; environmental organizations recommend “establishing an ecological restoration fund”; resident representatives emphasize that “livelihoods depend on tourism and oppose a one-size-fits-all visitor cap”; tourist representatives call for “strengthening environmental publicity and facility construction.” Students then engage in dialogue practice with AI-simulated “government officials” and “environmental experts,” with the AI providing arguments or challenges based on each role’s stance, thereby enhancing the depth of the debate. The four groups attempt to negotiate solutions and ultimately reach a compromise of “time-based visitor limits plus ecological post subsidies.”

【Design Intent】

To experience multiple perspectives, understand the importance of balancing interests, and exercise critical thinking.

4.7.4. “Future” Stage: Building the Future of the Hometown

【Practical Extension】

Teacher: The teacher assigns a post-class task: design an “Ecotourism Initiative” or a “micro environmental protection plan for Shibanyan Town.”

Students: Drawing on what they have learned in class, students investigate local cases and propose feasible suggestions. The teacher submits students’ development proposals for the hometown to AI, which transforms these suggestions into simulated videos and other formats for class presentation.

【Design Intent】

To transform theory into practice and strengthen the practical value of geographic knowledge.

【Summary and Elevation】

Teacher: The teacher summarizes the principle of “protection first and rational development” and presents successful domestic and international cases (e.g., the ecotourism model of Guizhou^[11]).

Students: Students reflect on the learning process and write a reflection: “How can I, starting from myself, support the sustainable development of my hometown?”

【Design Intent】

To deepen the concept of human–environment harmony and internalize a sense of social responsibility.

4.8. Teaching reflection

In this lesson, students developed a deeper understanding of the complexity of development and conservation through role-playing, and the proposals they formulated demonstrated both creativity and feasibility. Although some initial success was achieved, further improvement is still needed. Field investigation components should be added—for example, organizing students to investigate the current status of waste management in Shibanyan Town to enhance practical perception. A long-term follow-up mechanism should also be established to encourage students to participate in community environmental activities and transform classroom outcomes into social action.

5. Conclusion

This paper systematically constructs an AI-empowered local geography 4F teaching model. Through theoretical elucidation and case design, it demonstrates multiple pathways by which artificial intelligence enhances the effectiveness of local geography teaching. The progressive reflective framework advocated by the 4F model—“Fact—Feel—Find—Future”—perfectly aligns with the inherent logic of local geography teaching, guiding students from “knowing their hometown” to “identifying with their hometown” and then to “building their hometown.” Through the case design centered on “Environment and Development” in Shibanyan Town, Linzhou City, this paper concretely illustrates how, with the assistance of AI, the 4F structure can transform complex real-world issues into actionable instructional content. This model not only responds to the policy direction of educational digitalization but also provides geography teachers with a replicable and scalable teaching framework, contributing to the shift of local geography teaching from “knowledge transmission” to “competency cultivation,” thereby truly realizing the educational function of the geography discipline.

Future efforts may further explore mechanisms for integrating AI with field-based investigation, establish socialized pathways for students’ sustained participation in local practice, and enable local geography teaching to better serve local sustainable development and students’ lifelong growth.

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Disclosure statement

The authors declare no conflict of interest.

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