

Reform and Practice of Research-Based Teaching Mode for Innovative Talents in Local Undergraduate Physical Geography

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Abstract: The traditional Physical Geography teaching, focusing on theory and neglecting practice and innovation, fails to meet the needs of talent cultivation. In response to the aforementioned pedagogical challenges, this study adopts a student-centered and holistic educational philosophy, leveraging an intelligent teaching platform to develop a research-oriented teaching model. This model integrates scientific research papers and current news as context, thematic presentations as an introduction to knowledge, and field internships, annual papers, research projects, and disciplinary competitions as practical bridges. The aim is to enhance students' comprehension of the course material, foster innovative thinking and research capabilities, and drive comprehensive reform and innovation in Physical Geography courses within higher education institutions.

Keywords: Research-based teaching; Physical Geography; Top innovative talents

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1. Introduction

Cultivating high-quality talents with innovative spirit, practical skills, and a strong sense of social responsibility has become an important historical mission entrusted to higher education in the new era. Against this backdrop, enhancing the quality of course education and training high-quality innovative talents has become a significant issue in the teaching reform of colleges and universities^[1]. Currently, there is a noticeable deficiency in the teaching of Physical Geography courses, primarily characterized by an overemphasis on the impartation of basic theoretical knowledge and a lack of in-depth integration of cutting-edge and interdisciplinary knowledge, resulting in a limited knowledge system for students. In terms of teaching methods, many teachers still adhere to traditional didactic teaching, where students are in a passive state of reception, and the cultivation of their proactivity, practical skills, and innovative abilities is severely neglected^[2]. This model can no longer meet

the new era’s demand for cultivating high-quality creative talents, making teaching reform an urgent priority. This study focuses on the “pain points” in the teaching of Physical Geography, adhering to the core concepts of “student-centered” and “holistic education,” and fully utilizing intelligent teaching platforms to innovatively construct a research-oriented teaching model. The aim of this study is to comprehensively stimulate students’ inherent potential and develop their advanced capabilities and innovative thinking, thereby improving teaching quality to meet the urgent demand for the cultivation of composite geographical talents in the new era.

2. Connotation of research-based teaching

Research-oriented teaching encompasses both the research-informed instruction by teachers and the research-based learning by students. It refers to the process where educators design teaching objectives, content, methodologies, practices, assessments, and classroom activities to establish an environment akin to research. This approach emphasizes the central role of students, guiding and assisting them to actively investigate, identify, analyze, and solve problems within their learning and practical experiences. Consequently, it fosters the development of students’ creative abilities and spirit of innovation ^[3].

3. Construction of a research-based teaching model for Physical Geography courses

This paper adheres to the principles of “student-centered” and “holistic education” to construct a research-oriented teaching model for Physical Geography courses, encompassing aspects of teaching content, methodologies, classroom interaction, project practice, and course assessment (Figure 1).

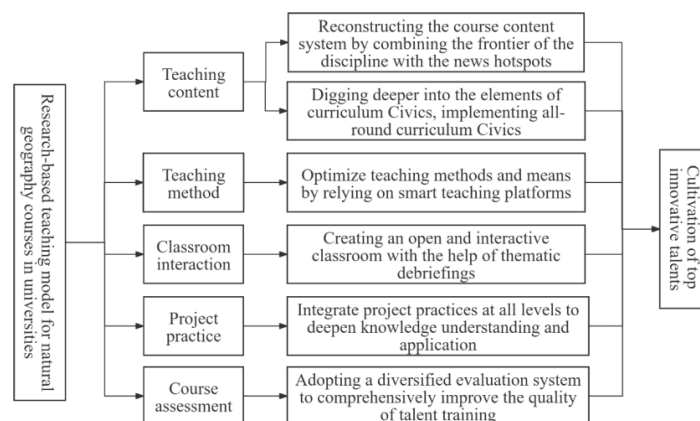


Figure 1. A research-based teaching model for Physical Geography

3.1. Reconstructing curriculum content by combining the frontier research and current events

The research-oriented teaching model demands that educators continuously renew course content by integrating cutting-edge research findings and current news events to reconstruct the curriculum content system. This approach ensures that students are exposed to the latest disciplinary knowledge and societal trends, enabling a better understanding of the practical applications of theoretical knowledge. Consequently, it stimulates students’ interest and engagement, broadens their horizons, and enhances their scientific literacy.

3.2. Deeply exploring and comprehensively integrating ideological elements in courses

The research-oriented teaching model emphasizes integrating knowledge and skills with the education of ideals and beliefs, fostering a sense of responsibility and mission in students to explore the unknown, pursue truth, and scale the peaks of science. It focuses on infusing ideological content related to national development strategies, ecological civilization construction, and environmental protection^[4]. It advocates extracting epistemology and methodology from dialectical materialism within physical geography, guiding students to analyze geographical issues holistically and systematically. This approach encourages students to draw on the spirit of innovation and science from advancements in physical geography, aiming to cultivate geographers with a global perspective and a sense of responsibility.

3.3. Leveraging intelligent teaching platforms to optimize teaching methods and techniques

The teaching content of Physical Geography encompasses a broad spatial scope and complex dynamic processes, necessitating a wealth of resources such as images, data, and case analyses for support. Utilizing intelligent teaching platforms, instructors can design interactive learning activities, including online topic discussions, quiz competitions, and voting, to enhance student engagement in the classroom^[5]. Moreover, the platform enables the customization of personalized learning paths to meet the diverse needs of students and improves the efficiency and effectiveness of teaching assessments through online testing and immediate feedback mechanisms.

3.4. Creating an open and interactive classroom through thematic presentations and debriefings

The research-oriented teaching model, adhering to the principles of “student-centered” and “holistic education,” constructs an open and interactive classroom through thematic presentations. Instructors select research topics based on course content, guiding students in in-depth exploration. Students, divided into groups, read relevant scientific papers or news, and actively identify and raise questions, with instructors providing guidance throughout the process. This approach encourages students to independently consult literature, organize materials, and design research plans, leading to deeper thinking and inquiry. Students then report their findings in groups, facing questions from peers and instructors, achieving knowledge sharing and intellectual exchange, which enhances their geographical literacy. This method not only increases student engagement and self-learning abilities but also fosters teamwork and oral communication skills, turning the classroom into a vibrant space for knowledge exploration and innovative thinking.

3.5. Integrating multi-level projects to enhance knowledge comprehension and application

The disconnection between knowledge and practice in physical geography education necessitates the deepening of understanding and application through diverse practical activities. Universities should leverage field internships as a unique resource, enabling students to directly experience natural geographical phenomena through on-site observation, sampling, and analysis, thereby enhancing their grasp of theoretical knowledge. Additionally, encouraging students to engage in multi-level research projects fosters the application of knowledge, problem identification, and resolution, cultivating scientific thinking and innovation capabilities^[6]. Participation in academic competitions and the writing of annual and graduation theses promotes continuous and in-depth learning, challenging academic difficulties, and enhancing overall quality. These activities facilitate

a shift in teacher-student relationships from “teaching and learning” to “guiding and researching,” nurturing professionals in physical geography with solid theoretical foundations and practical skills.

3.6. Adopting a diversified evaluation system to enhance talent cultivation quality

Research-oriented teaching emphasizes assessing students’ innovative thinking and problem-solving skills [7]. Course evaluations utilize smart teaching platforms to gather and analyze vast amounts of learning data, including online interaction frequency, study duration, and test scores, enhancing process-based assessments. Additionally, integrating project reports, academic papers, research findings, competition certificates, and student performance from practical activities into a comprehensive evaluation system provides a holistic assessment of learning outcomes.

4. Case studies in course applications: Taking “Climate Change” as an example

Climate change constitutes a central theme in physical geography, encompassing three main components: a brief history of climate change, the causes of climate change, and potential future climatic alterations. Through the study of this section, students will gain an understanding of the scientific principles of climate change and recognize its significance to the global environment and human activities. This paper adopts a research-oriented teaching model based on student-centered and holistic education philosophies, systematically arranging teaching resources and processes before, during, and after class to implement research-oriented teaching reforms (Figure 2).

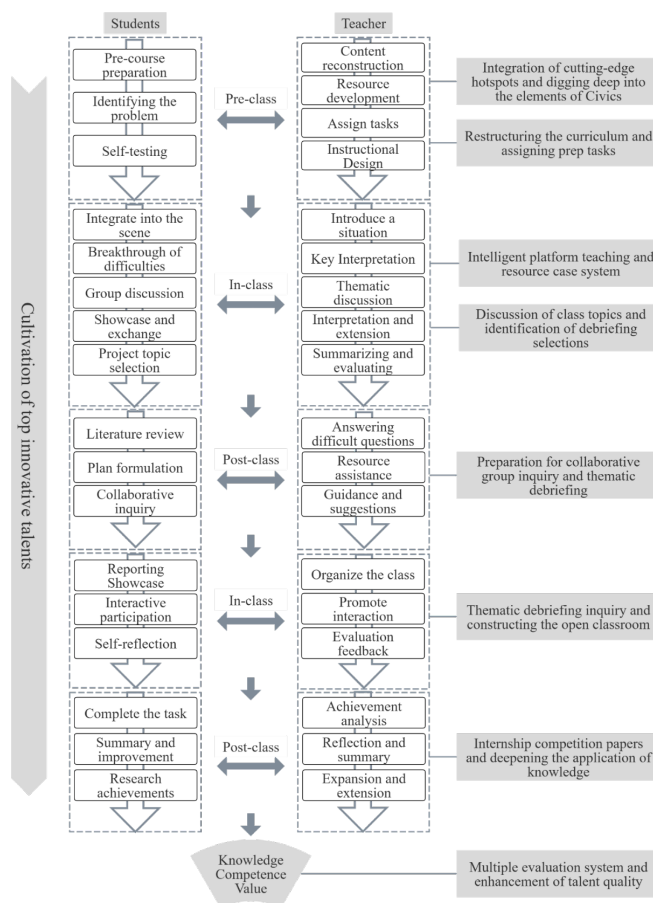


Figure 2. The teaching and learning process of the research-based teaching model

4.1. Integrating disciplinary frontiers and hotspots in course content restructuring

Given the early publication date of the Physical Geography textbook, it has not kept pace with the latest scientific advancements, which has resulted in a limited understanding of recent research developments among students, consequently affecting their interest in learning. To address this, the content of the textbook has been thoughtfully and judiciously updated to incorporate the latest scientific findings, including the “IPCC Sixth Assessment Report: Synthesis Report” and “Climate Change 2023,” as well as topical news such as “advancements in climate modeling and prediction technology.” These inclusions aim to familiarize students with significant discoveries and theoretical innovations in the field, piquing their interest in climate change issues. Furthermore, they are guided to delve into the characteristics, feedback mechanisms, and future evolution of the climate system, thereby deepening their comprehension and application of knowledge.

4.2. Holistically integrating ideological and political elements into curriculum teaching

This lecture is rich in ideological and political elements. By emphasizing the global impact of climate change on ecological security and human living environments, it aims to cultivate students’ global perspectives and sense of responsibility. Combining the country’s proactive actions and international commitments in addressing global climate change, such as the goals of “carbon peak,” it enhances students’ national pride and engagement. Discussing the close link between climate change and sustainable development fosters students’ green development concepts. Analyzing the impacts of climate change on different regions and groups strengthens students’ awareness of social equity and international cooperation. Presenting the outstanding contributions of Mr. Kezhen Zhu in the field of climate change research inspires students to pursue and uphold truth in scientific research and daily life. The integration of these elements combines ideological and political education with the study of professional knowledge, achieving an organic unity of knowledge transmission and value guidance^[8].

4.3. Revolutionizing teaching methods and improving teaching efficiency through smart platforms

This lecture enhances teaching effectiveness through smart platforms such as Chaoxing Learning Pass. Prior to class, instructors upload high-quality course materials and pre-class study guides on the smart platform to guide students in self-directed learning. Utilizing data provided by the platform, teachers gain insights into students’ learning difficulties and design classroom content accordingly. During the class, teachers delve into explanations of students’ challenging points and engage in interactive activities such as discussions, quizzes, and voting through the smart platform to increase student participation. The platform’s classroom management tools, including roll call, sign-in, and immediate feedback, assist teachers in improving classroom management efficiency. After class, the smart platform continues to serve as a tool for interaction and learning between teachers and students. The interactive learning, digital resources, and intelligent assessment features of the smart platform help to stimulate student interest and promote effective teaching.

4.4. Building an open classroom environment with group inquiry and thematic debriefing

In the class introduction, teachers pose questions about the origin of Henan Province’s abbreviation and link it to archaeological news of numerous elephant bones discovered there, prompting students to ponder why tropical elephants were found in Henan, thereby transitioning to the topic of climate change. During the main discussion, teachers provide three key resources: biological fossil evidence of geological climate change, Norway’s snowline heights over 10,000 years, and Kezhen Zhu’s reconstructed 5,000-year temperature curve for China, as well as recent estimates of Arctic greening and global warming. Students, in groups, explore the

characteristics, trends, and causes of climate change in geological, historical, and recent times, and predict future changes. Teachers closely monitor discussions, offering timely interpretations and extensions, guiding in-depth explorations, and assisting in designing research projects and plans. After class, students conduct literature reviews and write research reports based on their topics and plans. In the following session, students present their findings through class reports, which are jointly discussed by teachers and students to further refine report content. This teaching approach not only enhances student engagement but also fosters their research skills and critical thinking.

4.5. Integrating diverse practical activities to enhance students' innovative application abilities

The research-oriented teaching model in Physical Geography integrates field internships, academic competitions, academic year papers, and research projects at various levels to create a favorable practical platform for students. Through field internships, students are able to personally participate in the work of meteorological observation stations, enhancing their intuitive understanding and perception of climate change phenomena. Based on course content and students' project topics, they are encouraged to apply for various research funding programs, such as undergraduate research grants, and actively participate in academic competitions like the China Geography Science Exhibition Contest for Universities, in order to improve their research design and practical application abilities and cultivate scientific research thinking and innovative spirits. Additionally, students are guided to write academic year papers and graduation theses related to climate change, enhancing their research capabilities and academic literacy. This diversified practical teaching strategy helps cultivate students' innovative practical skills and high-level problem-solving skills for complex issues.

4.6. Developing a multifaceted assessment framework to foster students' overall literacy

The evaluation of Physical Geography courses emphasizes process-oriented and diversified assessment, with a comprehensive examination system consisting of "final exam + process performance + project practice." The final exam accounts for 60% of the total grade, with the test paper divided into three parts: basic knowledge questions (20%), knowledge application questions (50%), and material analysis questions (30%). This structure focuses on assessing students' abilities to apply physical geography knowledge to analyze and solve real-world geographical problems. Process performance, which includes students' performance in pre-class preparation, classroom interaction, and post-class assignments, accounts for 20% of the total grade. Project practice, encompassing project achievements, competition awards, and paper publications, constitutes the remaining 20% of the total grade.

5. Conclusion

Enhancing classroom teaching quality and cultivating innovative talents represent one of the core missions of higher education reform. Guided by the principles of "holistic education" and "student-centeredness," this study utilized an intelligent teaching platform to establish a research-oriented teaching model in Physical Geography. This model incorporates scientific research papers and news hotspots as contextual introductions, special topic reports as entry points for knowledge acquisition, and field internships, academic year papers, research projects, and discipline competitions as practical bridges. This teaching model not only deepens students' mastery of physical geography knowledge but also significantly enhances their innovative consciousness and research capabilities, providing solid support for cultivating outstanding innovative talents in the new era.

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Disclosure statement

The authors declare no conflict of interest.

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