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Design of a Coastal Volcanic Geomorphology Research Study Program for Cultivating Geographical Practical Competence

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Abstract: *The Geography Curriculum Standards for Ordinary Senior High Schools (2017 Edition, 2020 Revision) explicitly emphasize the cultivation of geographical practical competence. As a significant form of inquiry-based learning, research study programs not only enhance students' practical abilities but also deepen their understanding of human-environment relationships within authentic geographical contexts, thereby elevating their core geographical literacy. Grounded in the high school geography curriculum standards and leveraging the unique geological and geomorphological resources of the Zhangzhou Coastal Volcanic Geopark, this paper constructs a systematic research study activity framework through field investigation, observation, and survey methods. The design encompasses resource analysis, curriculum standard alignment, activity planning, and evaluative reflection. The study aims to explore a practical competence-oriented design pathway for research study programs, providing an operational model reference for coastal volcanic geomorphology field studies.*

Keywords: *Geographical Practical Competence; Research Study Program; Curriculum Design; Coastal Volcanic Geomorphology*

1. Introduction

The Geography Curriculum Standards for Ordinary Senior High Schools (2017 Edition, 2020 Revision) (hereafter "the Standards") explicitly advocate for enhancing students' ability to apply knowledge to solve practical problems through geographical practices, integrating geographical practical competence into the core literacy system. [1] Research study programs, as essential practical teaching forms, emphasize student observation, inquiry, and reflection in real-world geographical settings, [2] effectively fostering core literacies such as regional cognition, comprehensive thinking, and the concept of human-environment coordination. They represent a crucial pathway for cultivating geographical practical competence.

Current research on research study curriculum design lacks sufficient case studies for coastal volcanic geomorphology that concurrently address curriculum standard alignment and practical competence cultivation. Given the unique volcanic-coastal composite landform resources of the Zhangzhou Coastal Volcanic National Geopark and their high relevance to the curriculum, this paper selects it as the field study site to explore a systematic design approach for research study activities oriented towards geographical practical competence. This endeavor enriches practical teaching within physical geography themes, responds to the Standards' requirements for practical competence cultivation, and offers operational pathways and evaluation mechanisms for integrating regional characteristic resources into high school geography research studies, holding certain theoretical reference value and practical significance.

2. Analysis of Research Study Resources in Zhangzhou Coastal Volcanic Geopark

The Zhangzhou Coastal Volcanic Geopark is located in the coastal area of Qianting Town, Zhangpu County, Zhangzhou City, Fujian Province. It preserves rare Tertiary central volcanic eruption structures and features distinctive volcanic-marine erosion composite landform landscapes shaped by subsequent wave erosion. The area's most representative geological relics include four globally rare volcanic geological phenomena: columnar basalts, ancient volcanic craters, beaded volcanic vent clusters, and

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basaltic "watermelon-skin structures" . [3] The Zhangzhou Coastal Volcanic Geopark is an extremely rare, and China's only, coastal volcanic landform landscape, possessing significant geoscientific research and educational value, recognized as a typical Tertiary volcanic geological heritage site. [4]

Situated at the intersection of the Eurasian Plate's eastern marginal rift zone and the Western Circum-Pacific volcanic belt, the geopark is a key node in global volcanic tectonic activity. Nanding Island within the park hosts the world's most massive and densely packed columnar basalt cluster, remarkable for its scale and structural integrity. Niutoushan Ancient Volcanic Crater is well-preserved with clear volcanic activity traces and magnificent basalt structures, hailed by geologists as a "rare ancient volcanic museum at home and abroad," and is one of China's rarest and internationally best-preserved submarine ancient volcanic craters. Linjin Island, a volcanic island composed of basalt, features diverse geological landscapes such as volcanic craters, vent clusters, and ancient lava lakes. Its eastern shore distributes up to 16 circular rootless vent clusters, a rare phenomenon in global geological heritage.

The unique volcanic and coastal landforms of the Zhangzhou Coastal Volcanic Geopark provide abundant resources for field-based geographical research studies. The diverse and authentic geological structures within the park not only enhance high school students' field investigation skills but also offer an ideal platform for inquiry-based learning activities related to volcanic and coastal landforms, fully demonstrating the integrative teaching advantages of physical geography and geological science.

3. Analysis of Curriculum Standard Requirements

Leveraging the unique volcanic-coastal geological resources of the Zhangzhou Coastal Volcanic Geopark, the design of this research study program closely aligns with the core requirements of the high school geography curriculum standards, focusing on relevant content from compulsory module Geography 1 and selective compulsory module Fundamentals of Physical Geography.

The Standards for Geography 1 emphasize identifying 3-4 typical landform types through field observation, video, or imagery, and describing their main characteristics. In Fundamentals of Physical Geography, students are required to use schematic diagrams to understand the rock cycle process and, combined with specific examples, analyze the impact of internal and external forces on surface morphology evolution, further exploring the interrelationship between human activities and surface forms. To strengthen the connection between the research activities and the curriculum standards, this paper establishes a "Table of Articulation between Research Resources and Curriculum Content" (Table 1), facilitating the organic integration of teaching content and practical resources.

Table 1 Articulation Table of Research Resources in Zhangzhou Coastal Volcanic National Geopark

Practice Method	Research Site	Research Resource	Knowledge Articulation (Geo1/Selective 1)	Core Literacy Fostered
Landform Observation	Nanding Island	Columnar Basalt Pillar Cluster (1.4 million)	Identify volcanic landforms, describe columnar jointing morphological features (Geo1)	Regional Cognition, Comp. Think.
Geological Structure Survey	Niutoushan Ancient Crater	Intact Volcanic Crater, Eruption Sequence Profile	Analyze the impact of volcanic eruption (internal forces) on surface morphology (Selective 1)	Comp. Think., Geo. Practice
Vent Experiment	East Coast, Linjin Island	Circular Rootless Vent Clusters	Investigate post-volcanic geological processes, explain vent formation mechanisms (Selective 1)	Comp. Think., Geo. Practice
Coastal Landform Survey	Xiangshan Lava Platform	Sea Cliff, Sea Cave, Basaltic "Watermelon-skin"	Identify coastal landforms, analyze wave erosion processes (Geo1)	Regional Cognition, H-E Coord.
Human Activity Interview	Qisha Bay Mangrove Area	Planted Mangroves, Tourist Boardwalk	Explain the relationship between human activities and surface morphology (Selective 1)	H-E Coord., Comp. Think.

4. Activity Design for the Zhangzhou Coastal Volcanic Geomorphology Research Study

4.1 Determination of Research Sites and Itinerary

Based on a comprehensive review of literature related to Zhangzhou's volcanic geology and curriculum standard requirements, coupled with field survey results, this study systematically analyzed the distribution patterns and educational value of the volcanic-marine erosion landforms. Using criteria such as volcanic structural integrity, landform typicality, activity safety, and curricular relevance, five

ISSN 2522-6398 Vol. 8, Issue 11: 150-155, DOI: 10.25236/FER.2025.081122

core research sites were selected: Niutoushan Ancient Volcanic Crater, Nanding Island, Linjin Island, Xiangshan Lava Platform, and Qisha Bay.

Specifically, Niutoushan possesses a rare elliptical submarine ancient volcanic crater with clear and intact eruption sequences, meeting the standard requirement in Selective 1 to "analyze internal forces." The dense cluster of 1.4 million basalt pillars on Nanding Island represents the world's largest sample of columnar jointing, serving as a natural textbook for Geography 1's "identify volcanic landforms." The 16 circular vent clusters concentrated on Linjin Island visually demonstrate post-volcanic modification processes, aligning with knowledge on the "rock cycle." Xiangshan's basaltic "watermelon-skin structures" coexisting with sea arches and sea cliffs fully display wave erosion modification of volcanic landforms, meeting Geography 1's landform identification requirements. Qisha Bay's coastline, featuring both mangrove restoration projects and tourist boardwalks, provides a case study for learning about the "relationship between human activities and surface morphology."

The research itinerary follows a geological evolution sequence, prioritizing safety and feasibility, and constructs a four-stage linkage chain: "Magma Eruption → Lithification → Wave Erosion → Human Modification." The specific route proceeds as: Nanding Island → Niutoushan Ancient Volcanic Crater → Linjin Island → Xiangshan Bay → Qisha Bay, ensuring close articulation with curriculum content.

4.2 Setting Research Objectives

Research objectives form the starting point of activity design and a crucial basis for evaluating implementation effectiveness. [5] Grounded in the resource characteristics of the Zhangzhou Coastal Volcanic Geopark and aligned with the high school geography curriculum standards, this study establishes three integrated research objectives. First, in terms of knowledge and understanding, it aims to enable students to identify four typical volcanic-coastal landforms, comprehend the rock cycle process, and analyze how internal and external geological forces shape surface morphology. Second, regarding skills and methods, the study focuses on developing students' practical abilities, including the use of geological compasses, landform sketching, and conducting simple erosion experiments, thereby enhancing their geographical fieldwork competence. Finally, in the domain of affect and values, it seeks to deepen students' understanding of the human-nature relationship through geological observation and field investigation, strengthening their awareness of geological heritage conservation and fostering ecological civilization literacy.

4.3 Designing the Research Plan

4.3.1 Pre-Trip Preparation

(1) Knowledge Preparation: To enhance field study efficiency, systematic knowledge and skill preparation is required beforehand. Students should locate the Zhangzhou coastal geomorphological area on maps, understand its geological tectonic background, and review key content from Geography 1 Chapter 4 "Shaping of Landforms" and Fundamentals of Physical Geography Chapter 2 "Formation and Evolution of Surface Morphology." Training in interpreting geological maps, using a compass, and landform sketching should be conducted. To enhance practicality, a preset interview outline for Qisha Bay fishermen should be developed to discuss coastline changes and human activities, promoting integrated understanding of physical and human geography.

(2) Material Preparation: Essential materials and tools include: research handbook, tide timetable, magnifying glass, geological compass, measuring tape, sketchbook, first-aid kit, etc. The tide timetable ensures safety during coastal activities; the compass and tape are for landform mapping; the sketchbook is for recording observations, ensuring scientific rigor and safety.

(3) Group Formation: Prior to the trip, scientific team building is recommended. Administering a Kolb Learning Style Inventory can help identify students' learning characteristics regarding perception, processing, and judgment. Applying the principle of "homogeneity between groups, heterogeneity within groups", [6] students with different learning styles are strategically assigned to research teams. After grouping, encourage self-introductions, discussions on learning preferences, and work styles to build rapport and enhance collaboration efficiency.

4.3.2 On-Site Activities

Guided by the goal of cultivating core geographical literacy, activities are designed around the five research sites, emphasizing group collaboration, field observation, hands-on experimentation, safety, and

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standards, promoting deep integration of curriculum content and practice.

(1) Site 1: Nanding Island (Landform Observation)

Objective: Identify the typical volcanic landform—basalt columnar jointing—through field observation, describe its morphology, understand its formation via magma cooling contraction, and enhance regional cognition and comprehensive thinking.

Procedure: Under teacher guidance, groups safely observe the pillar cluster up close, measure orientation with a compass, and record jointing patterns, density, and overall morphology via photos or sketches. The student groups collaboratively count pillars within a defined area, estimate average diameter, compare them with textbook features, and discuss the formation process and cooling conditions.

Safety/Notes: Stay clear of cliffs and weathered rock; wear anti-slip shoes; do not climb on pillars.

(2) Site 2: Niutoushan Ancient Crater (Geological Structure Survey)

Objective: Observe the rare submarine ancient crater and its eruption profile, analyze the shaping mechanism of volcanic (internal) forces on surface morphology, identify main volcanic structural units, and cultivate comprehensive thinking and geographical practical competence.

Procedure: Follow the designated route to observe the crater, volcanic neck, multi-phase lava flows, and pyroclastic layers. The students use a compass to measure stratum attitude; identify physical characteristics of different layers under the teacher's guidance; draw a simplified eruption profile diagram and label key units. Subsequently, the students conduct group discussions on the cumulative impact of eruption phases on landform.

Safety/Notes: Heed safety in the crater area; do not enter restricted zones; be aware of falling rocks during profile observation; do not strike rock layers; respect heritage sites.

(3) Site 3: East Coast, Linjin Island (Vent Experiment)

Objective: Identify the distribution and morphology of rootless vents, understand their formation conditions and mechanisms via simulation, explore post-magmatic geological evolution, and enhance comprehensive thinking and geographical practical competence.

Procedure: Conduct field observation of vent shape, arrangement, and sedimentary infill. The students conduct a simple simulation: they use wet sand to simulate loose strata and blow through straws to mimic hydrothermal escape, then observe sand uplift and vent structure formation. Finally they compare simulation results with field observations, and analyze vent formation causes.

Safety/Notes: Monitor tides; the vent area surface is slippery; prepare and pack away experiment materials properly; maintain hygiene during the blowing experiment.

(4) Site 4: Xiangshan Lava Platform (Coastal Landform Survey)

Objective: Identify typical coastal landforms (sea cliffs, caves), understand the secondary modification of basalt platforms by weathering and wave erosion, recognize landform evolution under combined internal and external forces, and cultivate regional cognition and human-environment coordination awareness.

Procedure: Observe and record the spatial distribution, height, and morphology of coastal erosion features; identify "watermelon-skin" structures on basalt surfaces. The student groups conduct a simple experiment: they use a spray bottle to simulate wave erosion, compare the rock surface "before and after" erosion, and analyze the directionality and intensity of wave modification combined with field observations.

Safety/Notes: Do not climb cliffs or enter sea caves; avoid wave surges; watch footing on rocky surfaces.

(5) Site 5: Qisha Bay Mangrove Area (Human Activity Interview)

Objective: Analyze human intervention and impact on coastal morphology through observation of planted mangroves and boardwalks and interviews with fishermen, and enhance awareness of human-environment coordination and sustainable development.

Procedure: Observe and record the distribution and density of mangroves and mudflat changes; analyze the boardwalk's impact on landform structure. In a safe area, the students interview local fishermen using the preset outline (e.g., changes in the coastline before and after mangrove planting,

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wind and sand fixation effects, impacts on livelihoods). Then they collate observation and interview data; conduct group discussions on the pros and cons of mangrove restoration versus tourism development; summarize human-nature interrelationships.

Safety/Notes: Avoid trampling mangroves and mudflat traps; stay on designated paths; obtain consent before interviews; respect respondents.

4.3.3 Post-Trip Evaluation

A comprehensive evaluation system is crucial for assessing research outcomes. This program's evaluation, strictly based on curriculum standards and core geographical literacies, combines formative and summative assessment to measure the achievement of activity objectives across the five sites. It focuses on evidence of student learning, ensuring comprehensiveness, openness, and motivational effect, aiming for closed-loop optimization of teaching and learning via assessment. The specific performance evaluation rubric is detailed in Table 2.

Table 2 Research Study Performance Evaluation Rubric

Category	Stage	Criteria	Score	Self	Peer	Teach
Formative (60)	**Pre-Trip Prep (20)**	Adequate pre-learning	10			
		Complete material preparation	10			
	On-Site Process (40)	Practice Quality: Standardized measurement; Independent experiment completion	12			
		Inquiry & Collaboration: Clear roles, real-time data sharing	10			
		Safety & Protocol: Adherence to tide schedule; No touching heritage; Zero risk	10			
		Problem Solving: Identify/analyze typical issues, propose reasonable hypotheses	8			
Summative (40)	**Post-Trip Synthesis (40)**	Knowledge Integration/Application (Group): Explain columnar jointing; Argue H-E relationship at Qisha Bay	15			
		Outcome Creativity (Group): e.g., 3D volcano model, erosion animation	10			
		Presentation (Individual): Logical sequence; Accurate terminology	8			
		In-depth Inquiry (Group): Report includes specific data & conservation suggestions	7			
	Total Score		**100**			

5. Conclusion

Guided by the high school geography curriculum standards' emphasis on geographical practical competence, this paper selected the Zhangzhou Coastal Volcanic National Geopark as the field site and designed a research itinerary following the geological sequence: "Magma Eruption → Lithification → Post-formation Modification → Wave Erosion → Human Intervention."

Through diverse activities such as field measurement of columnar joints, vent simulation experiments, verification of wave erosion processes, and fisherman interviews, the program achieves deep integration with core curriculum content from Geography 1 (landform identification) and Selective 1 (human-environment relationship analysis). The construction of a performance-based evaluation rubric effectively quantifies the attainment of students' core literacies, enhancing the scientific rigor and effectiveness of the research study.

This research provides a methodologically sound and practically instructive reference for the design and implementation of volcanic-coastal geomorphology research study programs.

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References

[1] Ministry of Education of the People's Republic of China. (2020). Geography Curriculum Standards for Ordinary Senior High Schools (2017 Edition, 2020 Revision). Beijing: People's Education Press.
[2] Zhu, C. S. (2019). Research Study Program Design. Beijing: China Development Press.
[3] Shan, Y. (2019). The Strange Rocks of Volcanic Island: Xiangshan Small Dragon Head. Geography Teaching, (07), 65.
[4] Ding, D., & Qiu, Z. M. (2015). Zhangzhou Volcanic Island: Facing the Sea, Treading Waves, Listening to the Surf. Going Global, (08), 82-85.
[5] Shi, X. Y. (2019). Constructing Mind Maps to Enhance Comprehensive Geographical Thinking Ability. Geography Teaching, (14), 40-41.
[6] Hu, J. H., Muhtar · A., & Alim · Y. (2025). Research Study Design Based on Geographical Practical Competence: A Case Study of Zhangzhou Dongshan Island. Internal Technology, 46(01), 28-30+79.