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The Study on Ideological and Political Elements in *Introduction to the Earth* for the Science Education Major

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Abstract

As a foundational disciplinary course for the Science Education major, current practices of curriculum ideological and political construction in *Introduction to the Earth* mostly excavate ideological and political elements from the logical perspective of geoscience disciplines, with insufficient attention to the dual attributes of the Science Education major: normative teaching orientation and foundational nature. Based on the talent training orientation of the Science Education major, this paper proposes a four-dimensional framework of ideological and political elements: scientific spirit, dialectical thinking, ecological civilization, and cultural confidence. Accordingly, four integration pathways are designed: cognitive conflict, systematic thinking, authentic scenarios, and identity construction, so as to cultivate high-quality primary science teachers equipped with both scientific literacy and educational devotion.

Keywords

Science Education Major, *Introduction to the Earth*, Curriculum Ideological and Political Education, Ideological and Political Elements

1. Introduction

Curriculum ideological and political construction has moved from conceptual advocacy to in-depth implementation, yet disciplinary differences remain inadequately addressed. The *Guiding Outline for Curriculum Ideological and Political Construction in Institutions of Higher Education* requires that ideological and political elements be explored "in combination with the characteristics, thinking modes and value concepts of different courses". Nevertheless, existing research on curriculum ideological and political education for *Introduction to the Earth* is

largely concentrated on geoscience majors or engineering majors such as surveying, mapping and remote sensing. Their logical starting point for tapping ideological and political elements lies in the knowledge system of geoscience itself (Yang & Cheng, 2023; Zhu et al., 2022). Directly transplanting this logic to the Science Education major will lead to a fundamental mismatch: the Science Education major cultivates future primary science teachers. What they need is not merely to understand geoscientific knowledge, but the educational transformation capacity to comprehend "how scientific knowledge carries values" and "how to convey scientific spirit to children".

Scholars have explored models for curriculum ideological and political construction in the Science Education major from the perspective of educator spirit, pointing out problems including vague objectives, fragmented content and the lack of teacher-training attributes (Liu et al., 2025a; Niu et al., 2022). Within the curriculum system of the Science Education major, *Introduction to the Earth* functions to "build the basic framework of professional knowledge structure". The excavation of its ideological and political elements should transcend the superficial operation of "attaching value labels to professional content" and respond to a more fundamental question: when geoscientific knowledge enters student teachers' cognition, what kind of value experience and modes of thinking ought to be awakened simultaneously?

2. Curriculum Attributes and Principles for Excavating Ideological and Political Elements of *Introduction to the Earth* for the Science Education Major

2.1. The Duality of Curriculum Positioning

Introduction to the Earth holds a unique positioning for the Science Education major, distinct from geoscience majors. From the knowledge dimension, this course covers modules including the universe and Earth, sphere structure, minerals and rocks, geological processes, resources and environment, forming the foundational support for student teachers' knowledge system. From the educational dimension, it serves as a critical arena for student teachers to shape their views of science and science education. How a future science teacher perceives earth science will profoundly influence how they narrate the story of the Earth to children in the future.

As a general education course for non-geology majors, *Introduction to the Earth* plays an important role in "popularizing basic earth science knowledge, improving scientific literacy and fostering students' view of the Earth". This functional positioning is especially relevant to the Science Education major. Student teachers do not need to become geoscience specialists; rather, they should develop a view of the Earth and view of science sufficient to underpin their future teaching practice. It implies that the ideological and political objectives of this course should not be limited to "cultivating recognition of the geoscience profession", but oriented toward "cultivating self-awareness for the science education under-

taking". In other words, curriculum ideological and political education for the Science Education major needs to answer not only "what values earth science embodies", but also "how a science teacher ought to understand and transmit such values".

2.2. Three Principles for Excavating Ideological and Political Elements

Based on the above curriculum positioning, three principles should be followed when tapping ideological and political elements for *Introduction to the Earth* in the Science Education major.

Principle of priority for teacher-training attributes. The selection and transformation of curriculum ideological and political elements shall take "whether it facilitates the formation of student teachers' educational self-awareness" as the primary criterion. For instance, when extracting ideological and political elements from the Wenchuan Earthquake case, geoscience majors may focus on "responsibility for disaster prevention and mitigation". In contrast, the Science Education major should simultaneously explore "how to explain earthquakes to primary school pupils without triggering fear"—the latter represents the unique educational transformation capacity required of student teachers. For instance, disaster-themed teaching should "guide students to integrate personal values with national and social development". However, the science education major needs to go one step further: student teachers should not merely achieve such "integration", but also reflect on "how to teach children to make this integration".

Principle of cognitive deepening. Curriculum ideological and political education shall serve student teachers' understanding of the nature of science instead of pasting value labels on the surface of knowledge. The deep-time perspective, scale awareness and systemic concept embedded in earth science constitute the core of a scientific world outlook. Their ideological and political value lies in helping student teachers develop a mode of cognition that transcends daily experience, enabling them to guide children to understand "how science thinks" in future classrooms. The key to implementing the concept of "curriculum ideological and political education" in professional courses is to excavate and embed relevant ideological and political elements within professional teaching, closely integrating professional knowledge with ideological and political education to achieve subtle and holistic educational effects.

Principle of resource transformability. For each ideological and political element excavated, we must consider how student teachers can creatively apply it in future teaching scenarios. This principle demands that resource development extends beyond "cases usable for instructors" to "transferable teaching ideas for student teachers". It is necessary to construct a "curriculum-based ideological and political element case database". Instead of centering its design logic on "how teachers apply the cases", the database shall systematically consider "how student teachers adapt and utilize the cases".

3. Systematic Construction of the Framework for Ideological and Political Elements

Drawing on the three extraction principles of priority of teacher-education orientation, cognitive deepening, and resource convertibility, this study constructs a framework of ideological-political elements. The principle of priority of teacher-education orientation stipulates that all ideological-political dimensions must target the development of student teachers' educational competences, avoiding a mechanical copy of the talent-cultivation objectives for geoscience majors. The principle of cognitive deepening requires each dimension to be rooted in the inherent knowledge logic of earth science, rather than superficially attaching value-laden slogans. The principle of resource convertibility demands that materials corresponding to each dimension possess the potential for migration and adaptation to primary-school teaching. This study categorizes ideological-political elements into a four-dimensional framework: scientific spirit, dialectical thinking, ecological civilization cultural confidence.

3.1. Scientific Spirit: From Knowledge Conclusions to the Pursuit of Truth

The knowledge system of earth science records the human exploration of the unknown. When teachers present conclusions such as "the Earth is approximately 4.6 billion years old" and plate tectonics, Science Education majors should be guided to see the truth-seeking process behind these conclusions. During the paradigm shift from geocentrism to heliocentrism, the prudence of Copernicus, the courage of Bruno, and Galileo's observations jointly promoted cognitive revolution. Basalt samples returned by Chang'e-5 record lunar volcanic activity at approximately 2 billion years ago, expanding the boundaries of human understanding of the Moon's magmatic evolutionary history and embodying the ethos that "scientific conclusions are always open to new evidence" (Du et al., 2026; Feng & Hu, 2024; Sun et al., 2022).

This dimension carries dual ideological and political significance. On the one hand, it cultivates their own rational scientific spirit. On the other hand, it helps them realize that in future primary classrooms, when a child asks "Teacher, how do we know the Earth is 4.6 billion years old?", what they deliver should not merely be a number, but a way of thinking about "how science acquires knowledge".

3.2. Dialectical Thinking: From Classified Knowledge to Relational Thinking

Earth science inherently bears the attributes of systems science. Material circulation and energy flow among the lithosphere, atmosphere, hydrosphere and biosphere form an interacting whole. "Symmetry and symmetry breaking" in mineral crystal structures, "uniformitarianism and catastrophism" in geological evolution, and "enrichment and dissipation" in resource formation all embody dialectics

within the Earth system (Liu et al., 2025b). Philosophical connotations can be explored when explaining how various driving forces sustain the continuous motion of the Earth, so as to capture the dialectical features of geoscientific knowledge. In core chapters such as "Earth Material Composition" and "Geological Processes", the principles of dialectical materialism and the concepts of ecological civilization are integrated at the fundamental level.

The ideological and political value of this dimension lies in helping student develop relational thinking. When confronting discrete knowledge points in primary science textbooks in the future, they will consciously ask: "What is the relationship between this knowledge and others?" and "Where does it stand within the Earth system?" Such a cognitive shift from fragmented knowledge to systematic understanding is exactly what primary science education urgently needs.

3.3. Ecological Civilization: From Resource Utilization to Intergenerational Responsibility

Geoscientific knowledge naturally relates to value propositions of ecological civilization. The non-renewable nature of mineral resources, links between carbon cycles and climate change, and prevention and response to geological hazards all serve as concrete cases depicting human-nature relationships. China's practices in international resource governance, geoscientific pathways toward the "Dual Carbon" goals, and ecological restoration cases such as the Saihanba desertification control provide scientific evidence for the proposition that lucid waters and lush mountains are invaluable assets.

For the Science Education major, however, we need to go further: pre-service teachers should not only grasp the scientific underpinnings of ecological civilization, but also reflect on how ecological awareness can be fostered among children in primary science education. For example, the knowledge point of "non-renewable minerals" can be transformed into an inquiry activity suitable for primary school students: asking pupils to count mineral-derived materials in household goods and discuss "what happens once these resources run out". This pathway from knowledge comprehension to educational transformation constitutes the unique value of curriculum ideological and political education for the Science Education major.

3.4. Cultural Confidence: From Scientific and Technological Achievements to Identity Construction

Earth science abounds with Chinese stories. From embryonic geoscientific thoughts recorded in *Guanzi·Dishu* and *Dream Pool Essays*, to the dedication of senior geologists such as Tu Guangzhi and Yu Chongwen who devoted themselves to national mineral resource security; from the site selection wisdom of China's Five-hundred-meter Aperture Spherical Telescope (FAST), to China's world-leading number of Global Boundary Stratotype Section and Point (GSSP, or "golden spike") profiles (Liang et al., 2025). The value of these materials lies not merely in

inspiring national pride, but in helping student teachers build their identity as Chinese science educators.

Notably, the way patriotism is integrated serves as a demonstration for student . When they narrate the story of FAST in primary classrooms in the future, they need to learn not only to recount the achievement itself, but also to transmit value judgments on "why this achievement deserves pride". Therefore, resource development should include methodological guidance for "how to tell Chinese scientific stories to children".

4. Four Implementation Pathways for Integrating Curriculum-Based Ideological and Political Elements

4.1. Cognitive-Conflict Pathway: Fostering Evidence-Oriented Scientific Spirit through Conflicting Episodes in the History of Science

Training Activity for Pre-service Teachers: Implement the "Seminar Task on Cognitive Conflicts in the History of Science". Taking cases such as the debate between geocentrism and heliocentrism and evolving understandings of lunar volcanic activity, student teachers work in groups to sort out evidence, contradictions, and core scientific controversies across different historical periods. The core seminar question reads: Scientific conclusions change with new evidence. As primary-school science teachers, how will you avoid indoctrinating students with scientific knowledge as absolute and immutable truths? Student teachers submit seminar notes identifying pitfalls to avoid in their future teaching.

Adapted Teaching Scheme for Primary-School Students: An HPS (History, Philosophy and Sociology of Science) inquiry lesson *The Shape of the Earth*. Successively present historical viewpoints including "Heaven is round and the earth is square", the Hun cosmological theory, and the spherical-earth hypothesis. Layered cognitive conflicts are constructed. Students collect evidence through small-scale experiments such as a sailing-ship simulation and lunar-eclipse projection, so as to comprehend that "evidence supports viewpoints", rather than simply memorizing the conclusion that the Earth is spherical (Liu & Le, 2026).

4.2. Systematic-Thinking Pathway: Constructing Relational Dialectical Cognition via Tasks on Spheres Interaction

Training Activity for Pre-service Teachers: Assign the assignment "Mind-map Design for Spheres Interconnections". Centered on a selected geological phenomenon (e.g., soil erosion on the Loess Plateau), student teachers draw diagrams illustrating interactions among the lithosphere, atmosphere, hydrosphere and biosphere. Supplementary task requirements: extract 2 - 3 systemic logics accessible to primary-school learners, mark complex systemic concepts that require pedagogical simplification, and analyze the boundaries for cultivating systematic thinking at the primary-school level.

Adapted Teaching Scheme for Primary-School Students: Unit inquiry *Where*

Does Soil Come From. Through weathering-simulation experiments and observations of plants and animals in soil, students recognize that rocks, rainfall and organisms jointly contribute to soil formation. They initially develop the systemic notion that "multiple factors interact with one another", while complex specialized terminology is avoided.

4.3. Real-World-Context Pathway: Delivering Ecological-Civilization Education through Local Practical Issues

Training Activity for Pre-service Teachers: Mini-project on local geological-environment investigation. Student teachers work in groups to collect authentic news cases concerning local resource exploitation, geological hazards or ecological restoration, and analyze the underlying geoscientific principles. They produce a draft mini-teaching plan with a key reflective question: How can ecological and resource-related topics be transformed into feasible primary-school inquiry activities without triggering unnecessary panic or resorting to empty moralizing?

Adapted Teaching Scheme for Primary-School Students: Home-based mini-investigation *Minerals We Cannot Live Without*. Students count household items derived from mineral resources. A whole-class discussion is held on what will happen when mineral resources are exhausted, guiding students to develop plain-spoken ecological responsibility of resource conservation and care for the Earth.

4.4. Identity-Formation Pathway: Shaping Pre-Service Science Teachers' Professional Consciousness through Role-Model Narratives of Scientists

Training Activity for Pre-service Teachers: Group assignment "Teaching Design for Chinese Geoscience Stories". Select Chinese geoscientists and research achievements such as Li Siguang and the Chang'e-5 research team. Student teachers compile lecture scripts for primary-school classrooms with a central reflection: What core messages should be conveyed when telling scientists' stories to primary-school children? Rather than merely glorifying achievements, emphasis should be placed on scientific inquiry processes and commitment to the nation. Groups give presentations and conduct peer review, evaluating narrative appropriateness from the perspective of primary-school science educators.

Adapted Teaching Scheme for Primary-School Students: Story reading and classroom sharing *Our Lunar-Exploration Stories*. Combining the scientific procedures of Chang'e-5 sample collection, the lesson recounts how Chinese scientists overcame technical difficulties. Students are guided to appreciate the perseverance and rigor required in scientific research and form a rudimentary sense of patriotism toward scientific undertakings.

5. Conclusion

The core of curriculum ideological and political construction of *Introduction to the Earth* for the Science Education major does not lie in the quantity of ideolog-

ical and political elements excavated, but in whether it responds to the fundamental attribute of teacher training. When we shift the coordinate for excavating ideological and political elements from the geoscience knowledge system to the growth demands of future science teachers, the nature of the question transforms. The question is no longer "what ideological and political values this knowledge point carries", but "how this knowledge point helps student teachers understand scientific values and pass such understanding onward" (Zhai, 2024).

Curriculum ideological and political education for the Science Education major essentially unifies the ideological and political education of scientific views and educational views. Geoscientific knowledge acts as the carrier; modes of scientific thinking and value judgment constitute the core; and the ultimate goal is to enable future teachers to consciously translate this core into educational practice.

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Author Contributions

Conceptualization, H.W. and L.W.C.; writing—original draft preparation, H.W., L.W.C. and Y.L.R.P.; writing—review and editing, H.W. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

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

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