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Proposing a geoeducation framework for China's geoparks through insights derived from Tokachi-Shikaoi Geopark, Japan

（とかち鹿追ジオパークからの知見にもとづく中国のジオパークに対するジオ教育の枠組みの提案）

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Abstract

Geoeducation is a critical tool for fostering geoscientific literacy, environmental awareness, and sustainable development among students. Geoparks, as dynamic educational platforms, provide unique opportunities to bridge classroom learning with real-world geological phenomena. Despite the potential of geoparks to enhance educational outcomes, the efficacy and long-term impacts of geoeducation programs remain underexplored, particularly in the Chinese context. This study evaluates the geoeducation programs at the Tokachi-Shikaoi Geopark in Japan and the Cuihuashan National Geopark in China, aiming to enhance the quality and effectiveness of geoeducation across geoparks, in on China. The specific aims include: (1) to propose a new geoeducation framework in Tokachi-Shikaoi Geopark to maximize the efficacy of geoeducation; (2) to evaluate the current geoeducational practices at the Cuihuashan National Geopark to understand their efficacy and identify potential improvements; (3) to develop recommendations for enhancing geoeducation at the Cuihuashan National Geopark; and (4) to propose geoeducation framework for China's geoparks.

A mixed-method approach was employed to ensure a comprehensive evaluation of geoeducation programs. Quantitative data from questionnaire surveys assessed students' geo-knowledge comprehension and attitudes before and after participating in geoeducation programs. Qualitative insights were obtained through interviews with educators, geopark staff, and other stakeholders. Additionally, content analysis of educational materials, including textbooks and guidebooks, was conducted to evaluate their alignment with geoeducation goals. Statistical tools were used to analyze the findings, ensuring scientific rigor and reliability.

Findings from Tokachi-Shikaoi Geopark demonstrated the notable impact of its 15-year "Geoeducation Program," with 67.0% of participants expressing pride in their local geopark compared to 13.7% of non-participants. Students who participated in the program consistently showed higher geo-knowledge comprehension (mean score: 4.12 vs. 3.53) and greater interest in geopark-related activities (46.4% vs. 24.2%). However,

challenges such as insufficient teacher training, frequent staff turnover, and budgetary constraints limited program continuity and scalability.

At Cuihuashan National Geopark, students participating in study tours exhibited substantial geo-knowledge improvements. First-time participants' understanding of topics such as "Forces Shaping the Earth's Surface" increased from a mean score of 3.53 to 4.12, with 77.1% reporting heightened environmental awareness post-tour. Additionally, familiarity with the geopark increased significantly among both experienced (53.7%) and first-time participants (49.7%). Despite these successes, challenges included limited integration of geopark content into curriculums, large group sizes, and low teacher involvement during tours.

Based on these findings, this study proposes two adaptable models for geoeducation: a networked stakeholder model for geoparks with robust institutional support, and a government-led model for remote or resource-limited geoparks. Both models emphasize the integration of digital tools, such as e-guidebooks and virtual geotours, to enhance accessibility and engagement. Collaboration with universities and improved teacher training were identified as critical components for advancing geoeducation.

This study concludes with a comprehensive geoeducation framework tailored to the diverse conditions of Chinese geoparks, designed to maximize educational impact while promoting sustainability. By leveraging insights from the Tokachi-Shikaoi and Cuihuashan case studies, the proposed framework addresses critical challenges such as resource limitations, technological adoption, and stakeholder collaboration. This study contributes to the broader goals of fostering geoscientific literacy, environmental conservation, and sustainable development and offers actionable recommendations for policymakers, educators, and geopark administrators.

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Chapter 1. Introduction

1.1 Research background

1.1.1 Concept of geoeducation

Geoparks aim to fulfill three core objectives: the protection of geological relics, the dissemination of geoknowledge, and the promotion of local economic development (McKeever & Zouros, 2005; Dowling & Newsome, 2010; Erikstad, 2013; Stoffelen et al., 2019). Geoeducation (hereafter, all kinds of education, related to the main objectives of geoparks, such as geoscientific education, earth science education, geology education, and geography education are referred to as geoeducation) serves as the foundation for these objectives. Through geoeducation, geoparks not only protect geological/geographical relics but also cultivate public awareness of natural processes and geological formations and reinforce the appreciation and conservation of regional geological heritage (Ríos et al., 2020). Geoeducation provides valuable insights into geoheritage by offering educational activities centered on geosites, specific locations with significant geological importance, including geomorphological and paleontological features (Newsome and Dowling, 2018; Brocx and Semeniuk, 2019). A deeper understanding of geoeducation thus plays a crucial role in advancing sustainable development and geoconservation efforts across societies (Simbaña-Tasiguano et al., 2024)

1.1.2. Geoeducation on geoparks

Education for sustainable development is central to geopark programming, as it links environmental stewardship with community well-being (Takenouchi, 2016). Geoparks typically educate the public on geo-knowledge and environmental concepts through various means such as museums, information centers, guided tours, school programs, maps, educational materials, and seminars. These initiatives provide both formal and informal learning opportunities, promote environmental consciousness and

instilling the importance of sustainable development among students and the general public (Álvarez, 2020; APGN, 2022).

UNESCO Global Geoparks prioritize education as a fundamental goal, a point underscored by Štrba and Palgutová (2024), Despite this, research specifically targeting geoeducation is relatively limited, with only 15.7% studies from 2002 to 2018 focusing on this area (Stoffelen, 2020). Although there is the increasing number of literature spanning geoheritage conservation, geotourism and community development (Briggs, Newsome, & Dowling, 2022; Dousin, et al, 2022), the emphasis on geoeducation remains notably low. This trend is supported by a recent bibliometric review by Valencia-Arias et al. (2023), which analyzed 406 publications and identified research trends on the relationship between conservation, education and development in geoparks. The review highlighted significant publication peaks in 2019 and 2021 but pointed out that the educational aspects are still underrepresented.

Previous studies have illustrated the multiple facets of geopark research. For instance, Dousin et al. (2024) explored the mediating effects of support for geopark development on community well-being at the Kinabalu UNESCO Global Geopark in Sabah, Malaysian Borneo. This study highlighted the economic and socio-cultural benefits linked to geopark development. Additionally, Jeon et al. (2025) evaluated the local economic impacts of UNESCO Global Geoparks and their operational efficiency through Data Envelopment Analysis (DEA). Similarly, a conceptual review by Fauzi and Misni (2016) examined the indicators that affect the condition and sustainability of geoparks, focusing on ecotourism development and potential environmental impacts associated with increased tourism.

Despite these contributions, the educational value of geoparks, essential for sustainable development and community engagement, often receives less attention. Valencia-Arias et al. (2023) noted that while geotourism and geoheritage significantly contribute to the discussion, the educational component remains less prominent. This gap is notable, as geoeducation is essential for fostering public understanding and appreciation of geological phenomena and heritage, which supports the long-term conservation and sustainable use of these geosites. The overall low academic visibility

of geoscience, with fewer dedicated researchers compared to more established disciplines such as physics or chemistry, contributes to this issue. Over the past decade, there has been a significant decline in undergraduate enrollment in university geoscience programs (Stewart et al., 2023). In countries such as Australia, some universities have even closed their geoscience departments (Geoscience on the Chopping Block, 2021). Consequently, geoeducation and research face significant challenges, further exacerbated by limited departmental and programmatic support in universities (Ferrier et al., 2024). As a results, publications related to geoeducation are fewer and have less impact within the scientific community (Martínez‐Martín et al., 2023).

Nevertheless, case studies underscore geoeducation's value in formal education. Henriques et al. (2012) investigated Portugal's Arouca Geopark, found that geoeducation initiatives can heighten students' interest in geoscience and stimulate curiosity about other geoparks. Similarly, Comănescu and Nedelea (2020) emphasized the need to integrate geoeducation at all educational levels, both within and outside formal school setting, to enhance awareness of geoenvironmental factors. In Hong Kong UNESCO Global Geopark, educational programs focused on conveying geo-knowledge and cultural concepts, particularly through student-oriented guided geotours, seminars, and other activities (Wang et al., 2015). Additionally, Huangshan UNESCO Global Geopark in China provides educational programs and learning materials tailored to the needs of all levels in elementary, junior high, and high schools and universities, utilizing valuable educational resources for fieldwork and geological/geographical studies (Han et al., 2018).

Globally, geoeducation initiatives within geoparks are acknowledged for their contributions to sustainable development, geoheritage preservation and public engagement. For instance, Álvarez (2020) examined the Villuercas-Ibores-Jara UNESCO Global Geopark in Spain, where geoeducation is integrated into the local community to foster sustainable practices. Zelenka et al. (2024) illustrated how global geoparks encourage global citizenship through education on sustainability. Fernandes et al. (2021) investigated the role of geoeducation in the Estrela Geopark in Portugal

and emphasized that education supports geotourism and serves as a crucial pillar for heritage conservation, thereby supporting the sustainable development of communities. Additionally, Marescotti et al. (2022) analyzed the strategy employed by the Beigua Geopark to integrate geoheritage with education and tourism, which not only enhances local community engagement but also fosters sustainable tourism practices.

In Japan, geopark activities have become widely popular (Watanabe, 2018). Geoeducation is seen not only as a means of teaching geosciences but also as a way to instill local pride and encourage environmental stewardship among students and residents. Ogata (2009) highlighted the role of geoeducation in promoting geotourism, while Takahashi & Tsuchimoto (2016) showed that teaching in geosites can effectively raise students' interest and develop a sense of local pride. In Itoigawa UNESCO Global Geopark, the integration of geoeducation into school curricula, with teacher training support from the local Municipal Board of Education, exemplified how geoeducation strengthens community engagement (Takenouchi, 2016). Arima (2016) also emphasized geoeducation's tourism value, highlighting a project between Hakone Geopark and Teikyo University to enhance tourism education. In Muroto UNESCO Global Geopark, Yuhora et al. (2016) found that geoeducation initiatives strengthen connections between schools, local governments, and residents, enriching students understanding of geology, history, and culture.

In China, geoeducation within geoparks has become an important component of regional development, aligning with broader goals of environmental conservation and sustainable tourism. Jia et al. (2023) detailed the approach of the Longyan Aspiring Geopark, which integrates geoeducation with sustainable tourism to benefit local communities. Similarly, the Huangshan UNESCO Global Geopark offers well-structured, curriculum-aligned geoeducation programs that include geological fieldwork, providing students with practical, hands-on geological experiences (Han et al., 2018). The Dunhuang UNESCO Global Geopark serves as another example of successfully combining geoeducation with sustainable tourism practices, where educational programs not only encourage community involvement but also support conservation-oriented tourism (Cai et al., 2023). Furthermore, Jia et al. (2023)

highlighted the Longyan Aspiring Geopark's initiatives in geoeducation and geoconservation through local engagement and sustainable tourism. This view is also supported by Xu and Wu (2022), who contend that China's geoparks are instrumental in enhancing public awareness of geoheritage, positioning geoeducation as a foundational component of local geoconservation strategies.

1.2. Geopark system in the world

1.2.1 UNESCO Global Geoparks and national geoparks

The concept of UNESCO Global Geopark (UGGp) was formalized during the 38th session of UNESCO's General Conference in 2015, where 195-member states ratified the creation of the label under the International Geoscience and Geoparks Programme (IGGP). This program is designed to enhance the recognition of geoparks, promoting the conservation and public awareness of geologically significant territories (McKeever, 2015). UNESCO Global Geoparks are defined as unified geographical areas where landscapes and sites of international geological significance are managed under a comprehensive framework that emphasizes protection, education, and sustainable development. The governance of these geoparks adopts a bottom-up approach, integrating conservation efforts with sustainable development while involving local communities (UNESCO, 2024)

The geopark concept gained traction in the early 2000s, reflecting a growing global awareness of the need to preserve natural georesources. Initiated in some European Union countries in 2000, the movement quickly expanded to China, contributing to the establishment of the European Geoparks Network and the National Geoparks of China (Henriques and Brilha, 2017). This led to the support of UNESCO in 2004, facilitating the creation of the Global Geoparks Network (GGN). Initially composed of European and Chinese geoparks, GGN aimed to foster high standards in geopark services, promote shared strategies, and encourage best practices among its members, which numbered more than 100 by 2014, gaining legal status that same year (Eder and Patzak, 2004). By 2018, further networks such as the Asian Pacific Geoparks

Network and the Latin American and Caribbean Geoparks Network had been established (Pásková and Zelenka, 2018). As of 2024, there are 213 UNESCO Global Geoparks spread across 48 countries. The countries with the most significant numbers of geoparks, including China leading with 41 UNESCO Global Geoparks (19.2%), followed by Spain with 15 (7.0%), Italy with 11 (5.2%), Japan with 10 (4.7%), Germany with 8 (3.8%), and France and the UK each with 7 (3.3%), are distinctly featured (Figure 1.1).

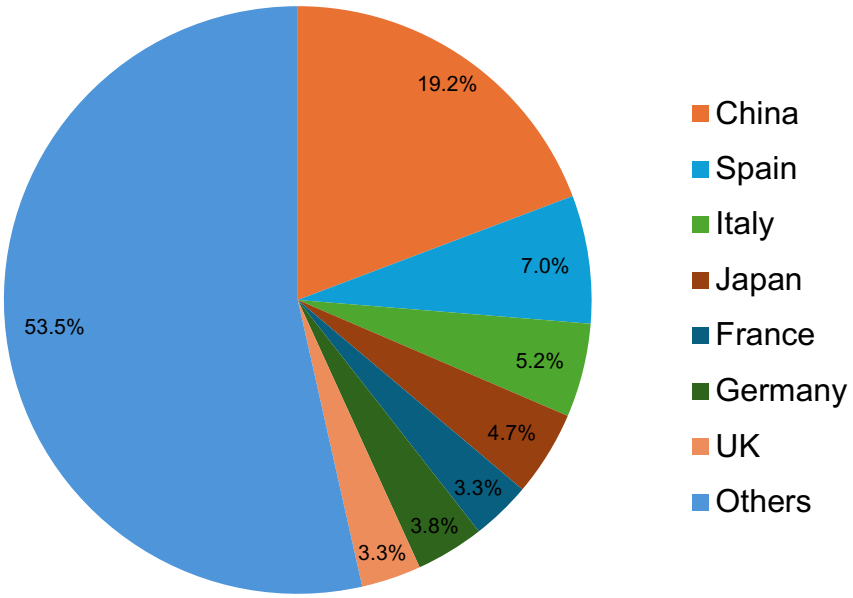


Figure 1.1. Countries with the higher number of UNESCO Global Geoparks as of 2024 (Source: Official website of UNESCO Global Geoparks)

In contrast, National Geoparks are recognized by national authorities that focus on preserving geoheritage and supporting local tourism through educational and tourism-related activities (Geopark Ries, 2021). While they share similar objectives with UNESCO Global Geoparks, National Geoparks are primarily managed at the national level and may adopt standards and objectives that reflect needs (UNESCO, 2015)

1.2.2 Chinese geoparks network

China's vast geographic expanse features complex geographical conditions, a variety of geological structures, and rich georesources. Recognized for its diversity geology, China is one of the few countries globally with multiple geological feature types. This diverse supports the establishment of geoparks across the nation, a movement initiated in response to both UNESCO's call for a "Global Geopark Network System" and the State Council's directive to protect georesources.

The Chinese Geopark Network (CGN) was officially established in 2002, catalyzed by the Ministry of Land and Resources. This development followed the global trend set by UNESCO in 2004, integrating eight Chinese geoparks initially. By 2022, the expansion of this network is evident with 41 sites designated as UNESCO Global Geoparks (UGGps) and 281 national geoparks. This growth has positioned China as a leading country in geopark development, underscoring its commitment to preserving geoheritage while fostering scientific research and public geoscience awareness (Xu and Wu, 2022). The expansion of geoparks has significantly influenced local economies, enhanced economic development and facilitated both domestic and international cooperation. The CGN plays a crucial role in coordinating these efforts, and ensures that both national and global geoparks with China operate efficiently (Ding et al., 2020).

The governance of Chinese geoparks is mainly state-led. Over the years, management practices have been refined to address the unique characteristics of each geopark and enhance the protection and conservation of geological heritage. This approach is facilitated by central and local government authorities and differs from other countries where non-governmental organizations or community groups play central roles. Despite the government-led model, many geoparks in China also function as nature reserves or national forest parks, this dual role introduces administrative complexities, and often leads to overlapping management and inefficiencies (Dong et al., 2006).

Within this framework, Chinese geoparks typically operate under enterprise-led management supervised by local governments, employing two primary models. The

first model utilizes State-Owned Enterprises (SOE) to manage all geopark resources. The SOE model designates SOEs to oversee resource management, emphasizing the conservation of geological relics while also generating revenue through ticket sales allocated to the government and other business incomes shared with the management committee. Conversely, the Private Enterprise model empowers private firms to manage tourism-related activities, including ticketing, with exclusive rights and the obligation to pay a franchise fee to the geopark administration, reflecting a partnership for heritage preservation and sustainable tourism development (Cai et al., 2021).

Between 2004 and 2024, the number of UNESCO Global Geoparks in China increased from 8 to 47 to make the highest growth worldwide. However, it is important to note that, due to recent efforts by the Chinese government to integrate and optimize natural protected areas, the updated number and the official list of Chinese national geoparks are currently unavailable, with the last recorded count standing at 281 (Figure 1.2).

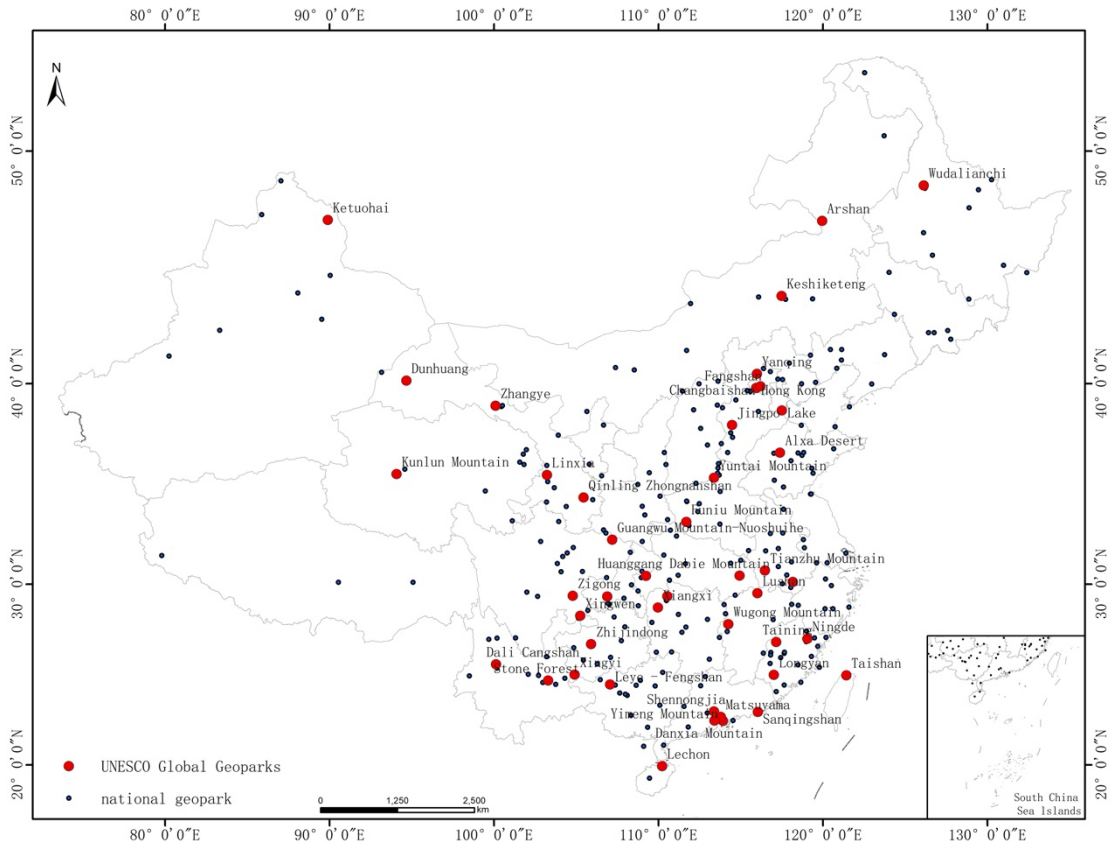


Figure 1.2. Distribution of UGGps and national geoparks in China. There are 47 UNESCO Global Geoparks as of 2024 and 281 national geoparks (including 47 UNESCO Global Geoparks) as of 2020 in China (Data unpublic data from Kongjian Guihua Data).

1.1.3 Japanese geoparks network

Geopark initiatives in Japan commenced in 2004 with the establishment of the Geoscience Utilization Promotion Institution to enhance the use of geological information. The following year, the Japanese Geopark Establishment Promotion Committee was created under the Geological Society of Japan. This committee adapted the Japan's GGN guidelines for national use and encouraged local governments with geological heritage sites to apply for geopark status (Ohtani & Kikuchi, 2019). By 2007, the formation of the Japan Geopark Promotion Council, consisting of several local governments, laid the foundation for the establishment of the Japan Geopark Committee (JGC) in 2008, composed of geoscience experts driving these initiatives (Ogata, 2009). The popularity of geoparks increased with the establishment of the

Japanese Geoparks Network (JGN) in 2009, which brought together established and aspiring geoparks to promote geotourism and raise public awareness of geoheritage (Watanabe, 2018). The JGC plays an important role in overseeing the application and evaluation process for international recognition and managing active geoparks.

Since 2016, the Japanese National Commission for UNESCO has officially recognized the JGN as the Japan Geopark Committee, empowering it to oversee the application processes for UNESCO Glaobal Geoparks status and national geopark designations. To be recognized as a UNESCO Global Geopark, the site must first be acknowledged as a Japanese National Geoparks by the JGN (Mammadova, 2018). The JGN' key initiative encompasses a range of activities aimed at: (1) promoting regional economic growth; (2) protecting the environment and promoting social education; (3) popularizing geoknowledge; (4) promoting physical and intellectual development of children; (5) promoting disaster prevention education; and (6) promoting events on "how to achieve social sustainable development" (JGN, 2023).

Notably, geoparks in Japan do not hold any formal legal status or framework. The management, evaluation, and networking of both UNESCO Global Geoparks and Japanese Geoparks are handled by two nonprofit organizations: the Japanese Geoparks Network (JGN) and the Japan Geopark Committee (JGC). Japan currently has 10 UNESCO Global Geoparks and 47 national geoparks (Figure 1.3), reflecting its committee to integrating geoheritage into broader social and educational frameworks.

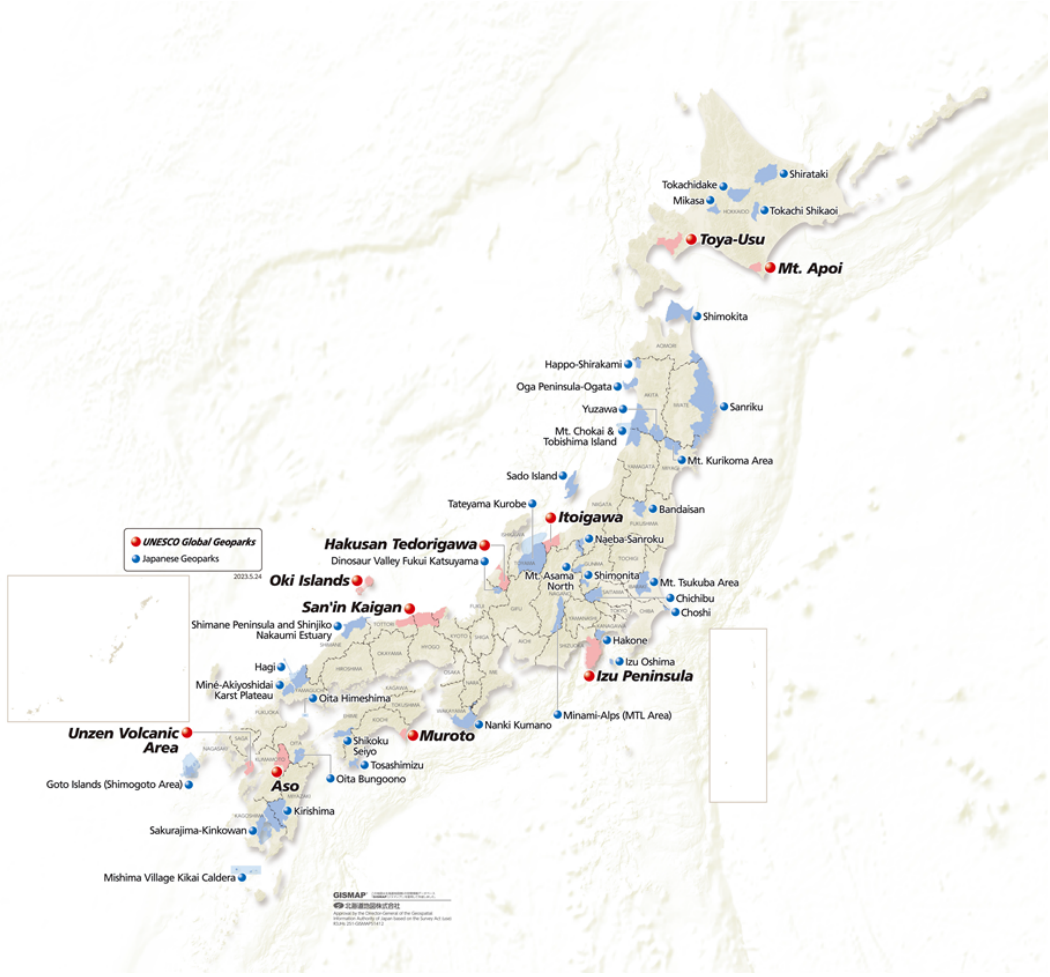


Figure 1.3. Location of geoparks in Japan (Source: Official website of Japanese Geoparks Network, https://geopark.jp/).

1.3 Research objectives

The growing importance of geoeducation in geoparks has been increasingly recognized as key for promoting sustainable development (García-Sánchez et al., 2021). Despite the widespread establishment of geoparks and their potential as educational platforms, the efficacy and impact of geoeducational programs vary considerably (Henriques et al., 2019). Moreover, comprehensive analyses of these programs, especially within the Chinese context, remain limited. This study aims to enhance the quality and effectiveness of geoeducation across geoparks, focusing particularly on China.

Schools in Shikaoi Town, northern Japan, had been designated as the ‘Research Development Schools’ by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) from April 2003 to March 2018. This resulted in the

implementation of a 12-year consistent system of education for elementary, junior high, and high school students in the town (MEXT, 2022). In this program, an independent discipline known as the 'Geoeducation Program' was developed, encompassing a stage referred to as 'Shin-Chikyu Gaku' (New Earth Science). This has become a compulsory course for up to 15 years, aiming to foster the development of a sustainable society. Since its establishment, the Tokachi-Shikaoi Geopark, certified in December 2013, has been included in the program to help geoeducation. However, no research on the long-term efficacy of such educational programs exists. Therefore, this study first aimed to examine of educational approaches and their long-term impacts at the Tokachi-Shikaoi Geopark, Japan. This study also aimed to conduct a comprehensive assessment of the geoeducational approaches employed at the Cuihuashan National Geopark in China to identify strengths and pinpoint areas needing enhancement. This evaluation will serve as a case study, providing a foundation for understanding the effectiveness of current educational practices within the broader scope of Chinese geoparks. Insights gained from the Tokachi-Shikaoi Geopark will inform targeted recommendations aimed at refining geoeducation strategies at Cuihuashan National Geopark.

The primary study of this research is to optimize geoeducation within China's geoparks by drawing on the experiences and insights from the Tokachi-Shikaoi Geopark. The specific aims are as follows: (1) to propose a new geoeducation framework in Tokachi-Shikaoi Geopark to maximize the efficacy of geoeducation, (2) to evaluate the current geoeducational practices at the Cuihuashan National Geopark to understand their efficacy and identify potential improvements, (3) to develop recommendations for enhancing geoeducation at Cuihuashan National Geopark, and (4) to propose geoeducation framework for China's geoparks, thereby fostering a geoeducational environment conducive to long-term sustainable development.

1.4 Study framework

This study is organized to systematically investigate and enhance geoeducation within geoparks, particularly focusing on examples from China and Japan. The

structured approach is pictured in a framework (Figure 1.3), which shows the relationships among the chapters for a consistent understanding of the thesis structure.

Chapter 2 delivers comprehensive descriptions of both Tokachi-Shikaoi Geopark in Japan and Cuihuashan National Geopark in China. It specifies the general methodology used to assess and improve geoeducational practices within two geoparks. Following this, Chapter 3 presents the current state of geoeducation in Tokachi-Shikaoi Geopark, followed by a detailed account of the proposed new framework to maximize educational outcomes in the geopark. Chapter 4 shifts the focus to evaluating geoeducation at Cuihuashan National Geopark, where the present state of geoeducation is assessed for its efficacy and areas needing enhancement are identified. This assessment incorporates both qualitative and quantitative evaluations of educational methods and their impacts. In Chapter 5, insights from the earlier chapters are integrated to discuss findings and offer specific recommendations for advancing geoeducation at Cuihuashan National Geopark. This chapter also explores how these enhancements could be extended to other geoparks across China. The last chapter concludes, which the study findings and highlights the contributions of the findings to the field of geoeducation.

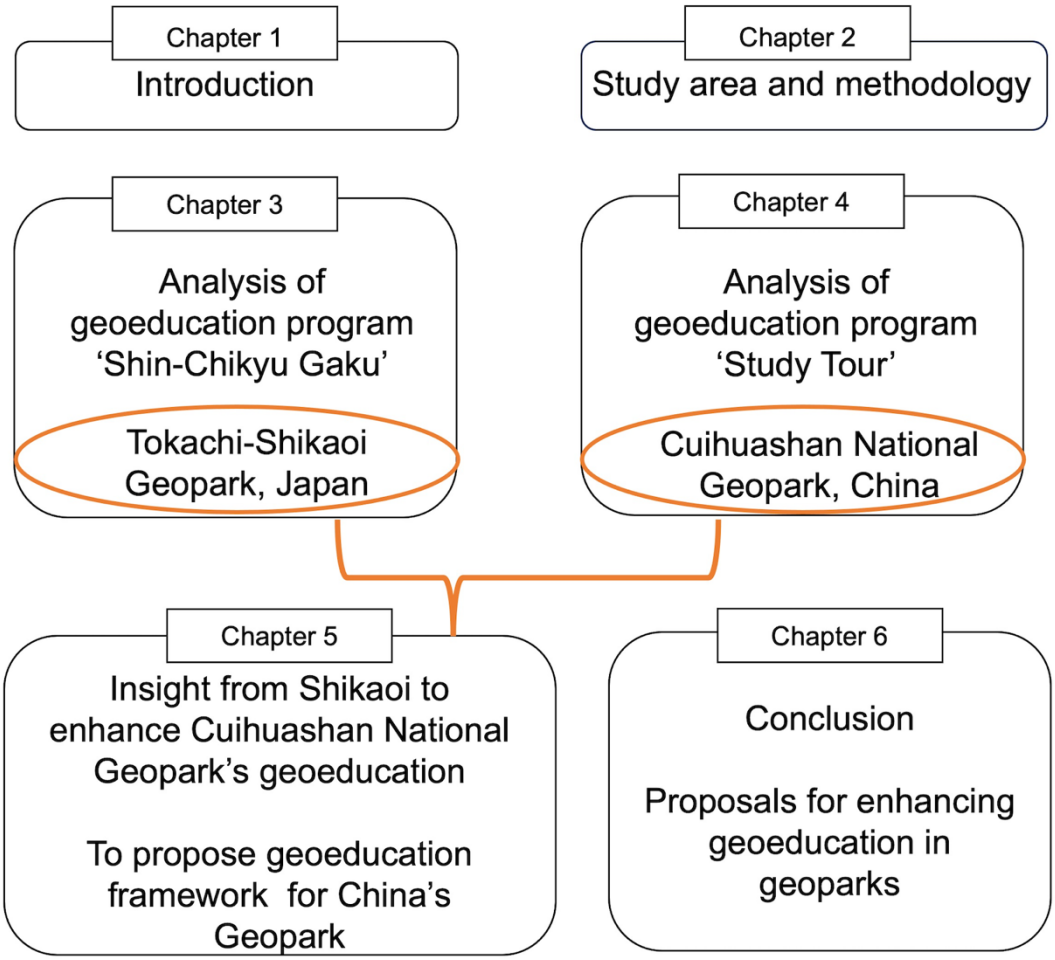


Figure 1.4. The structure of this dissertation

Chapter 2. Study area and methodology

The primary study area for this research is the Cuihuashan National Geopark in China, preliminary web searches and interview surveys were conducted before designing and arranging this research. The initial interview survey, carried out from January 23–28, 2022, which provided a basic understanding of the formal geoeducation model at Cuihuashan National Geopark. Interview results identified May to July as the most favorable period for field studies, attributed to favorable safety conditions, climate, and accessibility, enhancing the learning experience regarding the geology of Cuihuashan National Geopark. These factors motivated the choice of this period. Furthermore, an interview with a managerial staff member conducted online, significantly contributed to the design of this research.

In addition to Cuihuashan, one of study area continues to be the Tokachi-Shikaoi Geopark in Shikaoi Town Japan. This geopark was included in the 12-year consistent 'Geoeducation Program,' established by Shikaoi Town Schools under the MEXT from April 2003 to March 2018.

2.1 Study area

2.1.1 Tokachi-Shikaoi Geopark, Japan

In continuation of my previous research on the geoeducation of Japan, this dissertation further explores the geopark education program framework within the Tokachi-Shikaoi Geopark. Shikaoi, located in Hokkaido's Tokachi Sub-prefecture, is a town with a rich heritage and a name derived from the Ainu language, meaning 'following and hunting deer' ('Kutek-us-i) (Town of Shikaoi, 2016a). As reported by the 2022 census, Shikaoi had a population of 5,266 and spanned an area of 404.70km2 (Town of Shikaoi, 2016b), which is depicted geographically in Figure 2.1A.

The landscape of Shikaoi is distinctly divided, with the northern half consisting of volcanic mountains that are part of the Daisetsuzan National Park (Figure 2.1B), contrasting sharply with the southern half's expansive farmland situated on a flat plain. This variation in terrain is encompassed within the Tokachi-Shikaoi Geopark, which

covers the entire town (Figure 2.1C). The geopark not only preserves numerous geological and geographical treasures but also provides an important educational resource, facilitating the education of future generation on natural and geological heritage.

The geological history of Shikaoi, shaped by ancient volcanic eruptions, has endowed the region with a diverse array of natural resources, enhancing its value as prime location for studying volcanic processes and their impact on the land (Onishi, 2018). Unique within Japan, the Tokachi-Shikaoi Geopark focuses on the theme of 'ice,'

Owing to its permafrost features, which allows exploration of life adaptations in cold climates and the resulting geographic, ecosystem and industrial developments (Sawada et al., 2003).

The geopark offers a comprehensive exploration of Hokkaido's geological evolution, with a particularly focus on the Shikaribetsu Shikaoi Area volcanic group in northern Shikaoi and the Tokachi Plain to the south. It provides visitors with direct experiences of geological processes and periglacial phenomena, including freeze-thaw-weathered slopes and windholes that release cold air in the summer and warm, moist air in winter. As a valuable educational resource, the geopark effectively promotes the dissemination of geological knowledge, offering activities that significantly enhance visitors' understanding of geoscience. This makes the geopark an excellent venue for educating the public about geological phenomena and their broader environmental implications.

For my dissertation, the Tokachi-Shikaoi Geopark provides a vital case study in evaluating the effectiveness of geoeducation programs in Japan. It offers 17 designated geosites, each presenting unique learning opportunities about the area's geology, ecosystem, and regional culture.

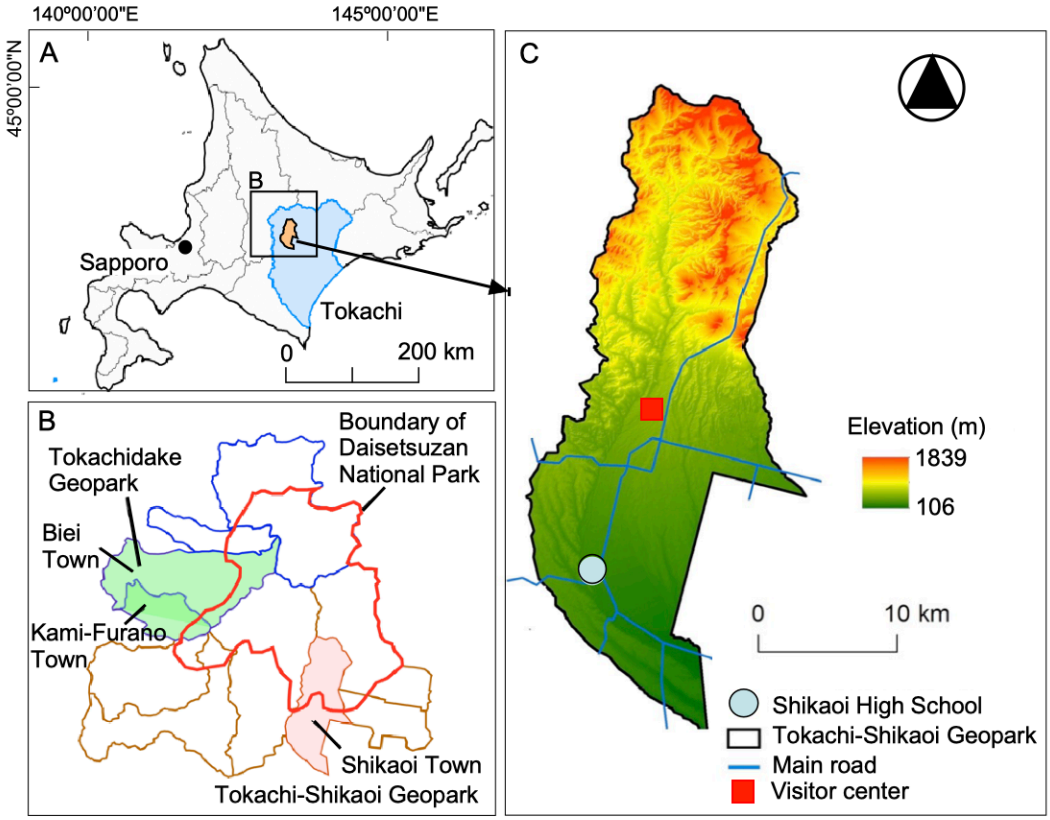


Fig. 2.1. Study area. A: Location of Shikaoi Town in Hokkaido; B: Daisetsuzan National Park and its geoparks; C: Tokachi-Shikaoi Geopark, created with a 10-m Digital Elevation Model provided by the Geospatial Information Authority, Japan.

2.1.2. Cuihuashan National Geopark, China

Cuihuashan National Geopark is a core part of the Qinling Zhongnanshan UNESCO Global Geopark (QZUGG) and lies within a short 25km distance from Xi'an, making it the closest geopark to a city worldwide (Yang et al., 2018). Initially designated a member of the Global Geopark Network (GGN), QZUGG spans 1074.85 km2 and holds the title 'Chinese Central National Park.' It includes eight National Forest Parks: Cuihuashan, Nanwutai, Zhuque, Taiping, Lishan, Heihe, Wang Shunshan, and Lantian Ape Man Site. These forest parks are integral to the geopark, to showcase a rich tapestry of geological, cultural, and natural heritage sites (Table 2.1). Notably, Cuihuashan serves both as a National Forest Park and a National Geopark, making it one of the focal research areas (Figure 2.2). QZUGG encompasses major attractions across the Qinling orogenic Belt, Quaternary geological heritages, geomorphological

sites, and the heritages of Homo erectus. Located at the primary intersection of the northern and southern continental plates in China, The QZUGG functions as a natural boundary. This division delineates distinct differences in geology, geography, ecology, climate, environment, and culture between the northern and southern regions of China. Since its endorsement by UNESCO in August 2009, the geopark has been recognized as the first global geopark in northwest China (Qinling Zhongnanshan UNESCO Global Geopark, 2024a).

Table 2.1. Summary of parks in the Qinling Zhongnanshan UNESCO Global Geopark

Park Name	Key Features
Cuihuashan	Mountain collapse-slide relics; ranked first in China, third globally; nature-endowed rare geological relic
Nanwutai	Buddhist culture; Wutai granite and Shengshou Temple scenic groups; diverse geological formations.
Zhuque	Periglacial landforms; cliffs; forest; fossil sea; Qinling International Juvenile Geoscience Campsite.
Taiping	Four landscape groups; historical imperial recreation site; Sui and Tang Dynasties; diverse geological formations.
Lishan	Geological heritage; tectonic activity; Neogene and Quaternary stratigraphy; historical uplift.
Heihe	Quaternary glacial morphology; natural alpine meadow; virgin forest; Qinling Nature School
Wangshunshan	Granite landscapes; Yuhuang Peak (2,239m); vertical joints; waterfall.
Lantian Ape Man Site	Homo erectus jawbone and brain box fossils; ancient mammal fossils; important archaeological site.

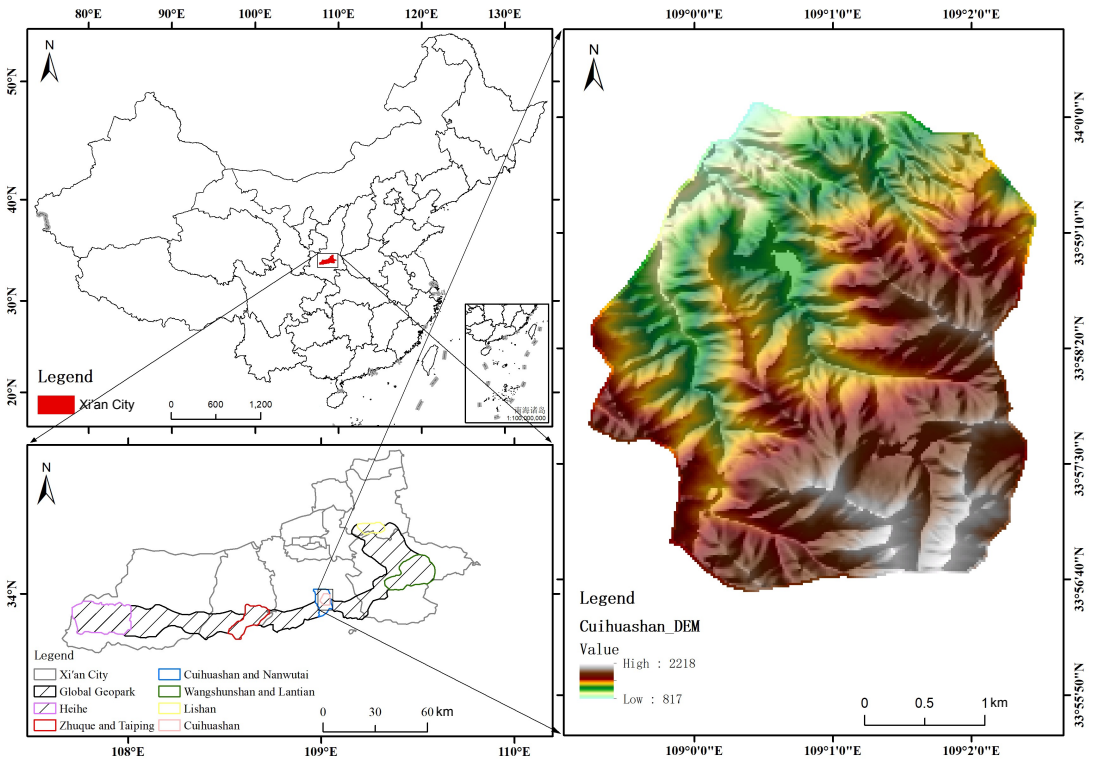


Fig. 2.2. Study area. The location of Cuihuashan National Geopark and their elevation range (m)

Located at the northern foot of the Qinling Mountains in Xi'an, Shaanxi Province, Cuihuashan National Geopark covers an area of 32km^2 and is famous for its unique geological landforms, making it one of the most scenic spots in China (Dong, 2010). The geopark holds the largest landslide geological relics in China and is ranked third globally in terms of scale. Moreover, it features the world's largest volume of a single collapsed rock, earning it the designation of a 'Mountain Collapse-slide Museum' (Qinling Zhongnanshan UNESCO Global Geopark, 2024b).

The geopark is divided into three distinct scenic areas: Bishan Lake, Tianchi Lake, and the Landslide Rock Sea. Each area provides a unique perspective on the region's geological history and natural beauty, famous for its features shaped by ancient landslide (Wang, 2015)

Furthermore, Cuihuashan National Geopark contains two unique caves formed by the shifting and accumulation of huge boulders during landslide events. The Ice Cave, deep and irregularly shaped, acts as a natural refrigerator, maintaining a temperature over 23°C cooler than the outside during the summer, ensuring that ice remains year-

round. The Wind Cave, a long narrow gap between two large boulders, creates a unique triangular structure that is over 30 m long and 15 m high. Its structure promotes constant airflow, keeping the cave cool. These caves, with their significant geological features, are of high scientific interest, offering valuable resource for geological research and education.

2.2 General methodologies

This research employs a mixed-methods design, integrating both qualitative and quantitative approaches to evaluate the effectiveness of geoeducation programs in two geoparks. The study engages a diverse group of educational stakeholders, including students, teachers, geopark staff, and other key informants, to ensure a comprehensive analysis of educational impacts.

Data collection are two aspects: Questionnaire surveys measure geoeducational impacts before and after students participate in geoeducation programs, assessing geo-knowledge acquisition and attitudinal changes towards geoconservation of geoparks. Concurrently, interview surveys with geopark staff and educators provide qualitative insights into the programs' operational strengths and weaknesses, identifying best practices and areas needing improvement. Additionally, this study utilized a content analysis approach, which interprets textual data through the systematic classification of content types (Hsieh & Shannon, 2005). For analysis, the contents of these materials were systematically categorized based on the information presented on each page. an analysis of educational materials evaluates the alignment of content with geoeducational goals and the integration into the geoparks' thematic contexts.

The findings from these methodologies will be analyzed using statistical software to ensure an evaluation of the programs' effectiveness. Detailed descriptions of the methods used are described in subsequent chapters, directly correlating with the specific aims of the study.

Chapter 3. Analyses of the geoeducation program related to Tokachi-Shikaoi Geopark

3.1 Introduction

The Tokachi-Shikaoi Geopark, located in Shikaoi Town, Hokkaido, Japan, is designated in 2013. This geopark emphasizes the geological features of the area, including its frozen earth, unique volcanic landscape, and rich biodiversity, showcasing the interaction between geological processes and human activity. It plays a crucial role in promoting geoeducation within the local community and beyond. The abundant geo resources enabled active development of geoeducation for local schools. It has been serving as an outdoor classroom where students can engage with the landscape and learn about geological history, sustainable practices, and conservation efforts specialized for this land.

The Shikaoi Board of Education initiated specialized programs in April 2003, such as the Canada Study, a six-year English program for the 1st grade of elementary school to the 3rd grade of high school, and the 'Shikaoi Gaku' ('gaku' means 'study' in Japanese), later termed the 'Geoeducation Program.' The core terms (3rd–5th terms) of the program (The corresponding parts showing in red color in Figure 3.1) lasted for nine years, following the proto-type program in the 1st and 2nd terms.

This program was initially implemented over a three-year period from April 2003 to March 2006. Subsequently, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) adopted this program for a second term, which lasted from April 2006 to March 2009. A revised version of this educational program was later submitted by the Shikaoi Board of Education to MEXT and was implemented as the 'Chikyu Gaku' ('chikyu' means 'earth' in Japanese) for the 3rd term from April 2009 to March 2012. The 4th and 5th terms, running from April 2012 to March 2018, were under the 'Shin-Chikyu Gaku' (an updated version of 'Chikyu-Gaku'), focusing on environmental education, education for sustainable development and disaster prevention (Figure 3.1).

1st term	2nd term			3rd term			4th term			5th term			Post-program				Years students received Geoedu-cation Program
Canada Study & Shikaoi Gaku				Chikyu Gaku			Shin-Chikyu Gaku										
AY2003 -2005	AY2006	AY2007	AY2008	AY2009	AY2010	AY2011	AY2012	AY2013	AY2014	AY2015	AY2016	AY2017	AY2018	AY2019	AY2020	AY2021	
	EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	HG3					12
		EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	HG3				11
			EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	HG3			10
				EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	HG3		9
					EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	HG3	8
						EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	HG2	7
							EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	HG1	6
								EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	JHG3	5
									EG1	EG2	EG3	EG4	EG5	EG6	JHG1	JHG2	4
										EG1	EG2	EG3	EG4	EG5	EG6	JHG1	3
										KG	EG1	EG2	EG3	EG4	EG5	EG6	2
											KG	EG1	EG2	EG3	EG4	EG5	1
												KG	EG1	EG2	EG3	EG4	0

Figure 3.1. History of the development of the 'Geoeducation Program' in schools in Shikaoi Town in relation to the establishment of the Tokachi-Shikaoi Geopark. KG: kindergarten; EG: elementary school grade; JHG: junior high school grade; HG: high school grade. The yellow background indicates the students targeted for the questionnaire survey. AY: Academic years from April 1st March 31st.

Schools in Shikaoi Town were designated as 'Research Development Schools' for an extended period covering five terms (April 2003–March 2018). The 'Geoeducation Program', developed by the Shikaoi Educational Research Institute and administered by the Shikaoi Board of Education, aimed to educate students on the significance of conserving local resources and understanding the interdependence between human activities and the natural environment. The curriculum comprised four key domains: (1) regional nature/environment and disaster prevention, (2) regional culture, (3) international understanding, and (4) energy, with a focus on practical field studies and hands-on learning opportunities.

The termination of the course in 2018 was met with substantial regret by the key informants. This chapter aims to extend this foundational research by providing a deep analysis of the course content and proposing a framework for the effective revival of geoeducation in Shikaoi Town. To achieve this goal, a comprehensive analysis on the geoeducational model of Tokachi-Shikaoi Geopark in Japan is necessary.

3.2 Study materials and methods

3.2.1 Contents analysis

I analyzed the curriculum content of the 'Shin-Chikyu Gaku' courses related to the Tokachi-Shikaoi Geopark across all educational levels from elementary to high school in Shikaoi Town. This chapter encompasses the review of textbooks and teacher guides employed from 2013 to 2018, as well as annual reports issued by the Shikaoi Town Continuous Education Promotion Committee throughout the duration of the program.

Textbooks of 'Shin-Chikyu Gaku,' which had been used from April 2012 to March 2018 (Figure 3.2) includes information about the Tokachi-Shikaoi Geopark. The 'Geoeducation Program' with the textbooks was implemented in all schools in the town: five elementary schools, two junior high schools, and one high school. The program, encompassing both 'Chikyu Gaku' and 'Shin-Chikyu Gaku' (Figure 3.1), emphasized the importance of sustainable development and encouraged students to think critically about issues related to the environment. It aimed to foster responsible global citizens who could contribute to the conservation and protection of Earth's resources for future generations. It also focuses on the geoheritage of the region.

Teacher guides developed alongside the 'Shin-Chikyu Gaku' textbooks provided the necessary materials and support for teachers. Furthermore, annual reports published by the government reviewed the outcomes of the 'Chikyu Gaku' and 'Shin-Chikyu Gaku', providing a yearly summary of the program's achievements.

The teacher's guide serves as an essential tool that articulates the purpose of the teaching materials and clarifies the reasoning behind their design. It is designed to foster the enhancement of teaching skills and aids teachers in comprehending the course in its entirety. The teacher's guide offers detailed instructions on how to utilize the materials effectively, incorporating necessary cultural and contextual information (Cunningsworth & Kusel, 1991; Hemsley, 1997). It provides educators with critical information about the aims, content, desired learning outcomes, and knowledge requirements of the subject (Vinnervik, 2023). Additionally, it offers structured guidance on designing teaching and learning activities. Teacher's guides are developed

to align with and expand upon the written curriculum, detailing content decisions to enhance comprehension of the curriculum's scope and depth. Consequently, these texts were analyzed to determine the extent to which they influence teaching practices and the enrichment of students' understanding of textbook content.

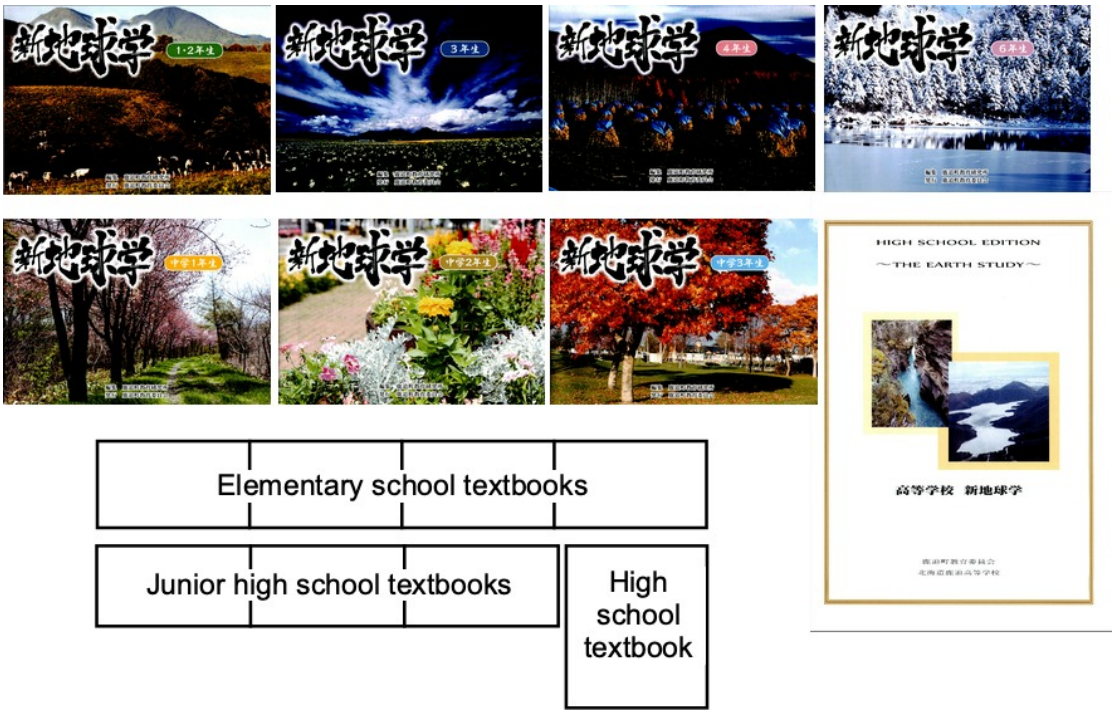


Figure 3.2. The 'Shin-Chikyu Gaku' textbooks for elementary, junior high and high schools in Shikaoi.

3.2.2 Questionnaire survey and interview survey

Data collection for questionnaire survey

Questionnaire survey was adopted to collect high school students' opinions. The selected participants were from Hokkaido Shikaoi High School in Shikaoi, Japan. The survey was conducted in a classroom. The questionnaires designed for Shikaoi High School students included two types of questions. The first type of question aimed to assess students' knowledge of geoparks using a five-point Likert scale, with scoring options ranging from 1 to 5 (Jamieson, 2004). The higher score reflects a superior level of knowledge, as it is recorded in this manner. The second type of questions was designed to explore students' attitudes towards life and to identify changes in their interests after attending the 'Geoeducation Program'

The questionnaire survey was conducted between December 2020 and October 2021 utilizing SurveyMonkey (https://www.surveymonkey.com), an established online survey service. The questionnaire was designed to allow customizable, web-based distribution. This service supports diverse question formats and offers analytical tools to evaluate responses. Distribution methods included QR codes and URL links, facilitated by school administrators.

Data collection for interview survey

This study conducted qualitative in-depth face-to-face interview surveys with four key informants from the Tokachi-Shikaoi Geopark (Table 3.1) to learn their knowledge concerning geoeducation. The individuals selected as key informants were those responsible for different development stages of the geoeducation. Their specialized knowledge was considered crucial to gain a deeper understanding of the issues and potential solutions related to the study. All responses were recorded using audio devices and documented in notebooks to ensure accuracy and thoroughness in data collection.

Table 3.1. Details of the interview surveys conducted with four key informants

Area	Key informants	Identity	Survey date	Time duration (minutes)
Shikaoi	Mr. O	Director of the Geopark Visitor Center	12/11/2020 & 14/11/2020	54 63
Shikaoi	Mr. F	Editor of textbooks “Shin-Chikyu Gaku”	13/11/2020	112
Shikaoi	Mr. T	Principal of the Hokkaido Shikaoi High School	13/07/2021	109
Shikaoi	Mr. A	Director of the Shikaoi Town Board of Education	13/07/2021	53

3.3 Results

3.3.1 Contents analysis for Tokachi-Shikaoi Geopark

Textbook analysis of 'Shin-Chikyu Gaku'

The 'Geoeducation Program,' unique to Shikaoi, affords a valuable opportunity to evaluate the effectiveness of its educational resources, including the pivotal 'Shin-Chikyu Gaku' textbooks. These textbooks play an essential role in the program's curriculum. The goal of the program is to assess their potential capability for further education within and beyond the geopark territory. The textbooks cover ecological, cultural, and historical aspects, as well as geoscience, to provide a holistic educational experience that fosters a sense of pride and connection among the local residents.

For elementary school students, there were five books in total: one book was used by Grades 1 and 2, and it consisted of seven chapters across 24 pages. The other four books were designed for each grade level from Grades 3 to 6, with 22 pages each and containing nine, six, eight, and seven chapters, respectively. Geopark-related content varies: the third-grade textbook has four pages on geosites in the Tokachi-Shikaoi Geopark, the fourth-grade textbook has one page, the fifth-grade textbook allocates seven pages for the geopark's geosite, and the sixth-grade grade dedicates 15.5 pages exclusively to the geopark.

Textbooks for junior high schools are composed of separate textbooks for each grade, with five chapters for the first and second years (26 pages and 28 pages, respectively), and six chapters for the third year (30 pages). Only the third-year textbook includes 2.5 pages on geoparks, with a detailed introduction to the Tokachi-Shikaoi Geopark.

The high school textbook, intended for students in the first to third grades, includes four chapters, each with three sections and a total of 89 pages. Here, five pages are devoted to geoparks within four pages of concepts and origins, including a focus on the Tokachi-Shikaoi Geopark. Another page explores geoheritage.

Only representative sections have been included in Appendix 1—namely, two pages from Grade 5 on geosites, two pages from Grade 6 on geopark/geosite concepts,

the full 2.5-page section from junior high introducing the Tokachi-Shikaoi Geopark in detail, and five pages from high school.

All textbooks are A4 sized, tailored to suit students' learning needs, and cover themes including regional nature/environment and disaster prevention, regional culture, international understanding, and energy. Of the 285 pages in the elementary, junior high, and high school textbooks, 52.2% focused on regional nature/environment and disaster prevention, 17.3% on regional culture, 16.1% on energy, and 14.5% on international understanding (Figure 3.3). However, only small percentage (8.4%) of the regional nature/environment section and 10.5% of the disaster prevention section in the textbooks refer to and relate to the Tokachi-Shikaoi Geopark. This disparity points to a significant underrepresentation, considering the potential of the geopark as a contextual and educational resource.

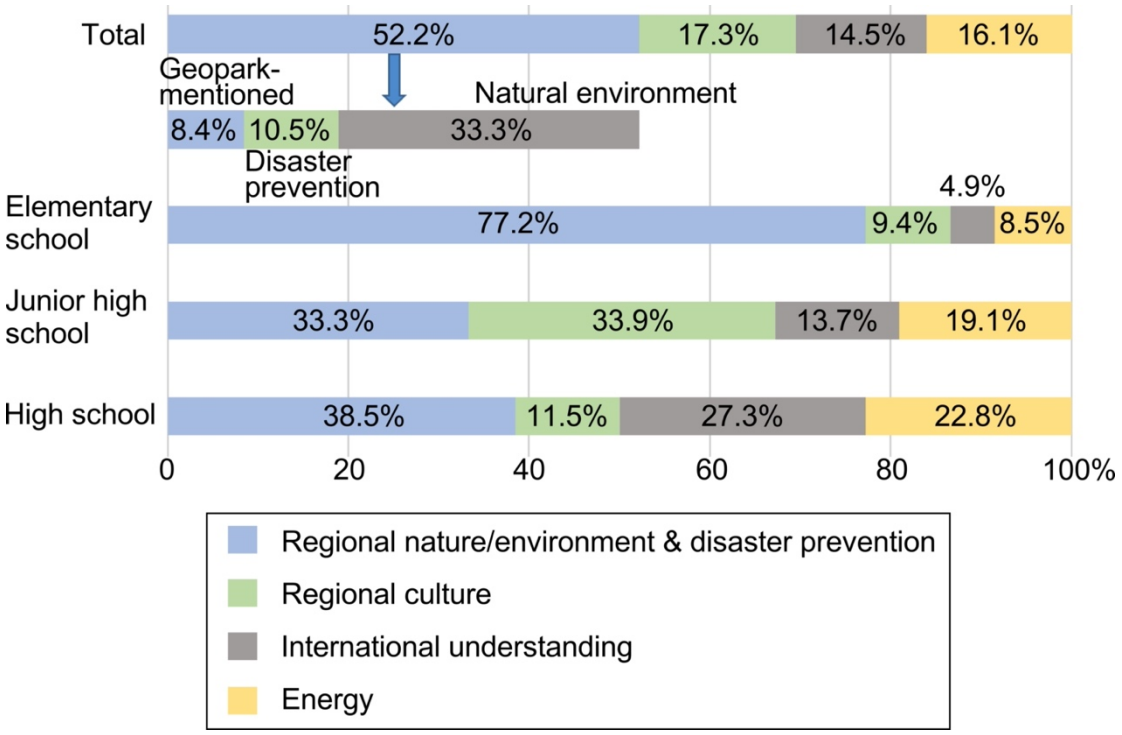


Figure 3.3. The percentage of textbooks 'Shin-Chikyu gaku' content for elementary, junior high, and high schools in Shikaoi Town

Experiential learning in elementary schools, which includes direct engagement with the natural environment of Shikaoi Town, provides foundational appreciation for the local ecosystems. Elementary school textbooks also include disaster prevention instruction, which provides students with the knowledge they need to understand. As students advance to junior high and high schools, they encounter a broadened curriculum with the themes of regional culture and international understanding. However, the integration of geopark-related content remains shallow and does not leverage the full potential of the geopark as a tool for deepening environmental education and global awareness. For instance, the textbooks only provide a basic definition of geoparks and offer a brief introduction to the Tokachi-Shikaoi Geopark. While they mentioned some well-known heritage sites, these contents lack any direct connection to the Tokachi-Shikaoi Geopark. Such content fails to convey the ecological significance, geological diversity, and cultural heritage of the geopark, which are important to enhance students' understanding of the geopark's role in broader environmental and cultural contexts.

Therefore, while the progression of education in geopark from elementary to high school is satisfactory in scope and depth, there is an evident opportunity for more integrated and comprehensive inclusion of the Tokachi-Shikaoi Geopark throughout the curriculum. Enhancements could include the development of dedicated geopark chapters, interactive geopark-based activities, and fieldwork projects that align with each educational level's learning objectives, thereby ensuring strong, more meaningful engagement with geoheritage.

Teacher Guides analysis of 'Shin-Chikyu Gaku'

The teacher's guide and the student textbook are both published by the Shikaoi Town Committee and primarily supervised by the director of the Shikaoi Educational Research Institute. This supervision significantly ensures the consistency of content across educational material, with the teacher's guide enhancing the textbook information by adding depth to the educational content delivered.

In the context of elementary school, there are five teacher guides corresponding to the student textbooks, organized by grade level: one guide covers grades one and two, and each of the grades three through six has its own guide. Each guide commences with an instructional plan for the school year, outlining the designated periods for studying 'Shin-Chikyu Gaku' and the objectives for each grade. These objectives are enhancing four key areas of student development: (1) interest/engagement/attitude, (2) thinking/judging/expressing, (3) skills, and (4) understanding of knowledge.

The instructional plans categorize the content that students learn into four domains that are consistent with textbook: (A) for regional nature/environment and disaster prevention, (B) for regional culture, (C) for international understanding, and (D) for energy. The plans specify the months during which 'Shin-Chikyu Gaku' is to be studied, detailing the number of hours and the content to be covered. Specifically, the instructional duration for students in the first and second grades is set at 20 hours per year, while students in higher grades receive 35 hours of instruction annually. They provide a more detailed description of the specific topics that students are expected to learn and classify these topics into the respective domains. Moreover, the plans describe the interconnections between this content and other subject areas within the curriculum, highlighting how these integrations enrich the overall educational experience. Furthermore, each chapter in the teacher guides offers comprehensive preparatory guidance for teachers. It identifies the essential content that teachers should familiarize themselves with beforehand and directs them to appropriate resources for additional research. The guides also give detailed explanations of the specialized content found in the student textbooks, including examples of how to pose questions to students and anticipate their responses.

In the context of geoparks, the teacher guides primarily deliver scientific explanations of the geosites and geo-knowledge presented in the student textbooks. These guides explain and expand upon the concepts introduced in the textbooks, ensuring that students achieve a comprehensive understanding of the information related to geosites. However, the content concerning the geopark and national geoparks in the teacher's guide mirrors that of the student textbooks without further expansion.

For Junior-high school, there are three teacher guides, each corresponding to a different grade level's textbook. The instructional plans in these junior high teacher guides are also structured around the four key domains. Spanning four pages, each page is dedicated to one of these domains and provides a detailed breakdown of the textbook units. These pages outline the unit names, objectives (from an evaluative perspective), content and time allocation, specific teaching strategies, and interrelationships with other subjects. This structured approach ensures a comprehensive and integrated understanding of each domain, aligning closely with the curricular goals and facilitating an interdisciplinary educational experience. The teacher guides also offer extensive instructional guidance, delineating the content to be taught during specific lesson segments and detailing the necessary knowledge that teachers should possess prior to instruction. Furthermore, these guides enhance the teaching process by providing explanations and expansions on specialized content, advising on question strategies for student engagement, and suggesting possible student responses. Notably, at the end of the teacher guide for the third year of junior high school, there is the systematic summary and differentiation of the educational content covered over the three years of junior high school (Table 3.2).

Table 3.2. Summary of three-year junior high school curriculum content

Grades	Regional nature/ environment and disaster prevention	Regional culture	International understanding	Energy
Grade 1	Natural environment of Shikaoi	History and culture of Shikaoi	History and culture of Canada	Current status of energy
Grade 2	Environmental protection activities in Shikaoi	Current issues and challenges within Shikaoi	Impact of invasive species on Shikaoi	Use of natural energy sources
Grade 3	Analyzing on town planning in Shikaoi from the perspectives of environmental protection and disaster prevention	Utilizing the culture of Shikaoi in town planning	Reflecting on Shikaoi's town development through the lens of urban planning in Canada and other counties	Considering town development in Shikaoi with a focus on energy issues

Despite these detailed instructions, coverage of geopark-related educational content within the guide remains limited. Throughout the junior high period, the teacher

guides elaborate on the Tokachi-Shikaoi Geopark based on the student textbooks. They only provided a more detailed explanation of the geopark's theme, "Volcanic and glacial life stories," and described one of the geopark's characteristics: the consistent educational approach from elementary through high school known as 'Shin-Chikyu Gaku'"

It should be noted that for high schools, no teacher guides are provided for reference, indicating a gap in structured support for teachers at this educational level.

Annual reports of the 3rd to 5th program term

The annual reports of the program from the third to fifth terms provided a comprehensive longitudinal analysis. These reports offer a detailed synthesis of findings, evaluating the efficacy and sustainability of the educational strategies employed throughout the program's later phases.

The third term of the program (Chikyu-Gaku) was introduced as an innovative response to global and local environmental challenges. It focused on developing environmental literacy through interactive and practical learning experiences across consistent education from elementary to high school. This term set the foundational goals and curriculum structures, designed to foster an appreciation and understanding of environmental issues among students. The subsequent 'Shin-Chikyu Gaku' (fourth and fifth terms) built on this foundation by enhancing interdisciplinary learning and expanding global environmental perspectives. Furthermore, incorporating more comprehensive and practical approaches, including disaster education and sustainable development across all school levels, focused on refining teaching methodologies, and enhancing continuity and depth in learning. The program also increased its integration with other academic disciplines.

The effectiveness of the program on student outcomes was evaluated at each term through questionnaire surveys, as detailed in the annual reports. These reports provided a quantitative assessment of student engagement and comprehension, which formed the foundation for measuring the program's success. During the 3rd term, over the span of three years, more than 86% of elementary students consistently reported high levels of

enjoyment in ‘Chikyu-Gaku’ related activities. Junior high school students showed slightly fluctuating but generally high engagement around 75% (Figure 3.4). Both elementary and junior high school students reported high levels of understanding of the coursework, with more than 85% of students across all three years affirming that the ‘Chikyu Gaku’ classes were understandable and engaging (Figure 3.5).

In addition, the report of the final year (2011) during the 3rd term pointed out that despite the successes, several challenges were identified, primarily related to curriculum integration and transition phases between different educational levels. In the impact of curricular integration, there were notable gaps in smoothly transitioning students from elementary to junior high and then to high school, especially in adapting the curriculum to the evolving comprehension and maturity levels of the students. Furthermore, current assessment methods were deemed inadequate in fully capturing the depth of student understanding and engagement, suggesting a need for more detailed assessment.

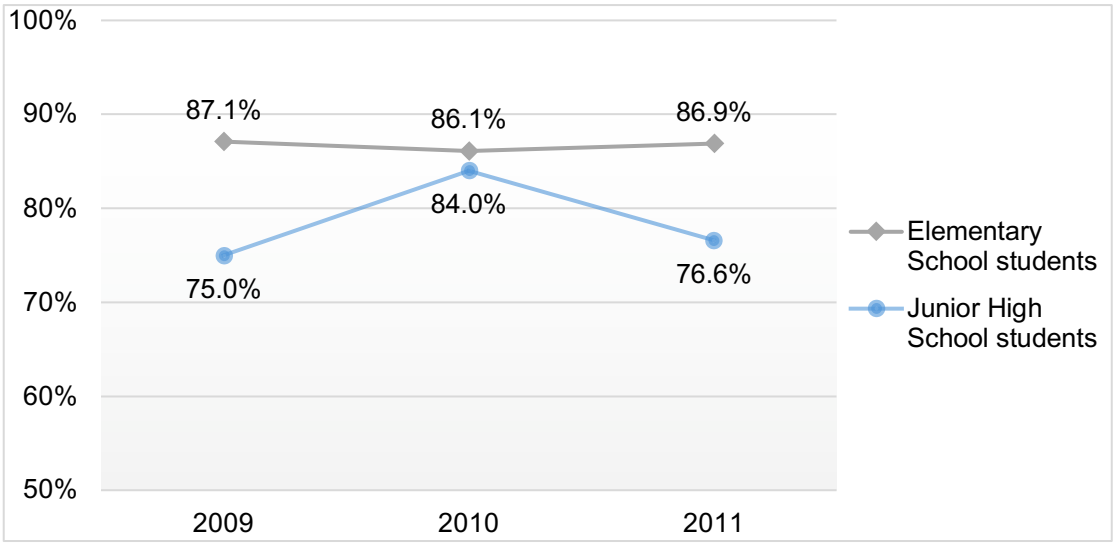


Figure 3.4. Students’ interests in ‘Shin-Chikyu Gaku’ (Adapted from the annual reports of 2009–2011)

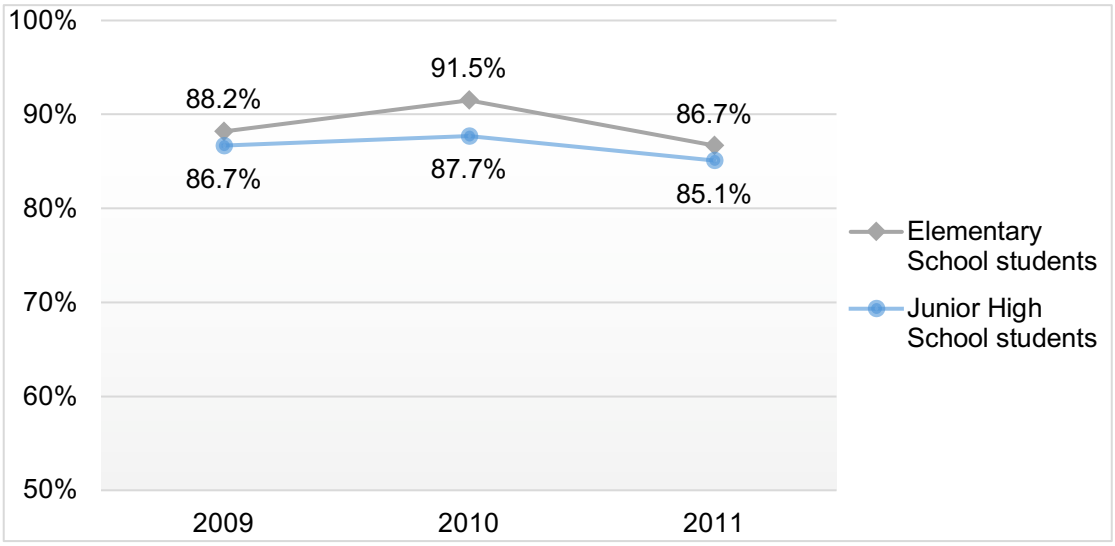


Figure 3.5. Students' understanding of the content taught in the 'Shin-Chikyu Gaku' (Adapted from the annual reports of 2009–2011)

The analysis of Shin-Chikyu Gaku's effectiveness, detailed in the annual report for the fourth term spanning three years (2012–2014), provided insight into both the successes and areas for improvement. At the elementary level, student interest remained high and relatively stable, though there was a slight decrease from 2012 (87.9%) to 2014 (86.5%). Conversely, interest among junior high students exhibited a slight upward trend, beginning at 75.9% and progressively increasing to 77.2% and then 81.0% in the subsequent year. The trend at the high school level diverged significantly, with interest initially increasing but then experiencing a substantial drop in the third year, from 81.7% to 56.0% (Figure 3.6).

Comprehension levels at the elementary level were consistently high, maintaining around 80.0% throughout the three years. Junior high students similarly showed high and consistent understanding of the curriculum, with comprehension percentages increasing from 84.4% to 91.4%. However, high school students demonstrated a declining trend in comprehension over the three years, eventually decreasing to 60.8% (Figure 3.7). The report from the third year of term four indicated that the transition from elementary to high school was facilitated by the curriculum design of 'Shin-Chikyu Gaku,' although continuous adjustments were deemed necessary to maintain its relevance and effectiveness. Additionally, the report highlighted that the designation

of the Tokachi-Shikaoi Geopark in 2013 had boosted students' interest in the local area, underscoring the need to incorporate related learning content into the curriculum for junior high and high school students, and to design contexts that allow for the flexible application of geo-knowledge. The report also raised concerns about budgetary constraints, notable the significant costs associated with textbook printing. To make revisions and updates easier, the explorations of digital options were suggested as a necessary step forward.

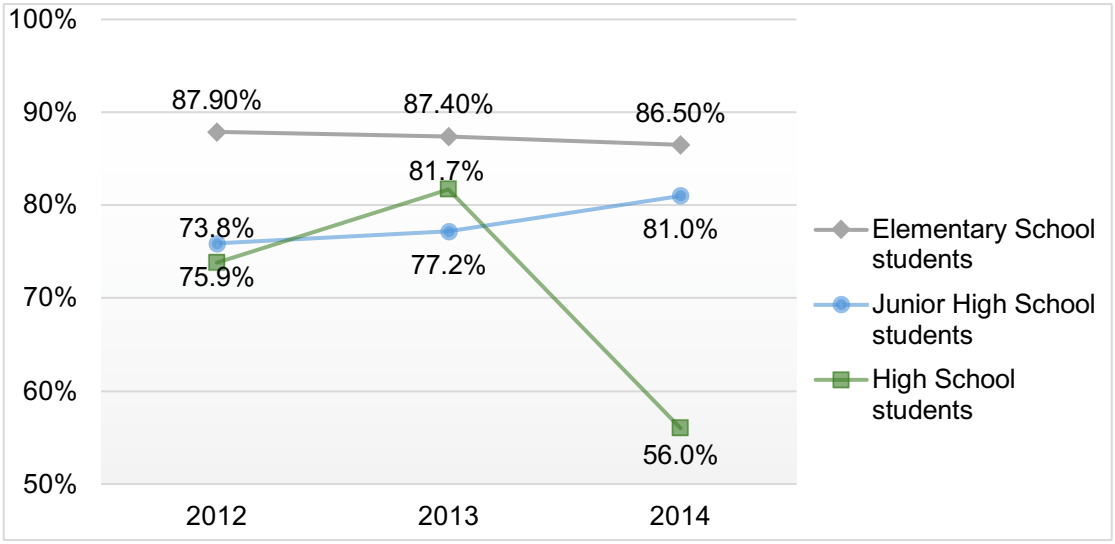


Figure 3.6. Students' interests in 'Shin-Chikyu Gaku' (Adapted from the annual reports of 2012–2014)

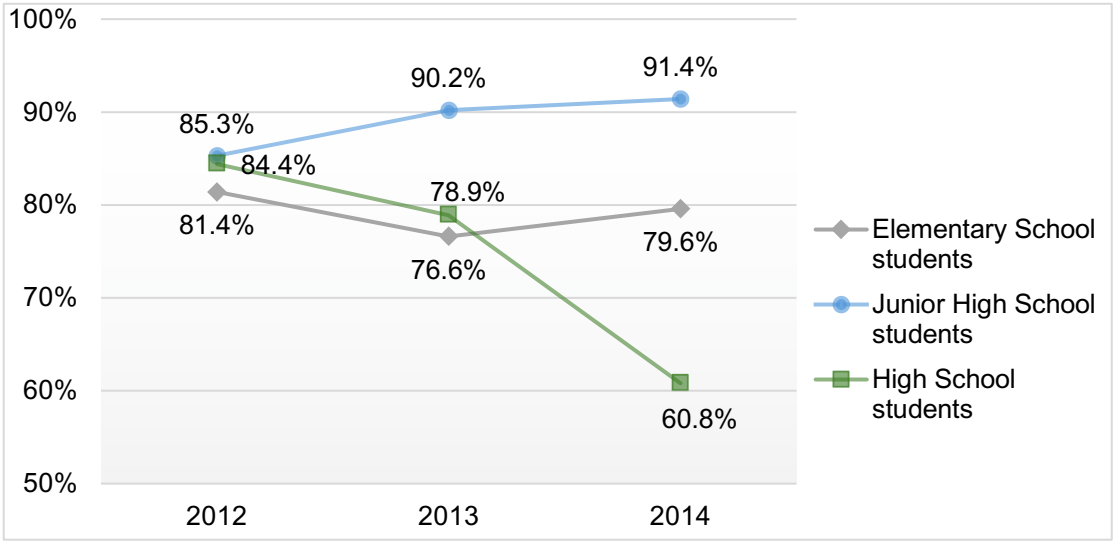


Figure 3.7. Students' understanding of the content taught in the 'Shin-Chikyu Gaku' (Adapted from the annual reports of 2012–2014)

In the final term of Shikaoi Town's geoeducation program, the annual report of 5th term provided a comprehensive description of the 'Shin-Chikyu Gaku' curriculum and detailed finding from student surveys. Students form Shikaoi schools were categorized into three distinct groups for the survey: Grades 1-4, Grades 5 to 2nd year of junior high school, and 3rd year of junior high school to 3rd year of high school, each receiving tailored questionnaires. For elementary students from Grade 1 to Grade 4, the 'Shin-Chikyu Gaku' curriculum aimed to cultivate an interest in the relationship between the individual and nature through direct engagement with local ecosystems. Activities were designed to promote environmental management and included exploring local landscapes, utilizing regional resources such as the Shikaoi Nature Center, Tokachi-Shikaoi Geopark, and Daisetsuzan National Park, as well as visits to facilities that convert bio-waste into energy. Results from the questionnaire survey revealed high levels of engagement and learning, with 85.0% to 93.0% of students reporting significant gains in knowledge about their local environment (Figure 3.8A). More than 75% of students in each grade reported frequent activities and discussions with friends (Figure 3.8B). However, there was a slight decline in the proportion of students who reported opportunities for discussion and idea exchange with friends during class, though the rate remained above 70% across the grades (Figure 3.8C). These funding underscores the effectiveness of the 'Shin-Chikyu Gaku' curriculum in not only fostering an understanding of the natural environment but also in enhancing communicative and collaborative skills among young learners.

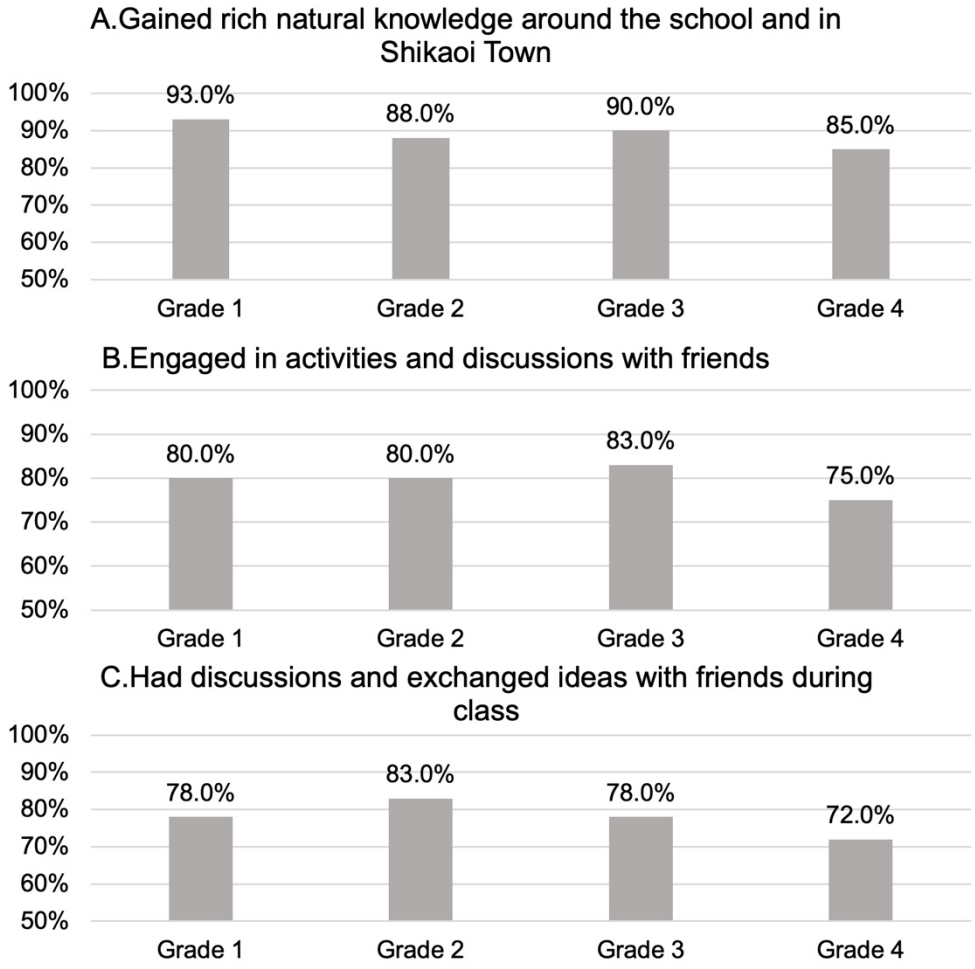


Figure 3.8. Effectiveness of the 'Shin-Chikyu Gaku' curriculum on the education for Elementary Grades one to four (Adapted from the annual reports of 2015–2017)

Students from Grade 5 of elementary to Grade 2 of junior high school experienced a curriculum that emphasized the richness of local nature and current environmental challenges during the 1st phase (from Grades 1 to 4). This 2nd phase focused on scientific data collection and analysis concerning local nature and industries, developing skills and values for environmental preservation. The curriculum also encouraged a positive and multi-faced approach to environmental issues. A significant majority, 75.0% to 85.0% of students engaged had time for conversations and idea exchanges with friends (Figure 3.9A). Furthermore, more than 75.0% of every grade students reported conversing and exchanging ideas during class (Figure 3.9B). These findings highlight that the curriculum not only facilitates in-depth learning and

interaction among students but also shows that as students' progress through the grades, their overall knowledge of environmental issues increases.

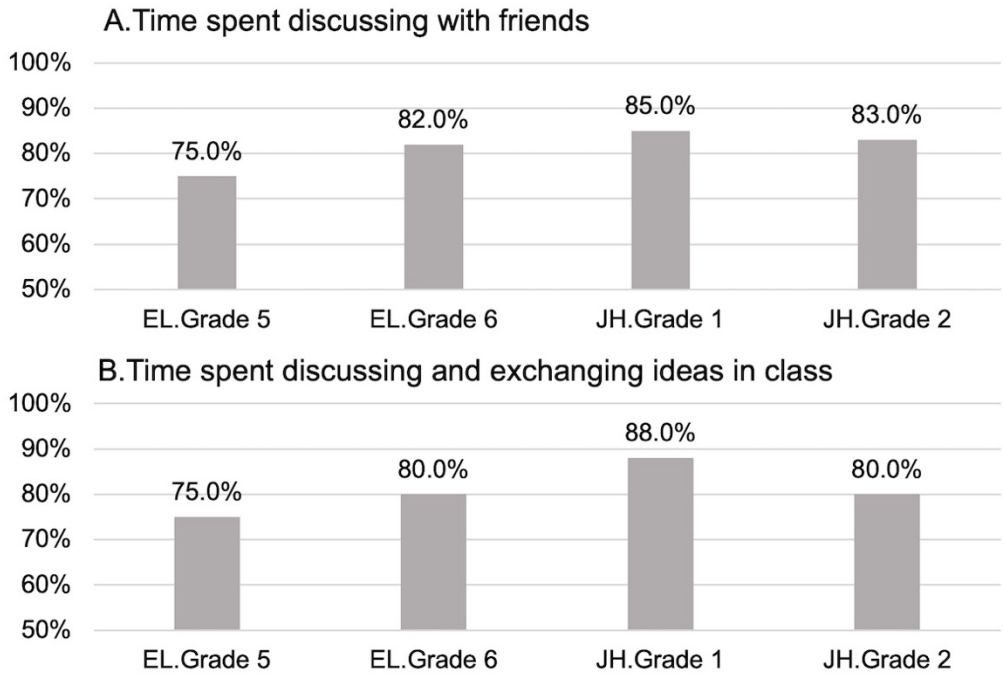


Figure 3.9. Effectiveness of the 'Shin-Chikyu Gaku' curriculum on the education for Grade five of Elementary school to Grade 2 of Junior High school. EL: elementary school; JH: junior high (Adapted from the annual reports of 2015–2017).

For older students, from Grade 3 of junior high school to Grade 3 of high school, the curriculum focused on understanding various human perspectives on nature, addressing environmental practices and new energy sources, and contemplating the role of humans in building a sustainable global society. Survey results showed that most students had time to discuss and deepen their understanding of learning content with classmates (Figure 3.10A). The curriculum successfully engaged students in meaningful discussions, with 65.0% to 76.0% of students felt they could actively express their thoughts on local and global environmental and energy issues (Figure 3.10B). These results suggest that students were able to discover environmental issues, gather information, deepen their perspectives, and develop the ability to communicate their thoughts effectively.

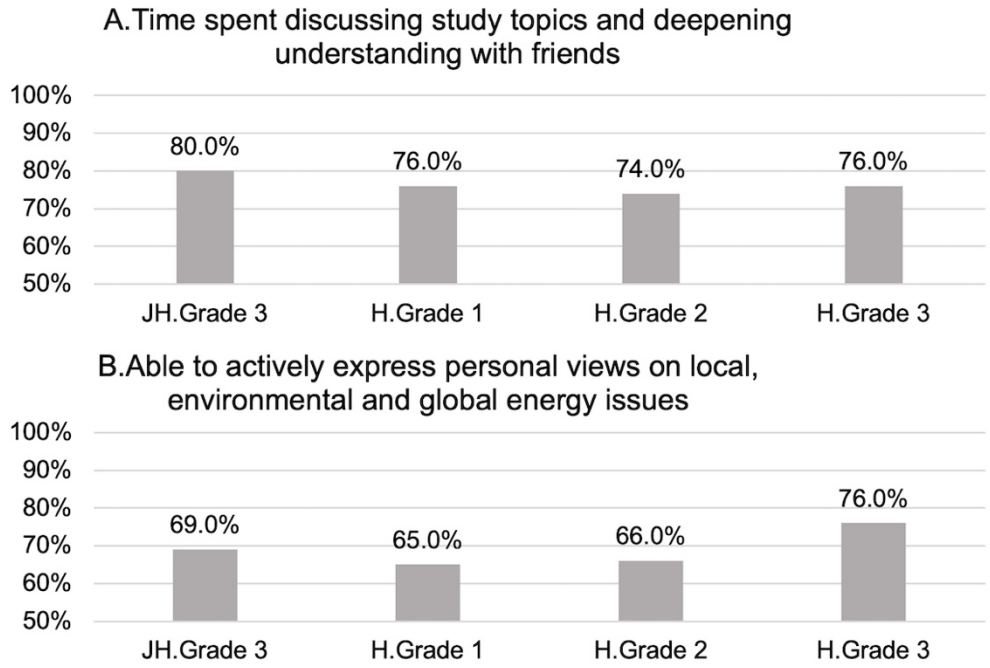


Figure 3.10. Effectives of the ‘Shin-Chikyu Gaku’ curriculum on the education for Grade 3 of Junior High school to Garde 3 of High school. JH: junior high school; H: high school (Adapted from the annual reports of 2015–2017)

Overall, ‘Chikyu Gaku’ and ‘Shin-Chikyu Gaku’ curriculum effectively engaged students across different educational stages, fostering a deep connection with nature. The curriculum’s success is evidenced by high levels of student engagement and learning across all grade levels, suggesting that such educational frameworks can significantly contribute to developing informed and proactive future citizens. Annual reports presented that the implementation of the ‘Geoeducation Program’ over three terms has significantly contributed to raising environmental awareness and understanding among students from elementary through high school. However, continual adjustments and enhancements are necessary to ensure that the curriculum remains relevant, engaging and sufficiently challenging to prepare students for the environmental challenges of the future.

3.3.2 Evaluating geoeducation approaches at Tokachi-Shikaoi Geopark

Assessing geo-knowledge comprehension among student groups

The questionnaire survey with the students of Shikaoi High School achieved a high response rate of 100.0% and a high effective rate of 94.7%, encompassing 178 effective respondents (Table 3.3). The respondents were divided into two groups based on their experiences of participating 'Geoeducation Program' in Shikaoi. Group one included 112 students who had six to nine years of learning experience and participated in the 3rd to 5th terms of the 'Geoeducation Program.' In group two, there are 66 students who studied outside the Shikaoi town before entering Shikaoi High School. These students had never taken part in the program.

Table 3.3. Details of the questionnaire surveys conducting with Hokkaido Shikaoi High School

Geopark	Grade	Conducting date	Effective number
Tokachi-Shikaoi	Grades 1–3 in 2020 & Grade 1 in 2021	2nd Dec. 2020 & 12th Oct. 2021	178

The knowledge and attitudes of two groups of students towards geoparks, specifically the Tokachi-Shikaoi Geopark were compared. In group one, 110 individuals were raised in the town of Shikaoi. The data indicated that students with program experience had a better understanding of geo-knowledge in textbooks (Figure 3.11).

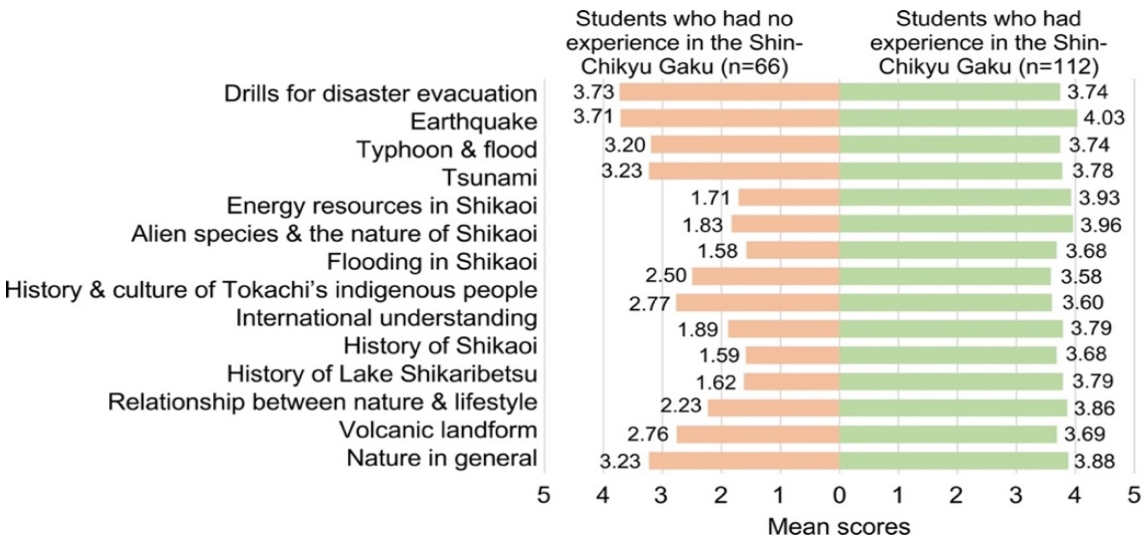


Figure 3.11 Mean scores of students' understanding of the geo-knowledge of the 'Geoeducation Program' as measured by a Likert Scale in the two respondent groups.

Figure 3.12A shows that 70.5% of students with experience in the program thought that geoparks should be established, compared to only 24.2% of students without experience. Furthermore, the results show that the students who had experience in the program had a greater interest in learning about geoparks (46.4% of them expressed this wish) than those who had no experience with the program (Figure 3.12B). Students who had experience with the program had a considerably higher level of knowledge of the concept of geoparks than those who had no experience with the program (61.7% vs. 9.1%; Figure 3.12C). Students who had experience with the program showed a higher level of pride (67.0%) in establishing the geopark in Shikaoi Town than those who had no experience (13.7%). Students who had no experience in the program showed a higher proportion of neutral attitudes (72.7%) towards the establishment of the Tokachi-Shikaoi Geopark (Figure 3.12D). The results also show that the students who had no experience in the program have limited knowledge about the Tokachi-Shikaoi Geopark, with 62.1% of them answering 'I am extremely unfamiliar with the Tokachi-Shikaoi Geopark' (Fig. 3.12E). In contrast, students who had experience with the 'Geoeducation Program' had a higher level of knowledge about the geopark.

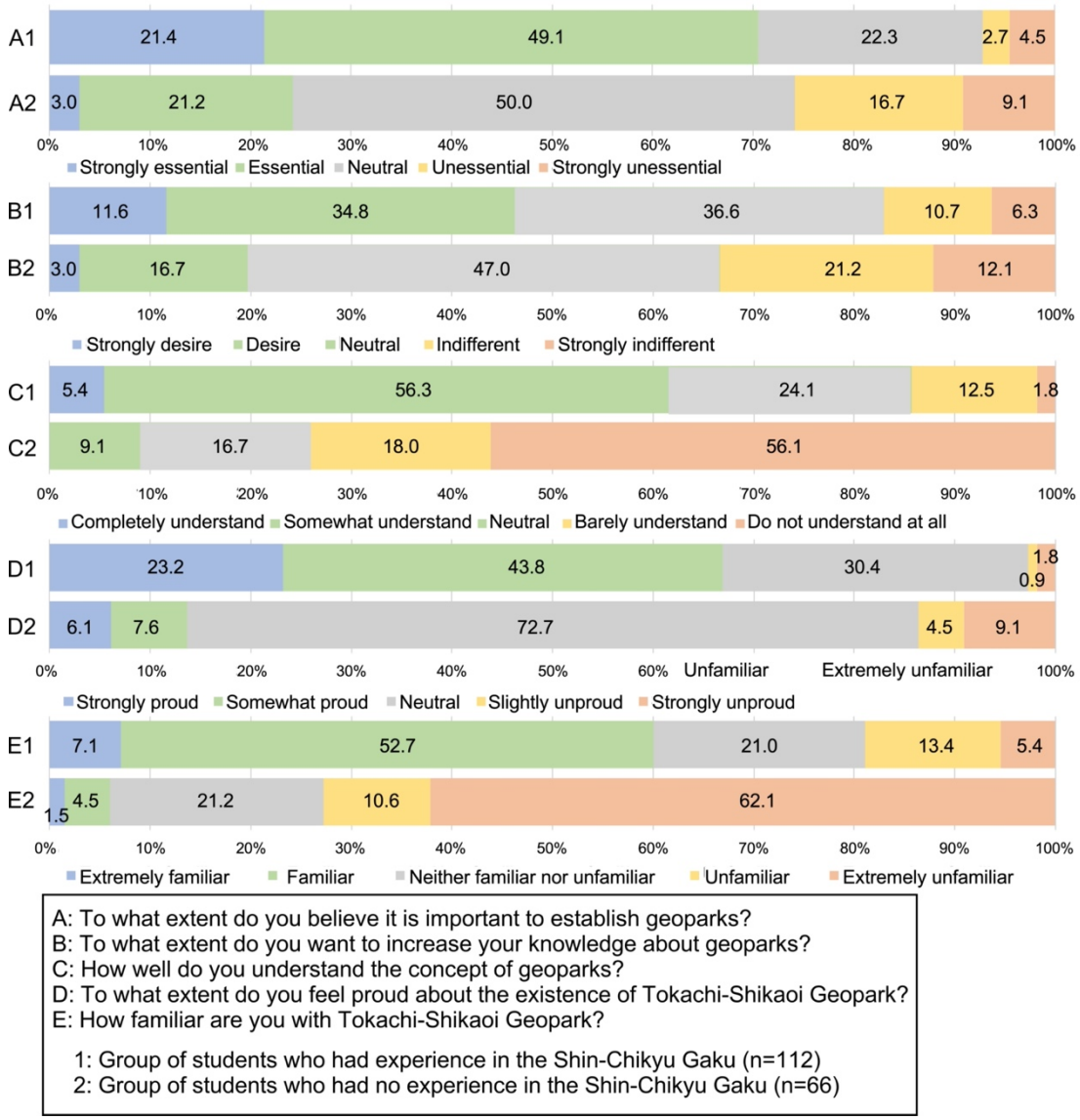


Figure 3.12. Assessment of geo-knowledge comprehension between the two student groups.

There is an apparent association between participating in the program and visiting geo-sites in the Tokachi-Shikaoi Geopark (Figure 3.13). In terms of school-organized visits to geo-sites during the program, students with experience in the program visited more geo-sites than those without. Except for a few well-known geo-sites (Figure 3.14A). Assessing geo-knowledge comprehension between the two student groups. 83.3% of students with no experience in the program did not visit any geo-sites in Shikaoi (Figure 3.13). It is important, however, to note that many students with program

experience have not visited lesser-known geo-sites during their study of the program (Figure 3.14B)

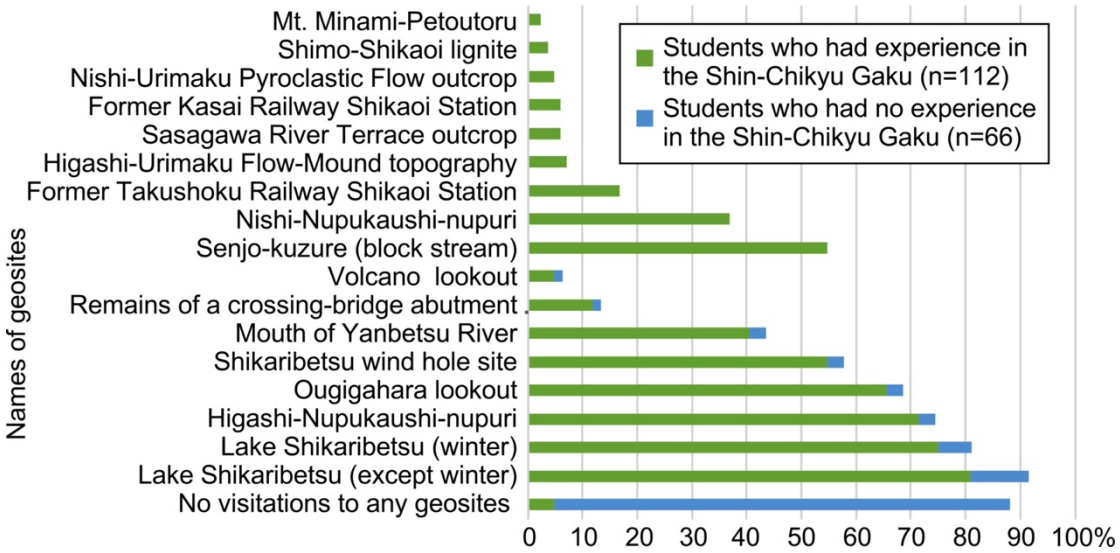


Figure 3.13. Percentage of geo-sites visited by the two groups of students

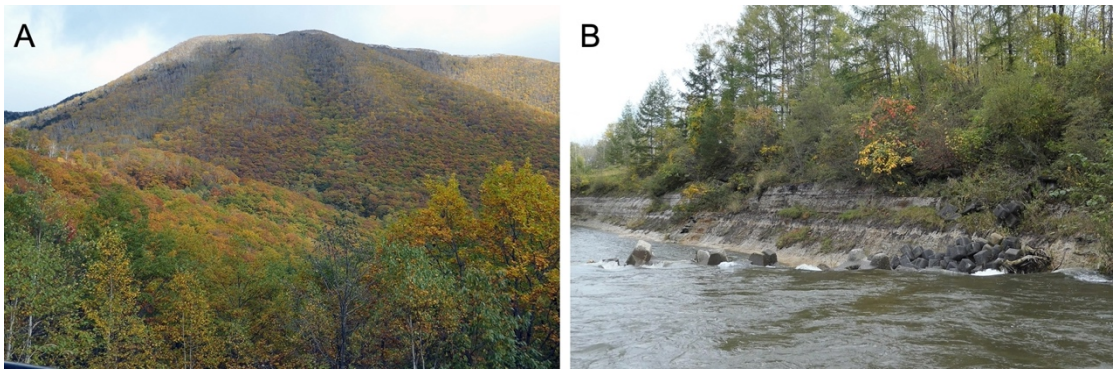


Figure 3.14 Examples of geosites in the Tokachi-Shikaoi Geopark. A: Mt. Higashi-Nupukaushi-nupuri, one of the most popular geosites of the Tokachi-Shikaoi Geopark; and B: Shimo-Shikaoi lignite outcrop, one of the least popular geosites, photos by T. Watanabe.

Assessing the impact of the 'Geoeducation Program' on students' attitudes and interests

After taking the 'Geoeducation Program' (n=112), a considerable number of students underwent a change in their perspectives across various aspects of attitudes and interests about geoparks (Table 3.4). Seventeen percent of the students exhibited heightened awareness of articles and news about geoparks, 13.4% felt equipped to

inform tourists about the Tokachi-Shikaoi Geopark, and 4.5% were inspired to volunteer at geopark related events. Beyond these geopark-centric changes, 50.0% of the students developed an increased concern for environmental conservation, and 16.1% gained interest in geology and geography. Despite these positive shifts, 28.6% reported no change in their attitudes, indicating potential areas for further program development.

Table 3.4. The proportion of the answers by the students who had experience with 'Geoeducation Program' being asked, 'Did you change your thoughts about any of the items below after learning of "Shin-Chikyu Gaku"?' (n=112)

Statements	Number	Percentage
1. Started to pay attention to the articles and news about geoparks	19	17.0
2. Was able to confidently introduce the Tokachi-Shikaoi Geopark to tourists	15	13.4
3. Wanted to participate as a volunteer in the events that are held by the Tokachi-Shikaoi Geopark	5	4.5
4. Started to pay attention to environmental conservation	56	50.0
5. Became more interested in geology/geography	18	16.1
6. Others	1	0.9
7. Nothing had changed	32	28.6

3.3.3 The attitudes and perceptions of key informants

Relevance of the 'Geoeducation Program' to the Tokachi-Shikaoi Geopark

Mr. F emphasized that Tokachi-Shikaoi Geopark is important to Shikaoi Town. He believed that 'Shin-Chikyu Gaku' integrated into the 'Geoeducation Program' could enhance local sustainable development through geoeducation. This program would foster a deep connection with the town's history and ecology, cultivating a local identity among students. Mr. O mentioned that although the program was not designed exclusively for the geopark, it significantly enhances students' understanding of geoparks at all educational levels, contributing to the reassessment and identify of Tokachi-Shikaoi Geopark.

All key informants recognized the significant impact of the program. Many graduates of the program who were former students at Hokkaido Shikaoi High School later returned to Shikaoi Town and contributed to its socioeconomic and educational advancement. During the study tours to the geo-sites, the alumni shared their knowledge

regarding the site with their peers and instructors. They took pride in educating others about the geopark's unique geological/geographical features and historical significance, thereby contributing to a deeper understanding of the natural and cultural heritage of their hometowns, demonstrating the program's role in fostering pride. The discontinuation of this program raises concerns about worsening the talent shortage in the region, highlighting its importance for local sustainability.

Mr. A and Mr. T pointed out issues in the program, suggesting necessary improvements to address educational challenges. At the elementary and junior high levels, stronger ties to Tokachi-Shikaoi Geopark could enhance geoscientific awareness. Due to budget constraints, teachers cannot receive formal training in geoscience and must rely on self-directed learning, which is not ideal. Moreover, the frequent relocation of teachers, a systemic issue, disrupts the continuity of geoeducation, emphasizing the need for stronger government support. Despite the termination of MEXT's "Research and Development School" designation in 2018, key informants supported continuing the Geoeducation Program, emphasizing its important role in imparting geo-knowledge and fostering regional sustainability.

3.4 Discussion

The need of establishment of a new geoeducation program

The 'Geoeducation Program' was a component of the compulsory curriculum for all students in Shikaoi Town for 15 years in total. There are only two instances in which goeducation has been positioned as a year-round subject in the Japanese school curriculum. One is Shikaoi, and the other is Itoigawa, central Japan (Takenouchi, 2016). Other geoparks that help geoeducation in Japanese schools offer lectures and geotours using lecture slots only.

Although the 'Geoeducation Program' in Shikaoi was completed in March 2018, its educational benefits have now been recognized. Students who had attended the program showed a higher understanding of geo-knowledge and more geosite visitations (Figures 3.11–3.13). One group of questionnaire survey respondents had taken the 'Geoeducation Program' for six years in elementary school or for seven to nine years

in elementary and junior high schools (Figure 3.1). In other words, no students had taken the Geoeducation Program at the high school level because the program was terminated before their enrollment (Figure 3.1). Despite this, a clear difference in the educational efficacy was observed between the students who had studied ‘Shin-Chikyu Gaku’ for six to nine years in elementary school and junior high school and those who had not studied ‘Shin-Chikyu Gaku’ at all (Figures 3.11–3.13). A survey of high school graduates who studied ‘Shin-Chikyu Gaku’ at the high school level was not conducted in this study because of the difficulty in accessing them.

Because the ‘Geoeducation Program’ in Shikaoi was terminated, introducing a similar program in the school curriculum is desirable. However, it would be extremely difficult to change the school curriculum in Japan in a decade or so: the responsible ministry (MEXT) has decided on a standardized curriculum based on the law to ensure that students can receive a certain level of education in all schools across Japan. Therefore, it is realistic to develop a new alternative geoeducation program to be led by a geopark (or geoparks) with the cooperation of stakeholders.

Figure 3.15 illustrates the proposed framework led by the Tokachi-Shikaoi Geopark. Yuhora et al. (2016) pointed out that there are few professionals who can provide geoeducation related to geoparks in Japan. Partnerships among geopark experts, university researchers, and other stakeholders will compensate for the lack of geoeducation specialists.

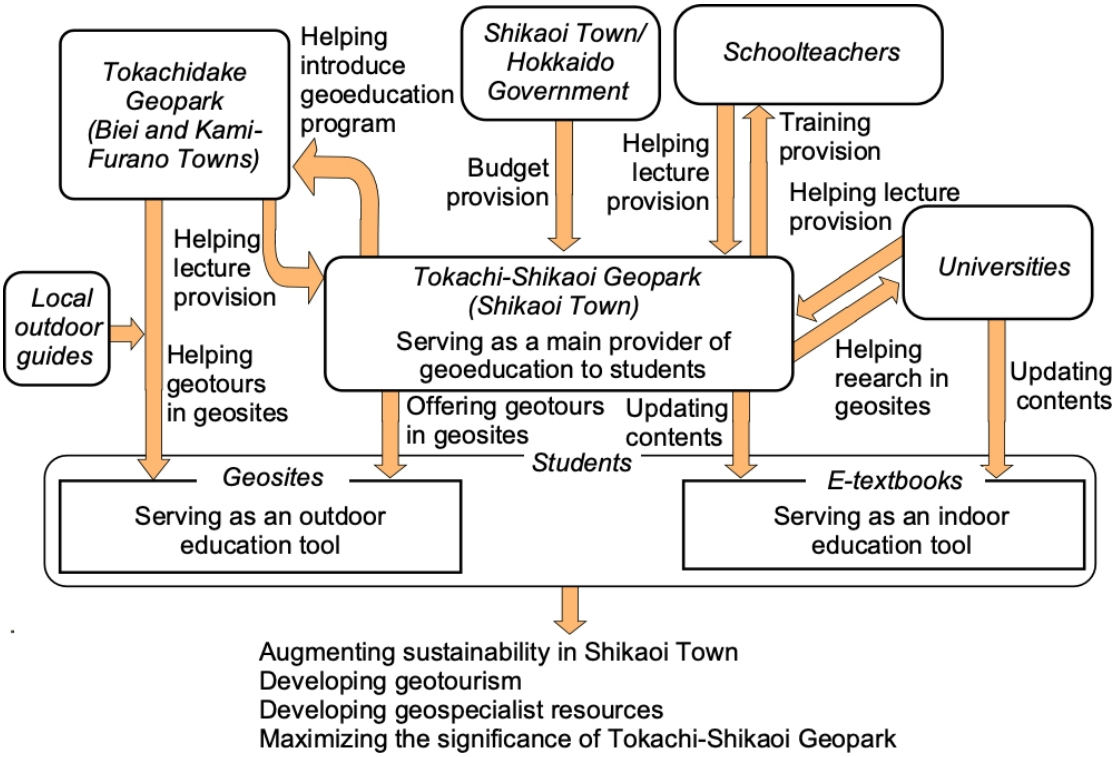


Figure 3.15. Proposed geoeducation framework through a partnership program in Shikaoi with Tokachi-Shikaoi Geopark placed at the core

The involvement of the Tokachidake Geopark, another geopark in Daisetsuzan National Park (Fig. 2.1) will be important to help provide geotours with geostory. Local outdoor guides can contribute to the geotour development and implementation as well. Fieldwork is widely recognized as an effective learning strategy in geoeducation (Orion, 1993; van Loon, 2008; Stokes & Boyle, 2009; Esteves et al., 2015). Providing hands-on learning opportunities in a geopark can improve students' scientific literacy and contribute to positive social and economic outcomes. Students who studied in the program did not visit many geosites in the geopark (Figure 3.13). This suggests a weak connectivity between the schools and the Tokachi-Shikaoi Geopark during the 'Geoeducation Program.' If the experts of the Tokachi-Shikaoi and Tokachidake Geoparks, along with local outdoor guides, take a leadership position, the best and strongest geotours will be offered in geosites.

Universities play a role in developing and updating textbooks with geopark staff members to ensure content accuracy and relevance. In the case of the Tokachi-Shikaoi Geopark, Hokkaido University would be potential universities to become partners.

Specifically, in May 2025, Shikaoi and Hokkaido University plan to formalize their collaboration through an official partnership. This partnership will involve the signing of an agreement with the Faculty of Environmental Earth Science and the Graduate School of Environmental Science at Hokkaido University in order to foster a collaborative relationship with the Tokachi-Shikaoi Geopark. University faculty members and graduate students may help to offer lectures to students. Universities also play a key role in teacher training programs.

Regarding schoolteachers' involvement, the results of the interview survey found that the burden on teachers was high: challenges faced by teachers in Shikaoi Town included increased stress levels and limited training opportunities during the 'Geoeducation Program.' Because the proposed geoeducation framework will not be positioned as a school education program, the burden on teachers will be minimized. Nevertheless, educational support measures remain important (Takenouchi, 2016). Public schoolteachers change schools where they have worked for several years in Japan; therefore, support for new teachers transferred to and within the town is essential. The two interviewees highlighted the need for teachers to have a comprehensive understanding of geo-knowledge, which cannot be achieved solely through textbook learning. Interaction and experience with outsiders, such as geopark experts and university faculty members, will deepen schoolteachers' knowledge and interest in geoeducation and geoparks.

The textbook analysis revealed that students primarily sourced their geo-knowledge from the 'Shin-Chikyu Gaku' textbooks (Figures. 3.2, 3.3, 3.11, 3.12). Geoeducation textbooks play a crucial role in geoeducation (Stern & Roseman, 2004) because they serve as a key guide for imparting essential knowledge to students at a specific age and for a specific discipline (Pingel, 2010). We concluded that the 'Shin-Chikyu Gaku' textbooks were successfully organized to make geo-knowledge accessible to students. The associated teacher guides, with their structured approach, further enhances the educational framework by providing clear instructional guidance, detailed content breakdowns, and integration with broader curriculum subjects, enriching the learning experience. However, the limited inclusion of geopark-related

content and the absence of high school teacher guides indicate areas needing further development to better support both teachers and students.

The annual reports on the geoeducation program provided a longitudinal analysis that highlighted the program's implementation, outcomes, and emerging changes (Neale, 2020). These reports noted high levels of interest and comprehension among elementary and junior high students (Figures 3.4 and 3.5), highlighting the benefits of initiating environmental education early (Ardoin & Bowers, 2020). Yet, as students advanced to high school, their interest declined due to increased academic and career pressures, which decreased the curriculum's effectiveness (Figures 3.6 and 3.7). Research by Collie and Martin (2019) suggests that adapting curriculum to meet the evolving needs of older students could enhance engagement, but the curriculum contents was not sufficiently adapted, leading to lower interest and understanding at the high school levels (Figures 3.8–3.10). Continual curriculum adjustments are crucial to align with different developmental stages and interests. Nevertheless, the high costs of textbook production present significant budget challenges, limiting necessary curriculum adaptations.

Furthermore, despite the benefits of textbooks, several challenges must be addressed to improve their efficacy for future use. One of the main challenges is the lack of sufficient information on the Tokachi-Shikaoi Geopark itself and geoparks in general (Figure 3.3), which is natural because the Tokachi-Shikaoi Geopark did not exist when the textbooks were prepared. To address this issue, it is recommended that they be easily updated in the form of e-textbooks. As Waller (2013) points out, the development of e-textbooks is a cost-effective alternative. The development of e-textbooks could provide both students and teachers with suitable, up-to-date, accessible, and comprehensive geo-educational resources.

In addition, expanding the coverage to include more geosites is advisable because in situ geosite teaching offers hands-on learning opportunities. These geosites, with their didactic potential, can be utilized through various georoutes to enhance students' understanding of the geopark's geoheritage (Arrad et al., 2020). Utilizing the existing geoheritage as a resource for educational programs and teaching materials, the Tokachi-

Shikaoi Geopark can provide students with a deeper understanding of sustainable resource utilization and promote sustainable development and geotourism in the local community (Figure 3.15).

Effective geoeducation can play a significant role in addressing the shortage of geospecialists and increasing the overall geoscientific literacy of society, as noted by Mayer (2002) and Gonzales & Keane (2010). Offering both outdoor (geosite) and indoor learning (e-textbooks) can help cultivate geoscientific literacy and produce an adequate number of geospecialists to meet future workforce demands (Mosher et al., 2014). Two interviewees acknowledged the advantage of the 'Geoeducation Program' in imparting geo-knowledge to the students.

3.5 Conclusions

This chapter presented the efficacy of the 'Geoeducation Program' in schools in Shikaoi Town, northern Japan, which lasted for 15 years from April 2003 to March 2018. The results of the questionnaire surveys revealed a substantial impact on students' understanding of and interest in geo-knowledge. The survey results found that not only indoor learning with textbooks but also outdoor learning at geosites is important. The content analysis showed that the integration of geopark-related content into school curriculums was uneven, with significant underrepresentation in junior high and high school materials. The interview survey highlighted that teacher training emerged as another critical issue, as most educators lacked formal geoscience training and relied on self-directed learning. Frequent teacher relocations disrupted the continuity of geoeducation which suggests the need for a training mechanism for schoolteachers, who can act as supporting instructors. However, there is room for introducing an alternative approach in the future. Utilizing geopark resources will be a realistic alternative provision of geoeducation to students because revitalizing the school geoeducation system will be extremely difficult. Since most operating costs of the geopark are paid by the town, and since the available geopark staff members are limited,

this study proposes to establish a new framework of partnership. This partnership was designed to offer outdoor (geosite) and indoor (e-textbook) learning.

Continued budget acquisition will be the largest challenge for the proposed program, because there will be no initial budget to implement the new geoeducation program under the proposed framework. Although this study did not discuss this issue, it is important to have cooperation between Tokachi-Shikaoi Geopark and Shikaoi Town to secure external funding support.

The declining population of Shikaoi Town underscores the significance of providing comprehensive education to future citizens. As highlighted by Ríos et al. (2020), geoeducation is instrumental in attaining Sustainable Development Goals (SDGs) by contributing to integral fulfillment. Geoeducation plays a critical role in promoting the sustainable development of the Tokachi-Shikaoi Geopark, as well as other geoparks. The approach of the partnership framework ensures that the economic growth and development promoted by the geopark will be sustainable in the long term, avoiding the depletion of natural resources or environmental degradation.

Chapter 4. Analyses of the geoeducation program related to Cuihuashan National Geopark

4.1 Introduction

Cuihuashan National Geopark was among the first 11 national geoparks designated by the Ministry of Land and Resources in March 2011. This distinction emphasizes its unique geological attributes characterized by significant landslide and slide landforms, which not only display distinctive textures but are also exceptionally well-preserved. These geomorphological features, including natural wonders such as Tianchi (Figure 4.1A), the Wind Cave (Figure 4.1B), and the Ice Cave (Figure 4.1C), are integral to its designation as the only landslide national geopark in China. The geopark is famous for the Cuihua Rock Avalanche, which stands as a prototypical example of geological disaster relics conservation in China (Lv et at., 2014). This site is key in protecting geological heritage and enhances its value for geoeducation.

Cuihuashan National Geopark serves as an important educational resource, introducing visitors to significant geological features. It functions as an outdoor educational platform that enriches student' understanding of geological processes, effectively bridging classroom theory with real-world geological observation. This hands-on experience plays a crucial role in enhancing geoeducation by helping students gain a deeper understanding of geo-knowledge.

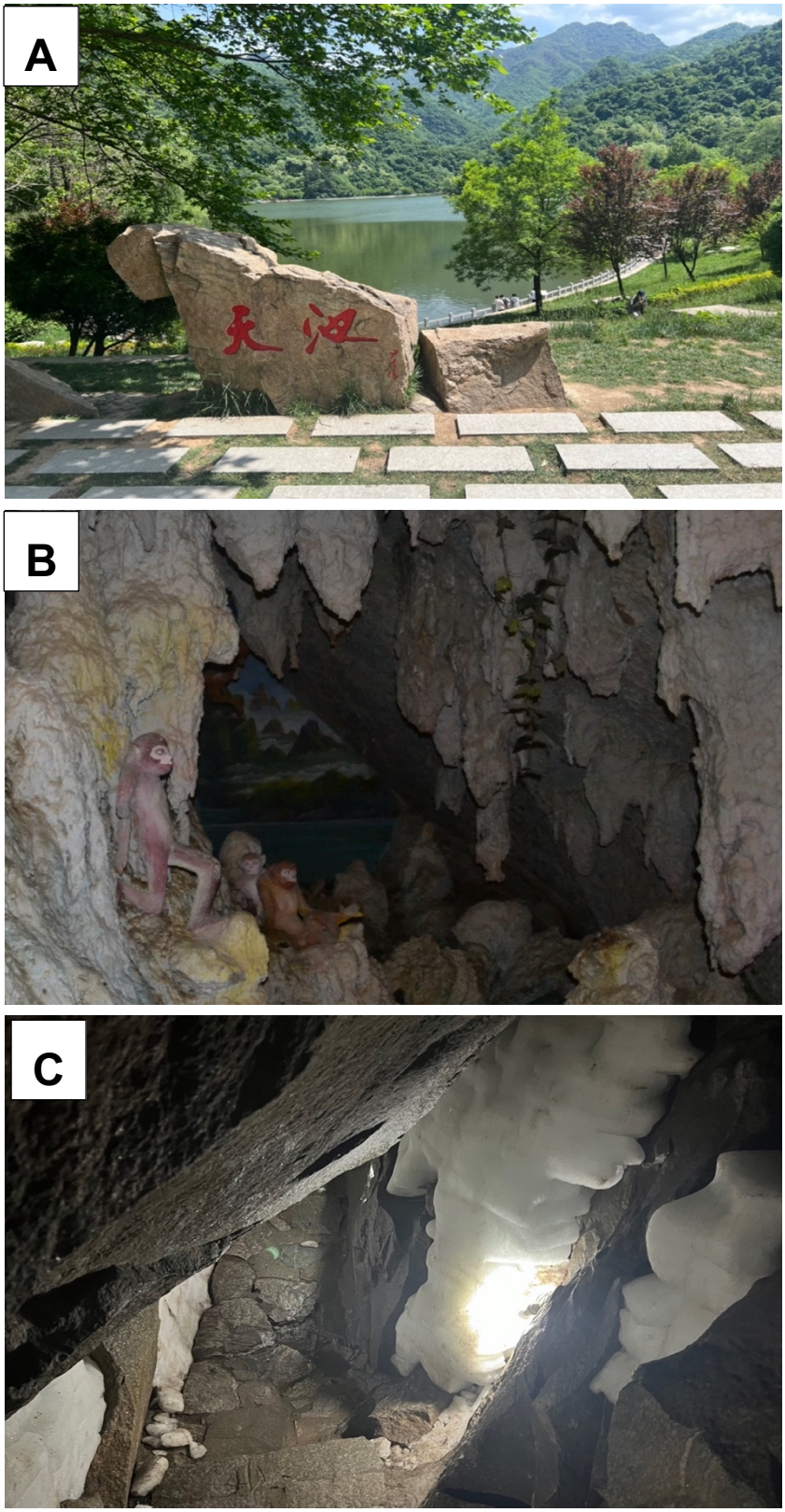


Fig. 4.1. Examples of geosites in the Cuihuashan National Geopark. A:The Tianchi; B: The Wind Cave; and C: The Ice Cave (photo by author)

Drawing on the experiences of educational trips in Japan and Western countries, Xi'an was selected as one of the initial pilot cities for research travel programs in 2013. Due to its rich historical and cultural heritage, the Ministry of Education of the People's Republic of China and the Shannxi Provincial Education Department recognized Xi'an as an ideal candidate for these initiatives. Study tours for elementary, junior high and high school students were organized and planned by educational departments and schools, combining research-based learning with travel experiences into an integrated educational activity. In November 2016, the Ministry of Education, along with eleven other departments, issued the 'Opinions on Promoting Research Travel for Students in Elementary to High Schools.' This document advocated the integration of study tours into the curriculum of all levels of schools, promoted the combination of these travel experiences with school education, and tailored activities to the specific characteristics of educational levels and regional features.

A 'study tour' represents a dynamic and emerging mode of experiential education in China, which gains recognition for its unique approach known as "learning through practice." Unlike traditional tourism, study tours are distinguished by their educational purposes, and can also be referred to as outdoor education or outdoor fieldwork. Outdoor education has been a significant educational form in Western countries and has generated extensive research. Research themes typically center on environment-related history, culture, values, nature and energy (Freeman, 2015; Tekakpınar & Tezer, 2019; Beery, 2020; Buldur et al., 2020; Cincera & Johnson, 2020). The objectives of outdoor education primarily focus on imparting environmental awareness and values and understanding natural resources and sustainability (Buldur et al., 2020).

At Cuihuashan National Geopark, a variety of thematic routes are tailored for different groups, each designed to provide distinct learning experiences. As delineated in the official guide map (Figure 4.2), four primary tour routes are featured, and categorized into two types. The first type includes walking educational routes: the highlight tour route covers approximately 5 kilometers and takes about 3.5 hours, featuring the Entrance gate, Shiba Pan trail, Landslide area, and Tianchi Lake; the insight tour route spans around 6 kilometers with a duration of about 5.5 hours,

including an extended route to Cuihua Peak; and the overall tour route, the longest, stretches approximately 7.5 kilometers and takes around 7 hours, adding the dam top of Bishan Lake and the dragon ridge to the route. The second type is a combination of driving and walking, consisting of a single route that covers around 8 kilometers and takes about 2.5 hours, starting from the Entrance gate to Tianchi driveway, then to Tianchi Lake, the Landslide area, and Cuihua Peak. All study tour routes have been adapted from recommended routes in the official guide map, with modifications specifically designed to meet the educational needs of different schools. Additionally, these study tours are accompanied by guides who provide detailed explanations of the geosites encountered.

Figure 4.2. The guide map of Cuihuashan National Geopark

The ‘Xi’an Primary and Secondary School Research Travel Theme Route Guide,’ which was produced in 2016, stands as a significant outcome of Xi’an’s initiatives in the study tour. This guide is divided into eight thematic categories: historical culture, revolutionary tradition, Xi’an’s heritage, Silk Road exploration, science popularization education, national defense education, natural and cultural humanities, and growth practices. Each section is supplemented by subsections on ‘purpose and significance,’ ‘study content,’ ‘activity design,’ ‘safety tips,’ and ‘resource introduction,’ along with ‘geographic location maps’ and ‘photos showcasing the distinctive features of the study destinations.’ This approach ensures relevance to students’ lives and facilitates teaching effectiveness. Information on the Cuihuashan National Geopark is included, which aims to enhance student’s understanding of local natural geology while visiting the site. Throughout the study tour process activities are closely linked with the school curriculum, thereby broadening student’s horizons, enhancing their pride and confidence, and fostering an appreciation of the importance of environmental sustainability.

In this chapter, the integration of Cuihuashan National Geopark into the school curriculum is examined through thematic routes from the ‘Xi’an Primary and Secondary School Research Travel Theme Route Guide’. The analysis focuses on how these routes are incorporated into educational strategies and assesses their impact on geoeducation. Additionally, this chapter presents finding from a questionnaire survey conducted among students who participated in study tours to the geopark, and details their experiences and educational outcomes. Perspectives from various stakeholders on the effectiveness and challenges of the regional geoeducation program are also explored, which provides an overview of the current state and potential improvements in geoeducation.

4.2 Study materials and methods

4.2.1 Contents analysis

While Xi'an does not offer courses specifically dedicated to the geo-knowledge of Cuihuashan National Geopark, significant strides were made Xi'an in 2016 with the publication of the 'Xi'an Primary and Secondary School Research Travel Theme Route Guide' (Figure 4.3). This guide is divided into three volumes tailored to different educational levels—elementary, junior high and high school—each designed to cater to students' respective cognitive and developmental stages. Each volume compresses 30 to 40 thematic routes, self-contained to serve as a reference for schools organizing educational travel activities. Notably, each volume includes at least one themed route to Cuihuashan National Geopark. The content of these guides builds upon the compulsory geography curriculum, extending learning beyond the classroom to deepen students' understanding of relevant geo-knowledge. This chapter will analyse the inclusion of Cuihuashan National Geopark within these thematic routes and its integration into the school curriculum as presented in the 'Xi'an Primary and Secondary School Research Travel Theme Route Guide.'



Figure 4.3. The 'Xi'an Primary and Secondary School Research Travel Theme Route Guide' guidebook for elementary, junior high and high schools in Xi'an.

4.2.2 Questionnaire survey and interview survey

This section evaluates the knowledge and attitudes of four distinct groups of students regarding the Cuihuashan National Geopark and examines the effectiveness of the study tours organized by their school. The groups were differentiated based on their prior experience with school-organized study tours and the timing of the survey (before and after the study tour). Specifically, the groups included: students who had participated in previous study tours and were surveyed before this study tour; students with no prior experience who were surveyed before this study tour; students who had participated in previous study tours and were surveyed after this study tour; and students with no prior experience who were surveyed after this study tour.

Data collection for questionnaire survey

Questionnaire survey was adopted to collect high school students' opinions. The selected participants were from a high school in Xi'an City, located near the Cuihuashan National Geopark. The survey took place during a study tour at the Cuihuashan National Geopark on 24th June 2023.

For Xi'an High School students, two versions of structured questionnaires were developed in collaboration with experts. One version was administered to students prior to their study tour of the Cuihuashan National Geopark, and the other was distributed upon completion of the tour. The difference between the two versions resides in the first part, which gathers general information. This section includes questions about whether the students had previously participated in school-organized activities at the Cuihuashan National Geopark before this tour. For students with prior experience, all the questions designed for post-tour survey were asked. For those without prior experience, certain questions concerning the geopark related geo-knowledge were omitted.

Both versions of the questionnaires are divided into three sections: students' basic information, opinions on the study tour, and perceptions of the geopark. A five-point Likert scale was used to evaluate student opinions. Response options are organized as follows: "I do not know anything about it," "I barely know it," "Neither," "I know it,"

and “I know it very well,” which correspond to scores from 1 to 5, respectively. Higher scores consistently represent a greater degree of knowledge. Most items were designed based on previous chapter. Initial statistical analyses involved frequency analysis and mean calculations, followed by t-tests to compare means. In this study, higher mean scores suggest a better understanding of geopark-related. Statistical significance was determined at a 0.05 level with a two-tailed test.

Before finalizing the questionnaires, comprehensive tests were conducted to assess both reliability and validity (Bashir et al., 2008). Cronbach’s alpha, a widely utilized reliability metric ranging from 0 to 1, was employed; scores closer to 1 denote higher reliability. In this study, a Cronbach’s alpha of 0.871 indicates a high level of reliability. For validity, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s test were used, adhering to standards comparable to those for Cronbach’s alpha. The questionnaire achieved a KMO score of 0.845, affirming its validity.

Data collection for questionnaire survey

This study conducted qualitative in-depth face-to-face interview surveys with key informants from Cuihuashan National Geopark. A total of six individuals were interviewed (Table 4.1) in order to gain the related information about geoeducation in the geopark. The individuals selected as key informants were those responsible for different development stages of their geoeducation. Their specialized knowledge was considered crucial to gain a deeper understanding of the issues and potential solutions related to the study. All responses were recorded using an audio device and documented in a notebook to ensure accuracy and thoroughness in data collection.

Table 4.1. Details of the interview surveys conducted with 6 key informants

Key informants	Identity	Survey date	Time duration (minutes)
Mr. A	Geoscience Educator of the geopark	14/06/2023	107
Mrs. B	Director of study tours at the geopark	14/06/2023	107
Mrs. C	Teacher of the high school	24/06/2023	72
Mr. D	Director of study tours at the Education Bureau	12/07/2023	58
Mr. E	Professor at the College of Tourism and Environment, Shannxi Normal University	04/10/2024	55
Mr. F	Director of study tours at the Zhuque Forest Park	08/01/2025	19

4.2.3. Conducting methods

The questionnaire survey was conducted online on 24th June 2023 at the Cuihuashan National Geopark. This survey used Wenjuanxing (https://www.wjx.cn/), a professional online survey service. All respondents were second-year high school students. Respondents were required to complete all questions to ensure the validity of their submissions.

Following the survey period, from 25th June to 4th July 2023, data were extracted and converted into .sav files for further analysis, with a total of 496 effective responses collected. The effective 496 responses included 153 students who were first time participants in a school-organized study tour to Cuihuashan National Geopark and 95 with multiple experiences: each group completed the questionnaire before and after their respective study activities. Data analysis, including frequency and mean analysis, was performed using SPSS 24 for Windows. The results were compared to identify significant differences.

4.3 Results

4.3.1 Contents analysis for Cuihuashan National Geopark

Guidebooks content analysis of 'Xi'an Primary and Secondary School Research Travel Theme Route Guide'

In 2013, Xi'an was designated as one of the first pilot cities in China for elementary to high school study tours as already mentioned. After over three years of exploration and practice, by 2016, significant experience had been accumulated, leading to the creation of the 'Xi'an Primary and Secondary School Research Travel Theme Route Guide'. This guide represents a significant achievement in enhancing the quality of study tours in Xi'an. It was developed with a focus on integrating knowledge enhancement into the design of themed routes. The guide considers the local natural, historical, cultural, and socio-economic developments to offer a variety of themed routes. Each phase of the guide includes study tour routes to the Cuihuashan National Geopark, showing a dedication to using local resources to thereby enhance students' geo-knowledge.

The elementary school guidebook comprises eight chapters, spanning 136 pages, with each chapter featuring 2 to 5 thematic routes, resulting in a total of 30 routes. In chapter 5, titled 'Science Education,' Route 20 focuses on the Cuihuashan National Geopark, elaborated on pages 87 to 90. The guide highlights the objective of this thematic route: to bring students closer to nature by visiting Cuihuashan National Geopark. The study tour content integrates textbook knowledge, linking to the lesson "Inspiration from Nature" from the fourth-grade Chinese language textbook (Renjiao version). The tour is designed to help students understand the geological conditions that led to the formation of the geopark, including the types of rocks and historical magmatic activities that contributed to the geopark's topography. During the visit, students can identify various plants and engage in a quiz competition designed to test their knowledge of the geoparks's formation, including questions on geohistorical and the natural forces shaping the landscape. Activity suggestions include searching for plant species and participating in this interactive quiz, making the learning process both informative and enjoyable.

Safety guidelines emphasize the importance of staying in groups, and. avoiding crowding. Background information on the geopark is also provided. On 23 August 2009, Qinling Zhongnanshan UNESCO Global Geopark was shortlisted as the first world geopark in China's northwest region, accompanied by a location map of Cuihuashan National Geopark.

The junior high school guidebook also consists of eight chapters, covering 136 pages, with each chapter featuring 3 to 5 thematic routes, totaling 30 routes. In chapter 7, titled 'Nature and Humanity," Route 20 is dedicated to the geopark and explained in detail on pages 116 to 119. The guide presents the purpose of this thematic route as fostering an understanding of the geological features of the geopark and linking textbook knowledge to natural setting. Students are expected to be prepared with knowledge about orogenic belts and rock formations, both of which are prominent in Cuihuashan National Geopark. This geopark is characterized by its striking granitic landforms, resulting from millions of years of geological evolution involving magma activity and erosion. The rock formations provide a practical example of igneous rock processes discussed in textbooks. This guidebook does not explicitly the thematic routes to specific curriculum units or lesson plans. The study project aims to develop their understanding of the geographical significance of the geopark. Suggested activities include watching related educational films, hiking through the geopark to explore its geological features, and enhancing their understanding of geoscience. Safety tips emphasize the need for students to follow teacher instructions, care for facilities and the natural environment, and avoid littering. Finally, the background of the geopark is discussed, highlighting its geological evolution.

The high school guidebook contains eight chapters over 192 pages, with each chapter presenting 3 to 6 thematic routes, making a total of 40 routes. In chapter 7, "Nature and Humanity," Route 20 focuses on Cuihuashan National Geopark, detailed on pages 139 to 141. This thematic route aims to help students understand the landslide features of the geopark and their formation causes, such as natural erosion, weathering processes, and potentially seismic activity, which are common factors in the region's geomorphology. Additionally, the route explores the cultural aspect of ancient imperial

rituals by discussing the temples built within the geopark, which serve as historical sites that blend the natural and cultural heritage of the area. The study tour content is linked to the compulsory geography textbooks for high school (Renjiao version): “Shaping of Surface Features” and “Holistic and Diverse Natural Environments” from Geography 1, as well as “Harmony between Humans and the Geographical Environment” from Geography 2. Activity suggestions include visiting geosites like the Landslide Area, Icey Cave, Windy Cave and Cuihua Palace within Cuihuashan National Geopark to witness rare landslide features and learn about surface shaping processes. Students are encouraged to visit the Qinling Zhongnanshan UNESCO Global Geopark Museum to gain an overall understanding of the geopark. Safety guidelines advise students to consider weather conditions and pace themselves during mountain hikes. Finally, the background information covers the imperial ritual culture, the main geosites of the geopark, and explanations of landslide processes.

All guidebooks are formatted in A4 size and encompass a diverse range of subjects about local resources. These include historical culture, revolutionary tradition, the heritage of Xi'an, Silk Road exploration, science popularization education, national defense education, natural and cultural humanities, and growth practices. The guidebooks, totaling 464 pages for elementary, junior high, and high school levels, distribute their content as follows: 14.6% on historical culture, 12.7% on revolutionary tradition, 16.6% on Xi’an’s heritage, 11.9% on Silk Road exploration, 13.2% on science popularization education, 8.0% on national defense education, another 13.2% on natural and cultural humanities, and 13.8% on growth practices (Figure 4.4). Notably, within the natural and cultural humanities section, there is a thematic route featuring Cuihuashan National Geopark. This section introduces geo-knowledge related to the geopark but represents only a small portion (2.4%) of the total content in the guidebooks (Figure 4.4). For detailed geopark-related study tour pages from the guidebooks, please see Appendix 2.

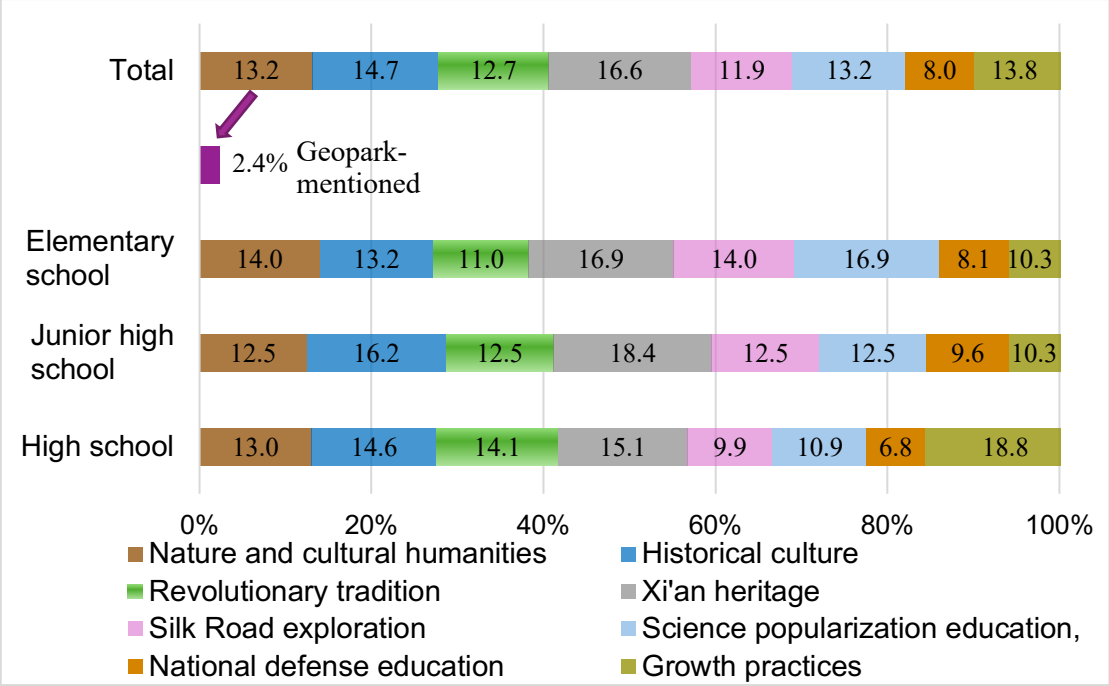


Figure 4.4. The percentage of guidebooks 'Xi'an Primary and Secondary School Research Travel Theme Route Guide' content for elementary, junior high, and high schools in Xi'an City

Integrating Cuihuashan National Geopark into school textbooks

Given Xi'an's rich natural study tour resources, guidebooks crafted for these tours effectively integrate textbook content with local natural attractions, such as Cuihuashan National Geopark. This integration allows students to directly engage with and experience the concepts taught in the classroom, thereby seamlessly connecting theoretical knowledge with practical application. Additionally, these guidebooks utilize local resources to deepen students' understanding of their own regions, fostering an appreciation for the natural environment, and encouraging a sense of duty and responsibility towards their local community. However, the thematic routes related to the geopark are limited to only one per educational level, resulting in students participating in just a single geopark study tour during each stage of their education. This underutilization of an optimal site for geoeducation limits students' opportunities to visually explore geological processes and reinforce their classroom-acquired geo-knowledge.

In terms of educational content, the guidebooks connect directly from textbooks to create meaningful links between classroom learning and field experience. Specific examples include the elementary school guidebook's section titled "Inspiration from Nature" drawn from the fourth grade Chinese Language textbook, and the high school guidebook sections "Shaping of Surface Features" "Holistic and Diverse Natural Environments" and "Harmony between Humans and the Geographical Environment" from Geography 1 and 2 as detailed in Table 4.2. These links ensure that field experiences strengthen specific curriculum topics, providing a structured way to bridge theory and practice. Nevertheless, the junior high school guidebook does not directly link to textbook content, instead merely suggesting that students need to understand geological belts and rock formations. This indicates a need for a more comprehensive integration of the geopark visits into the educational curriculum, which ensure that all educational levels benefit from structured and relevant field experience.

Table 4.2. Integration of Study Tour Guidebook Content with Textbook Curriculum

Education Level	Curriculum/Chapter/Lesson	Chapter Name	Lesson Name	Study Tour Theme	Study Tour Content	Study Tour Objective
Elementary	Chinese Language/3/12	N/A	Inspiration from Nature	Understanding the formation conditions of the geopark	Experiencing a close encounter with nature	Cultivate students' understanding of nature around them through observation
Junior high	N/A	N/A	N/A	N/A	N/A	N/A
High School	Geography 1/3/1	Shaping of Surface Features	Forces that Shape the Earth's Surface	Understanding the geological and geomorphological conditions of the geopark and the external forces that shaped these features	Observing the geological and geomorphological features of the geopark	Through observation, to make comprehensive judgments and identify different geological and geomorphological types and characteristics in the geopark, fostering students' regional cognitive abilities
High School	Geography1/3/2	Shaping of Surface Features	Formation of Mountains	Understanding the types of mountains in the geopark	Observing and identifying landslide and erosion impacts on mountain formation in the geopark	
High School	Geography1/3/3	Shaping of Surface Features	Development of River Landforms	Understanding the geological and geomorphological types of 'Tianchi'	Observing the 'Tianchi' (river landform) in the geopark	
High School	Geography1/4/1	Holistic and Diverse Natural Environments	The integrity of the Natural Geographic Environment	Understanding the geomorphological changes of the geopark over different periods	Visiting the geopark museum	Through observation and to visits to the geopark, understand its changing process and cultivate students' comprehensive thinking
High School	Geography1/4/2	Holistic and Diverse Natural Environments	The Diversity of the Natural Geographic Environment	Observing the overall natural geographic environment and its elements from the mountain top	Climbing Cuihuashan Mountain	
High School	Geography2/6/1	Harmony between Humans and the Geographical Environment	The Evolution of Human-Geography Relationships	Understanding the main environmental challenges faced by humanity	Conducting a current environmental situation survey of the geopark	Through surveys, analyze the current environmental status of the geopark and understand how the geopark can drive regional sustainable development, fostering students' pride in their hometown
High School	Geography2/6/2	Harmony between Humans and the Geographical Environment	Sustainable Development Practices in China	Understanding the sustainable development goals corresponding to the geopark	Surveying the current status of sustainable development in the geopark	

4.3.2 Evaluating the impact of study tours on student's geo-knowledge comprehension at Cuihuashan National Geopark

In the questionnaire survey, 248 high school students from a school in Xi'an participated, with 171 females (69.0%) and 77 males (31.0%). The results show varied participation in school-organized study tours to the geopark. Of the 95 students who had experienced study tours, 21 had participated once in a tour organized by their elementary school, 13 had joined a study tour organized by their junior high school, and 90 had been on a study tour organized by their high school.

Geo-knowledge comprehension among student groups

Figure 4.5 shows that students who had participated in multiple study tours began with higher initial scores before the tour, compared to those attending for the first time. First-time participants started with lower initial scores but made more substantial relative improvements, especially in topics related to nature and the environment. For example, their mean scores increased from 3.53 to 4.12 in 'Forces Shaping the Earth's Surface' and from 3.49 to 4.14 in 'Formation of Mountains.' Although both groups initially scored lower on these topics, the gains for repeat participants were less pronounced. Nonetheless, their overall understanding of geo-knowledge remained greater than that of the first-time participants. It is noteworthy that topics related to culture, such as 'Ancient Culture' and 'Story of the Taoist Immortal Taiyi Zhenren,' received lower scores, particularly before the tour.

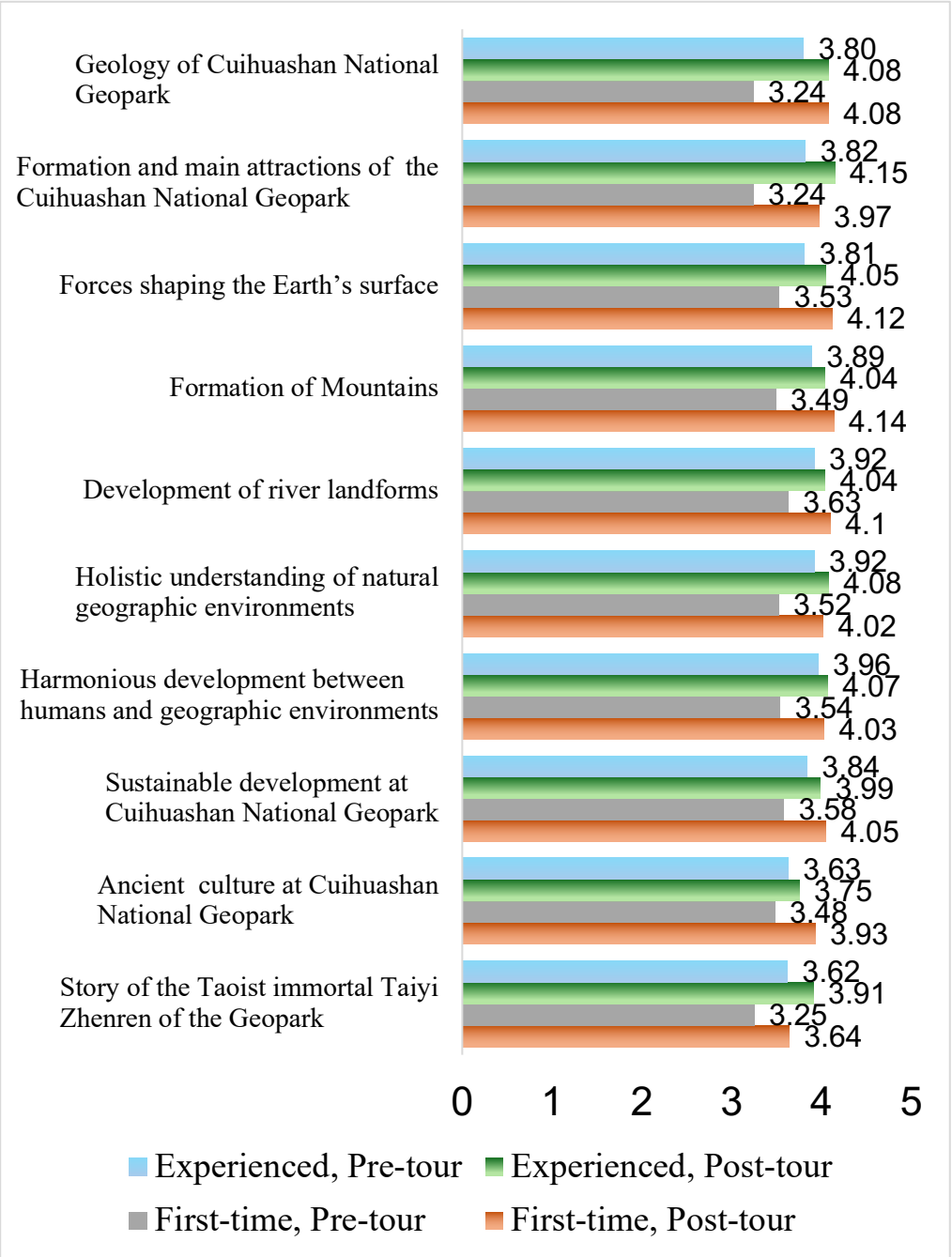


Figure 4.5. Mean scores of students' understanding of the geo-knowledge before and after the 'study tour' as measured by a Likert Scale in the four student groups.

Figure 4.6 shows data comparing the perceived importance of establishing a geopark among different groups of students. The percentage of students who regard the establishment of a geopark as 'strongly essential' or 'essential' increases in both groups A and B. Specifically, group A, which has previous experience, shows an initial high level of support with approximately 55.8% rating it as 'strongly essential' and 31.6%

as ‘essential.’ This support increased in the survey of after study tour, with 60.0% rating it ‘strongly essential’ and 28.4% ‘essential.’ A significant difference is noted between the two surveys, with a p-value of 0.005.

In contrast, the group without prior experience (Group B) shows a dramatic increase in support after the study tour. Initially, only 3.3% rating it ‘strongly essential’ and 28.8% ‘essential’ (B1). After participation in the study tour (B2), these figures jump to 52.3% and 27.5%, respectively, with a p-value of 0.000 indicating a significant difference.

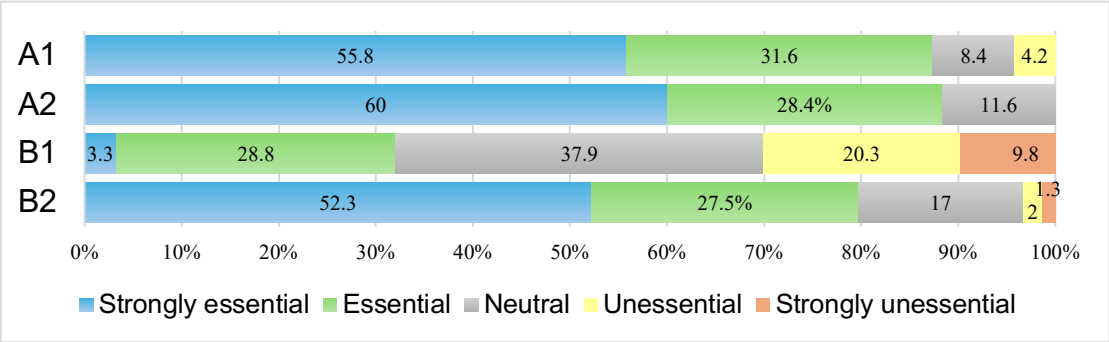


Figure 4.6. To what extent do you believe it is important to establish a Geopark? A1: Group of students who had participated in previous study tours and were surveyed before this study tour (n=95); A2: Group of students who had participated in previous study tours and were surveyed; after this study tour (n=95); B1: Group of students with no experience who were surveyed before this study tour (n=153); B2: Group of students with no experience who were surveyed after this study tour (n=153)

Figure 4.7 illustrates students' comprehension of the Geopark concept. Students with previous experience (Group A) reported a solid understanding before the study tour, with 16.8% fully understanding and 48.4% somewhat understanding the concept. After the tour, those fully understanding increased to 29.5%. The p-value was 0.060, indicating no significant difference within Group A.

Students without previous experience (Group B) showed a notable improvement. Before the study tour, only 2.6% fully understood the concept, which rose to 29.4% after the study tour, with markedly decreases in lower understanding levels. The P-

value was 0.000, indicating a significant difference between two surveys of Group B.

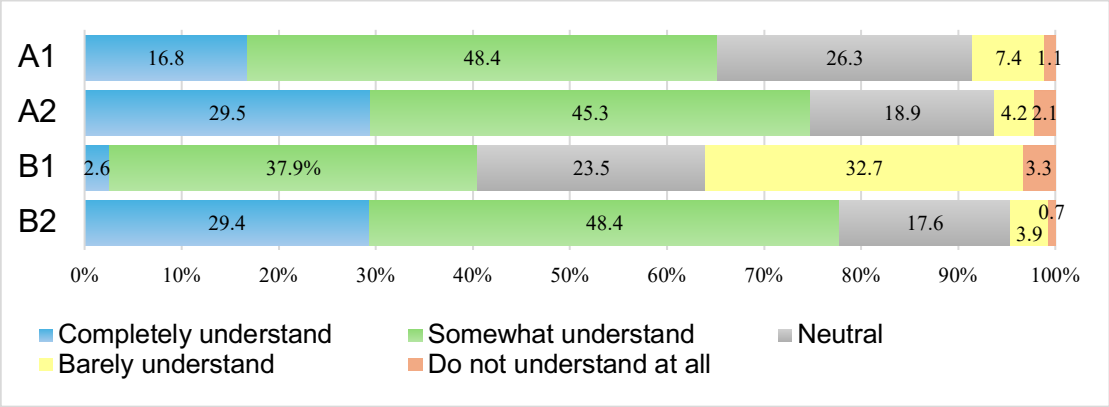


Figure 4.7. How well do you understand the concept of a Geopark? A1: Group of students who had participated in previous study tours and were surveyed before this study tour (n=95); A2: Group of students who had participated in previous study tours and were surveyed; after this study tour (n=95); B1: Group of students with no experience who were surveyed before this study tour (n=153); B2: Group of students with no experience who were surveyed after this study tour (n=153)

Figure 4.8 illustrates the students' pride in establishing the geopark. Students with previous experience (Group A) demonstrated consistently high pride levels, with 50.5% expressing 'strongly proud' and 29.5% 'somewhat proud' before the study tour. These figures remained stable post-tour, with 47.4% 'strongly proud' and 30.5% 'somewhat proud.' The P-value was 0.097, indicating that there does not exist significant difference between the two groups. In contrast, students without previous experience (Group B) reported an increase in pride. The percentage of 'strongly proud' responses rose from 38.6% before the study tour to 48.4% after the study tour. The P-value of this group was 0.000, signifying a significant difference within Group B. For both groups, there was a decrease in students feeling 'slightly unproud,' and 'strongly unproud' after the study tour. Notably, Group B displayed a substantial reduction in 'slightly/strongly unproud' from 7.9% to 2.6%.

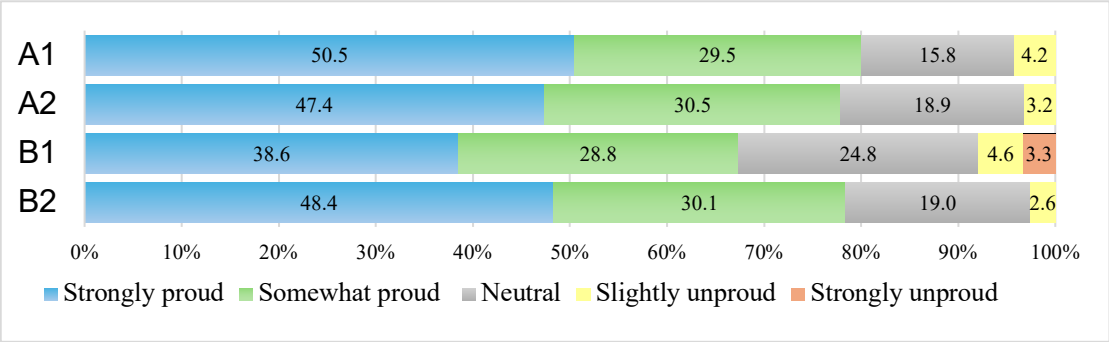


Figure 4.8. To what extent do you feel proud about establishing? A1: Group of students who had participated in previous study tours and were surveyed before this study tour (n=95); A2: Group of students who had participated in previous study tours and were surveyed; after this study tour (n=95); B1: Group of students with no experience who were surveyed before this study tour (n=153); B2: Group of students with no experience who were surveyed after this study tour (n=153)

Figure 4.9 highlights changes in familiarity with Cuihuashan National Geopark among students before and after the study tour. Before the study tour, students with previous experience (Group A) reported 15.8% "extremely familiar" and 43.2% "familiar," which increased to 14.7% and 53.7% respectively after the study tour, with a p-value of 0.000 indicating a significant difference.

Students without previous experience (Group B) started with 1.3% "extremely familiar" and 18.3% "familiar." After the study tour, familiarity increased to 19.6% and 49.7%, with the same p-value of 0.000, confirming significant improvement.

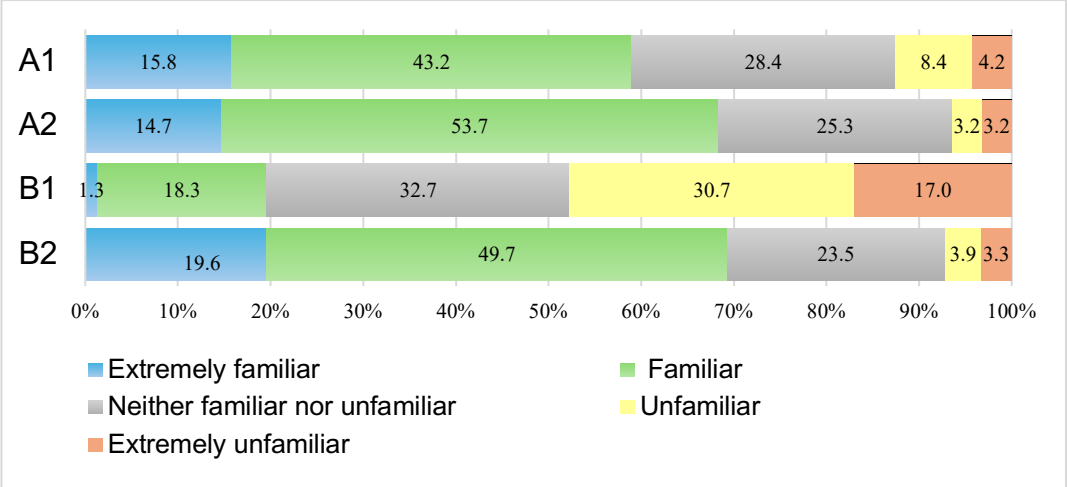


Figure 4.9. How familiar are you with the Cuihuashan National Geopark? A1: Group of students who had participated in previous study tours and were surveyed before this study tour (n=95); A2: Group of students who had participated in previous study tours and were surveyed; after this study tour (n=95); B1: Group of students with no experience who were surveyed before this study tour (n=153); B2: Group of students with no experience who were surveyed after this study tour (n=153)

Figure 4.10 presents data comparing the percentage of students who had participated in previous study tours with those survey after this study, based on their visitation of various geosites. Figure 4.10 clearly shows that the Museum of the Geopark had the highest visitation rate among students surveyed after this study tour, with 93.7% attendance. This is significantly higher compared to those who had participated in previous study tours, at 72.6%. Similarly, TianChi Lake and Icy Cave also show high visitation rates among students surveyed after this study tour, with percentages close to or exceeding 90%. On the other hand, the Cuihua Palace shows a stark contrast in visitor rates, with only 6.7% of students who had previously participated in study tours visiting, compared to 34.7% of the students after this study tour. The data indicates that well-known geosites, such as the Museum of the Geopark, TianChi Lake, and Icy Cave are more consistently visited, reflecting their educational value in the geopark's study tours. Conversely, geosites like the Cuihua Palace, Taiyi Palace have markedly lower visitation rates, likely due to a reduced emphasis or lesser

accessibility in the educational program, with a focus shifted towards natural and environmental elements rather than cultural heritage.

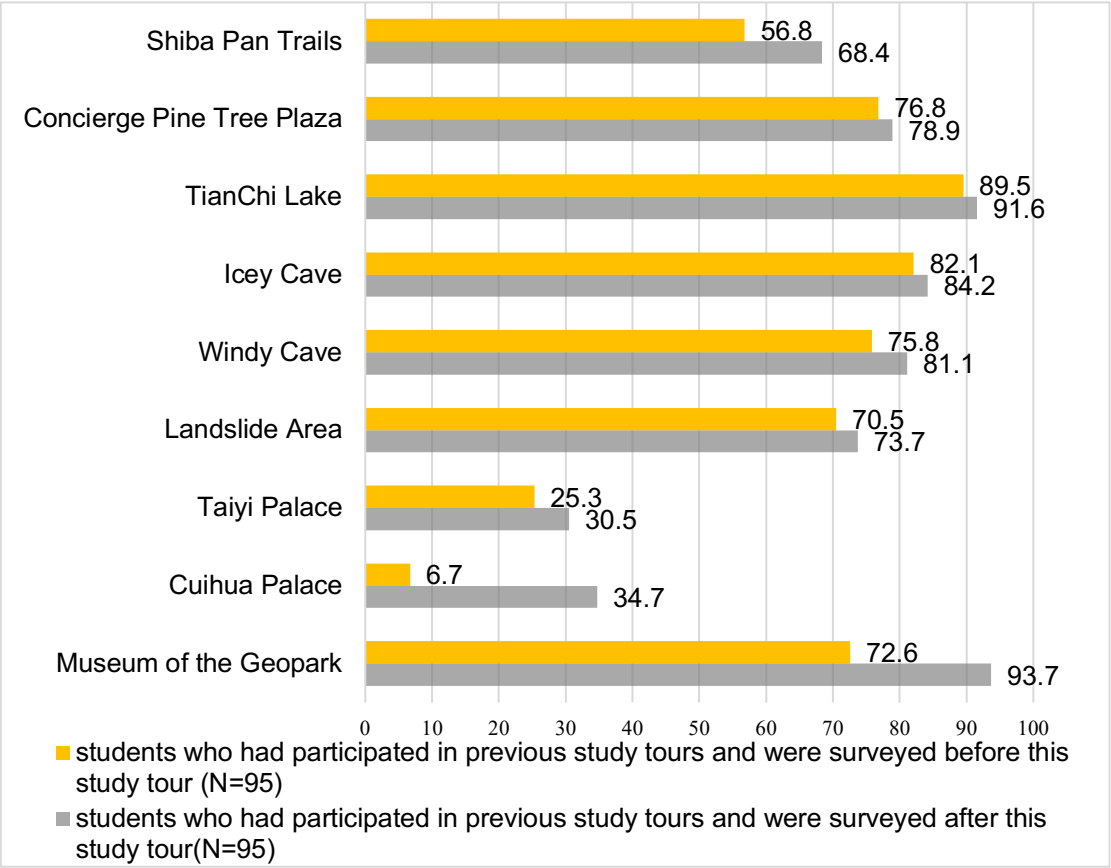


Figure 4.10. Percentage of geosites visited by the two groups of students

Assessing the impact of the 'study tours' on students' attitudes and interests

Upon participating in study tours at Cuihuashan National Geopark, notable shifts in student perspectives were observed (Table 4.3). Pre- and post-tour comparisons among experienced students showed increases in geopark-related awareness, with those confident in introducing the geopark to tourists rising from 34.7% to 54.7% those who wanted to be and volunteers from 33.7% to 50.5%. First-time participants also led to growth in environmental awareness (77.1%) and interest in geology (64.1%). The proportion of experienced students who reported no change in their views dropped from 13.7% students with pre-tour experience to an only 1.1% post-tour.

Table 4.3. The proportion of the answers by the students who had participated in previous study tours and were surveyed before this study tour being asked, 'Did you change your thoughts about any of the items below after study tours?' Pre-Tour, Experienced (n=95): students who had participated in previous study tours and were surveyed before this study tour; Post-Tour, Experienced (n=95): students who had participated in previous study tours and were survey after this study tour; Post-Tour, First-time (n=153): students with no prior experience who were surveyed after this study tour.

Statements	Student groups		
	Pre-Tour, Experienced (%)	Post-Tour, Experienced (%)	Post-Tour; First-time (%)
1. Started to pay attention to the articles and news about geoparks	61.1	64.2	33.3
2. Was able to confidently introduce the Cuihuashan National Geopark to tourists	34.7	54.7	13.7
3. Wanted to participate as a volunteer in the events that are held by the Cuihuashan National Geopark	33.7	50.5	7.8
4. Started to pay attention to environmental conservation	60	66.3	77.1
5. Became more interested in geology/geography	50.5	70.5	64.1
6. Others	5.3	7.4	7.2
7. Nothing had changed	13.7	1.1	15.7

4.3.3 Interview survey analysis

According to the Ministry of Education of the People's Republic of China (MOEPRC, 2016), the concept of study tours, inspired initially by practices in Japan and the U.S.A., aims to enhance student engagement with geoscience. These study tours are designed to provide experiences tailored to meet local educational needs, effectively connecting classroom theory with real-world geological application.

Table 4.1 presents the key informants and their identities, Mr. A and Mrs. B, who discussed the benefits and areas for improvement within the study tour program. They emphasized that one of the primary advantages of the study tours is the exposure to geoscience and natural heritage, which can stimulate student interest. Furthermore, they highlighted the need to make the contents more interactive and relevant, to link the

contents directly to the geo-knowledge covered in students' textbooks and their interests.

Educational activities within the geopark are promoted through well-defined, purpose-driven custom activities for different student levels before their visit, adjusted seasonally to increase appeal and participation. According to Table 4.4, which was provided by Mrs. B and based on the recommended routes in the official geopark guide map (Figure 4.2), one such study tour is titled 'Traversing Landside Relics, Solving Geographic Puzzles.' This full-day study tour is meticulously designed to provide a comprehensive educational experience, with activities that are updated annually to reflect the latest geological insights.

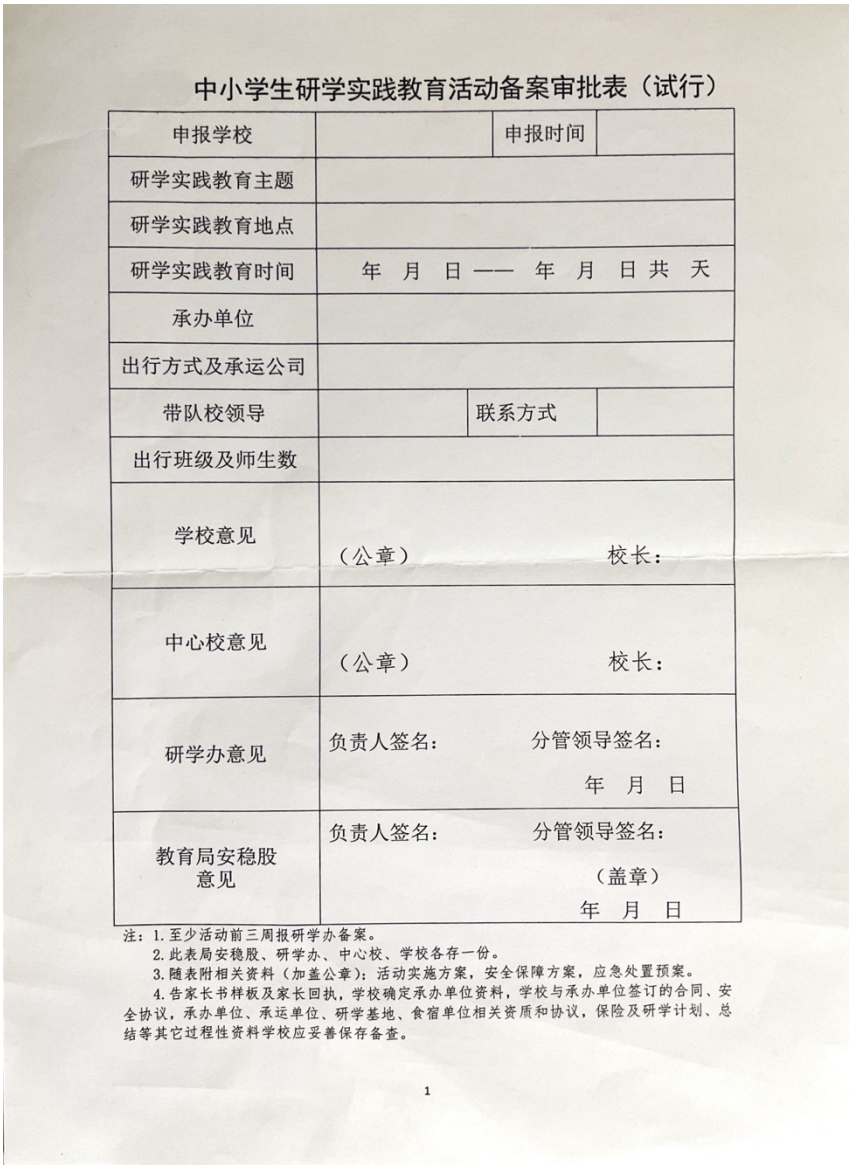
However, challenges arise due to the large number of students participating in each study tour-typically over 200, which complicates management and in-depth geological learning. Mr. A and Mrs. B also noted that all geological content of the geopark is delivered by the visit center. The geopark had 5 guides and 35 interpreters who adjusted to the size of the student groups, providing continuous interpretation during study tours. However, teachers serve merely as supervisors to keep students organized during the tours. Increasing teacher involvement in the presentations and interpretation could enhance attention to individual student needs. They further mentioned that most schools participating in the study tours are located near the geopark, as longer distances complicate logistical arrangements and increase transportation costs. However, students typically visit only once at each educational level, which limits their opportunities to deeply engage with geoheritage and understand geodiversity.

Table 4.4 Example of a study tour plan for high school students

"Traversing Landslide Relics, Solving Geographic Puzzles" – Themed Study Tour Activity Plan		
Location and Description	The Cuihua Mountain Scenic Area, located in the core zone of the Xi'an Qinlingzhongnan UNESCO Global Geopark at the northern foothills of the Qinling, in Taiyigong Town, Chang'an District, Xi'an, is 25 kilometers from the downtown area. The highest peak, Zhongnan Mountain, rises to 2,604 meters. The area is known for its beautiful lake views, rare landslide geomorphology, and is recognized as a unique geological wonder in China	
Activity Introduction	As a Shaanxi youth geoeducation practice base and the heart of the Xi'an Qinlingzhongnan UNESCO Global Geopark, Cuihuashan is being developed as a destination for geological and geographical education, enriching students' knowledge through explanations of the Qinling geological structures.	
Purpose and Significance	The "Traversing Landslide Relics, Solving Geographic Puzzles" event aims to enhance students' geo-knowledge through exploration of landslide relics and understanding of orogenic activities in the Qinling area, deepening their understanding of continental plate activities.	
Activities	1. Hiking through the Tianchi Landslide main geosite area to learn about related geo-knowledge 2. Organizing group activities or games to enhance students' teamwork skills.	
Organizing Units	Name of Xi'an School	
Service Provider	Xi'an Cuihuashan National Geopark Visitor Center	
Schedule	8:00	Students assemble at school, board buses, and complete headcounts. Travel safety guidelines are reviewed, and two student volunteers are selected to assist the guides
	09:00	Arrival and assembly at Cuihuashan National Geopark's parking lot (P905)
	09:10 - 09:20	Brief opening ceremony at the geopark entrance, including safety briefing and introductions
	09:30 - 11:30	Trek through the Shibapan to the Tianchi landslide main geosite area (6 km trek) for on-site geological studies
	12:00 - 13:30	Lunch break (self-provided)
	13:30 - 15:00	Visit Ice and Wind Cave and team-building activities
	15:00 - 16:00	Return to school
Work Requirements	Preparations include informing parents about the itinerary and costs, ensuring safety measures are in place, and organizing travel and on-site service teams.	
Notes	Students should cooperate with teachers and guides during the tour, maintain personal safety, and handle their valuables responsibly	

Mr. A and Mrs. B viewed the relationship between the study tours and the geopark as mutually beneficial. Guides conveyed unique geological information about the geopark to students, who in turn disseminated the geo-knowledge they acquired, thus promoting the sustainable development of the geopark.

Regarding the implementation of the study tours, Mr. D accounted for that the study tours ensure safety, which needs to be approved by the Ministry of Education. Schools must prepare a detailed safety plan covering transportation, meals, accommodation, and activity processes before the study tours (Figure 4.11). This plan is tailored to the school's specific conditions and submitted to the Ministry of Education three weeks in advance. Once the date for the study tour is set, it cannot be canceled except in the case of uncontrollable factors such as bad weather. The study tours, financially supported by parents with subsidies available for low-income families, allow for a high rate of participation. Due to the costs being covered by parents, the frequency of study tours is limited. Mrs. C emphasized that safety is the most critical factor effecting the implementation of study tours. Schools typically cooperate with travel agencies selected through a transparent and fair process to ensure safe travel for students. Each group of 20 students must be accompanied by a teacher. During the study tours at the geopark, geological explanations and interpretation are mostly provided by guides rather than teachers, who often lack specialized training in study tour content. This arrangement, along with the shortness of visits only one day per year and the large group sizes can reduce the educational impact, reflecting the concerns raised by Mr. A and Mrs. B. However, Mrs. C noted that the study tours increase students' interest in geography by allowing them to apply classroom, taught geo-knowledge to real-lift setting. Teachers can effectively use local geographical resources such as Cuihuashan National Geopark to make classroom content more engaging.



中小学生研学实践教育活动备案审批表（试行）

申报学校		申报时间	
研学实践教育主题			
研学实践教育地点			
研学实践教育时间	年 月 日—— 年 月 日共 天		
承办单位			
出行方式及承运公司			
带队校领导		联系方式	
出行班级及师生数			
学校意见	（公章） 校长：		
中心校意见	（公章） 校长：		
研学办意见	负责人签名： 分管领导签名： 年 月 日		
教育局安稳股意见	负责人签名： 分管领导签名： （盖章） 年 月 日		

注：1.至少活动前三周报研学办备案。
2.此表局安稳股、研学办、中心校、学校各存一份。
3.随表附相关资料（加盖公章）：活动实施方案，安全保障方案，应急处置预案。
4.告家长书样板及家长回执，学校确定承办单位资料，学校与承办单位签订的合同、安全协议，承办单位、承运单位、研学基地、食宿单位相关资质和协议，保险及研学计划、总结等其它过程性资料学校应妥善保存备查。

1

Figure 4.11. Record and approval form for study tour activities for elementary to high school students.

To improve the effectiveness of the study tours, Mrs. C suggested reducing the number of students per study tour and organizing them in batches for better management and guidance. Additionally, she proposed enhancing the post-tour activities, such as summaries, evaluations, and reflections, to reinforce the geo-knowledge gained. Increasing the frequency of the study-tour participation might also provide students with a deeper and more sustained engagement with geoscience as Mr. D mentioned. However, this would require more government support due to the associated costs.

As highlighted by Mr. E, the collaboration between universities and the geopark is instrumental in advancing the geopark's educational initiatives. Mr. E has been dedicated to the research and practical application at Cuihuashan National Geopark. He led the successful effort to have Cuihuashan recognized as a national geopark. Since 2006, he has supervised graduate students in their research and practical aspects of geotourism and geoeducation at the geopark. Every year since then, about ten students from his team have collaborated with the geopark to train staff and provide popularization of geo-knowledge. The current educational and geoscientific materials at the geopark, continually improved upon by their team, were initially drafted by them.

Furthermore, the interpretative signage within the geopark has also been created by the team. Additionally, Mrs. B highlighted the geopark's close geographical proximity, just four kilometers to Xi'an Fanyi University, which facilitated a partnership in 2020. Students from the Graduate School of International Business, specializing in Tourism Management, participate annually in the geopark's geoscience popularization contest at Cuihuashan National Geopark (Figure 4.12). Successful participants in these contests often go on to serve as interpreters, providing guided services during the geopark events.



Figure 4.12. Photo of the geopark's geoscience popularization contest

Regarding the current stage of the study tours, Mr. E mentioned that China was relatively late in adopting this concept. The Ministry of Education of China formally proposing the development of study tours in 2012, but only implemented the study tours in 2016. Mr. E believes that the geological literacy of the Chinese populace needs improvement; therefore, study tours are crucial in fostering scientific literacy from a young age. One challenge is that the interpretative signage often presents complex scientific concepts that visitors find difficult to understand. It necessitates a learning approach from the U.S.A. to integrate local culture for better comprehension of geo-knowledge. Mr. E emphasized the need for more professional geoscientists to collaborate and encouraged more universities to partner with the geopark.

4.4. Discussion

Xi'an, serving as one of the initial pilot cities for the "Study Tour" initiative in China, has significantly contributed to the educational landscape through the publication of the 'Xi'an Primary and Secondary School Research Travel Theme Route Guide.' This guidebook, unique to Xi'an, includes distinct editions tailored for elementary, junior high, and high school students. The analysis of these guidebooks is important as they represent a key achievement in linking educational content with localized environmental themes. These experiences promote active learning and help students connect textbook knowledge to real-world situations. Moreover, incorporating geopark-related content into school textbooks aligns with the findings of Scott et al. (2012), who emphasize that fieldwork substantially enhances geoeducation by fostering deeper cognitive engagement through experiential learning. This blend of classroom and field-based education is essential for a well-rounded learning experience. Utilizing the geoheritage of Cuihuaishan National Geopark in Xi'an as a resource in the educational program allows for the creation of tailored study materials, enriching students' learning (Figure 4.3). Providing students with essential geo-knowledge before their visit enhances their ability to engage actively during the study tours at the geopark (Table 4.2). Such preparation ensures that students can more effectively relate their onsite experiences at the geopark to the geological concepts discussed in their textbooks (Figure 4.5).

Despite the integration of the guidebook contents with the school curriculum, the junior high school guidebook does not directly link to specific textbook content (Table 4.2). This partial integration suggests a broader need for systematically integrating geopark visits into educational programs at all levels to enhance their comprehensiveness. Furthermore, the guidebooks published by Xi'an City underutilize the Cuihuashan National Geopark as an educational resource, with only limited alignment with textbook content, as shown in Figure 4.4. Studies indicate that geoparks can serve as powerful educational tools to enhance students' geo-knowledge when properly aligned with school activities and materials (Halim & Ishak, 2017; Álvarez, 2020). However, the current underutilization of the educational potential of the geopark

suggests that these tools could be further developed to maximize their potential impact on geo-knowledge, particularly through strategies that integrate classroom learning and field-based activities (Simbaña-Tasiguano, 2024; Carrión-Mero & Dueñas-Tovar, 2024).

In addition, the content analysis revealed some limitations. Although the guidebooks serve as a portal to the practical application of geoscience, they face challenges in maintaining their educational relevance due to the no revision of the guidebooks with no updates since their initial release in 2016. Scott et al. (2012) highlight that without continuous updates, educational materials can become outdated, limit their effectiveness in imparting current environmental knowledge and geo-knowledge. Despite the fact that students participate in a study tour at Cuihuashan National Geopark once at each educational stage—elementary, junior high, and high school—the guidebook has not been updated and remains in its original version, which was initially designed for Taiping National Forest Park. The COVID-19 pandemic further compounded to this issue by disrupting study tours until 2023.

Experiential learning is crucial for connecting classroom learning and field-based activities in geoscience. As Guillaume et al. (2023) suggest, outdoor fieldwork is a crucial aspect of learning in geosciences. It helps to enhance understanding of key principles through the integration of classroom knowledge within field-based activities (Boyle et al., 2007; Elkins & Elkins, 2007). This is apparent in the study tours at Cuihuashan National Geopark, where students' comprehension of geological concepts is strengthened through direct engagement with geosites (Figures 4.3 to 4.8). These on-site experiences provide students with a more grounded understanding.

According to Mogk and Goodwin (2012), experiential learning in the field fosters a sense of place, thus enhancing connections between students and the local environment. This aligns with the findings of this study, which show that students with prior study tour experience, compared to those on their first study tour, exhibit a stronger connection to the geopark. They place greater importance on the geopark, better understand the concept of a geopark, and are more familiar with its features. These students also feel a heightened sense of pride in the establishment of a geopark

in Xi'an City (as depicted in Figures 4.6 to 4.9). Simm and Marvell (2015) expand on this by suggesting that repeated field engagements not only foster profound learning but also deepen students' understanding of complex geoscience concepts and enhance geoconservation efforts within the geopark.

As students visit more geosites (Figure 4.10), they develop a more nuanced understanding of the geo-knowledge, which promotes a broader awareness and proactive conservation behavior. Data comparisons from before and after the study tour (Table 4.3) revealed substantial shifts in students' attitudes towards environmental conservation and geoconservation. These findings suggest that immersive, hands-on experiences, such as outdoor fieldwork, can profoundly influence student perceptions and foster proactive conservation behaviors (Zafeiropoulos et al., 2021; Morante-Carballo et al., 2022). Even a single study tour can greatly affect students' awareness and interests in these areas (Georgousis et al., 2021). Repeated participation in study tours further enhances students' engagement and confidence in understanding geopark concepts, demonstrating the importance of structured and ongoing exposure to the educational content of geoparks (Baharim et al., 2024; Koupatsiaris and Drinia, 2024).

While the efficacy of study tours in outdoor experiences has been demonstrated, challenges remain. Statistical analyses reveal no notable improvements in comprehension or pride among students with prior study tour experiences (Figures 4.7A and 4.8A). For students already acquainted with the geopark concept, study tours do not significantly enhance their understanding (Fanioudaki et al., 2024). Students with foundational knowledge may require more advanced materials or activities to realize educational benefits (Bosch et al., 2021). Additionally, the impact of study tours on students' sense of pride, particularly those with prior study tour experiences, appears minimal. The necessity for designing more engaging and innovative experiences that can deepen existing positive perceptions

The interview survey analysis revealed that study tours in geoparks offer significant educational benefits, such as enhancing student engagement with geoscience and providing exposure to natural heritage, which stimulates interest. This aligns with findings that geoparks effectively enhance student learning outcomes by combining

place-based education with geoheritage (Zafeiropoulos & Drinia, 2024). However, challenges exist, including the management of large group sizes, which hinders in-depth geological learning (Rodrigues et al., 2023), and the limited involvement of teachers in the educational process. Addressing these concerns is important, thus, reducing group sizes and increasing teacher involvement in presentations and interpretations are crucial steps to enhance the educational effect of the study tour. Additionally, the current once-per-educational level visit frequency limits students' opportunities to deeply engage with geoheritage, suggesting a need for more frequent visits, despite the associated costs. Safety concerns also play a key role in shaping the frequency and implementation of study tours.

Collaborative efforts between universities and the geopark are crucial for advancing educational initiatives. Mr. E's involvement in training staff and improving materials at the geopark highlights the importance of academic partnerships in enhancing the quality of study tours. The need for more professional geoscientists to collaborate with geoparks has also been identified as a priority. Such partnerships can develop effective educational strategies and materials, leading to a more sustained and comprehensive learning experience for students (Gerbaudo, 2024).

4.5. Conclusions

The integration of study tours into the educational curriculum, particularly in the context of geoparks, represents a notable advancement in the field of geoeducation. Xi'an's pioneering role in this initiative, through the publication of the 'Xi'an Primary and Secondary School Research Travel Theme Route Guide,' has provided a unique opportunity to explore the effectiveness of linking educational content with localized environmental themes. This study found both successes and areas for improvement through the analyses of the guidebooks and their implementation.

The guidebooks function as a crucial link between classroom learning and field experiences. It helps students prepare with essential geo-knowledge before their visits to Cuihuashan National Geopark. This preparation enhances student engagement

during the tours, allowing them to make meaningful connections between the geoconcepts they have learned and their real-world applications during study tours. The immersive experiences at Cuihuashan National Geopark have been particularly effective, which deepens students' understanding of geoconcepts through direct interaction with geosites. These field experiences not only ground students' knowledge but also cultivate a sense of place and enhance their connection to the local environment.

The findings of this study align with the broader literature on experiential learning in geosciences. Experiential learning, as emphasized by Guillaume et al. (2023), is crucial for connecting classroom learning and field-based activities. This is evident in the study tours at Cuihuashan National Geopark, where students' comprehension of geological concepts is significantly enhanced through direct engagement with geosites. Furthermore, the sense of place fostered through these experiences, as highlighted by Mogk and Goodwin (2012), enhances students' connections to the local environment and promotes proactive conservation behaviors.

Despite these achievements, several challenges remain. For example, the guidebooks for junior high schools do not fully integrate with the textbook content, the underutilized educational potential of Cuihuashan National Geopark with limited connections to textbook materials, and lack of updates to the guidebooks since 2016. In addition, while study tours confer substantial educational advantages, they do not markedly improve comprehension or pride among students with prior study tour experiences.

To address these challenges, several recommendations are proposed, which are as follows:

(1) To systematically review and update the guidebooks to ensure they remain relevant and align with current educational standards,

(2) To increase the frequency of geopark visits within the educational curriculum to maximize learning opportunities,

(3) To optimize study tours by reducing group sizes and enhancing teacher involvement to improve educational outcomes, and,

(4) To strengthen partnerships between universities and geoparks to enrich educational content and delivery.

In conclusion, the study tours in the geopark offer substantial educational benefits, enhancing student engagement with geoscience and fostering a sense of place and conservation. However, to fully realize the potential of these initiatives, a comprehensive approach that addresses the identified challenges is necessary. By implementing the recommended strategies, the educational impact of study tours can be greatly enhanced and contribute to a more informed and proactive generation of students who are deeply connected to their local environment and committed to its conservation.

Chapter 5. General discussion

5.1. Building an integrative geoeducation framework for Cuihuashan National Geopark: insights from the Tokachi-Shikaoi model

Geoeducation is a key component of environmental and scientific literacy. It helps students connect with geoheritage and develop a deeper understanding of Earth systems (Koupatsiaris and Drinia, 2024). Geoparks, which serve as primary providers of educational resources, offer unique platforms for learning and engagement. This chapter proposed a geoeducation framework for Cuihuashan National Geopark based on the cultural, educational, and institutional context of Xi'an, China (Figure 5.1). It adapts from the core principles of the Tokachi-Shikaoi Geopark's "Geoeducation Program." By acting as enablers, facilitators, and providers of effective educational programs (Atlantic Geoparks and European Union, 2024), geoparks such as Cuihuashan can address local challenges and enhance students' understanding of sustainability and geoheritage.

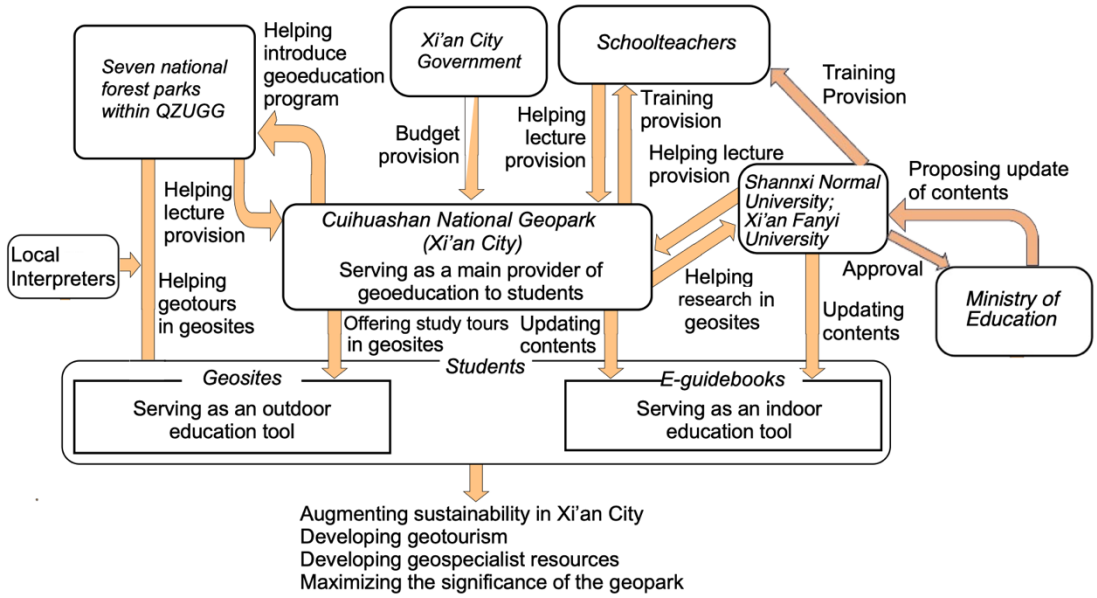


Figure 5.1 Framework for enhancing geoeducation at Cuihuashan National Geopark based on the Tokachi-Shikaoi model.

The proposed framework highlighted Cuihuashan National Geopark's central role in geoeducation by addressing local challenges while enhancing effectiveness. To illustrate how these principles can be implemented, the following sections focus on three key areas: (1) establishing collaborative partnerships, (2) integrating outdoor and (3) indoor education, and addressing critical challenges.

5.1.1. Establishing collaborative partnerships

Collaborative partnerships are vital for effective geoeducation, with geoparks acting as hubs that connect and coordinate the efforts of different bodies. Although the Tokachi-Shikaoi model remains a proposed framework rather than a validated approach, it nonetheless clearly depicted the importance of multi-stakeholder collaboration among geoparks, local governments, universities, and schoolteachers. Drawing on these insights, Cuihuashan National Geopark can adopt a similar strategy to strengthen the sustainability of their own educational program and support long-term success. One critical partner is the Xi'an city government, which provides essential support and resources. However, as Mr. D highlighted, most study tour costs currently fall on parents, which made tours less frequent and created financial barriers. To overcome this issue, the government could subsidize tour costs, reallocate resources, or develop dedicated funding streams to expand the capacity and accessibility. In addition, partnering with local companies or sponsors could further alleviate the financial burden.

The contributions of universities, such as Shaanxi Normal University and Xi'an Fanyi University are equally important. By providing academic expertise in content development, teacher training, and lectures, these institutions can help ensure the accuracy and currency of educational materials. Xi'an Fanyi University, in particular, strengthens the program by training interpreters with professional geo-knowledge, thereby improving the quality study tours. The Ministry of Education oversees and approves material updates, aligning them with national educational standards.

5.1.2. Integrating outdoor and indoor education

A dual approach that integrates outdoor and indoor education, inspired by the Tokachi-Shikaoi model, can maximize geoeducation effectiveness. This strategy is also essential for Cuihuashan National Geopark, so that the foundational geo-knowledge and experiential learning can both be delivered efficiently.

Outdoor education takes advantage of geosites in the geopark, turning them into "living classrooms." observe geological phenomena firsthand when visiting these geosite, which plays an important role in bridging textbook concepts with experiences (Fuller, 2006; Singtuen et al., 2022). Study tours led by knowledgeable guides and interpreters will further enhance the effect, thus encouraging deeper comprehension and retention. Indoor education will be conducted by using materials developed by the geopark in partnership with universities. These resources help students prepare before study tours and reflect on what they have learned afterward. Chapter 4 showed that the guidebooks have remained unchanged since publication. By shifting to digital materials, Cuihuashan National Geopark can ensure timely content updates, reduce printing costs, and tailor resources to various educational levels.

5.1.3. Addressing challenges

Geoeducation remains a central focus for all geoparks and aims to promote both education and sustainable development (Hose, 2012). Building on this premise, Chapters 3 and 4 investigated the effectiveness of geoeducation program on students in Tokachi-Shikaoi Geopark in Japan and Cuihuashan National Geopark in China. Each chapter highlighted the critical role of geoeducation in fostering the sustainability of the geopark and demonstrated that a combination of indoor learning and study tours significantly booted student's interest and understanding of geoscience.

Despite the positive outcomes from the Cuihuashan National Geopark's study tours, limited frequency often restricts deeper engagement and long-term ecological understanding (Morante-Carballo et al., 2022). Fortunately, the geopark is proximity to Xi'an City which provides numerous opportunities to organize additional tours. Furthermore, teacher training and resource availability require consistent attention. By

offering workshops and on-site sessions led by university and geopark, the geopark can equip schoolteachers to deliver high-quality lessons.

In addition, collaboration within the Qinling Zhongnanshan UNESCO Global Geopark network also addresses these challenges. This network includes eight National Forest Parks, such as Cuihuashan and Zhuque, each playing a critical role in resource sharing and geoeducation. In 2015, Zhuque National Forest Park established the Qinling Youth Camp, which can integrate science education, study tours, and outdoor activities (Figure 5.2). Mr. F, Director of Study Tours at Zhuque National Forest Park, highlighted that regular exchanges and annual workshops within the network will promote mutual support and allow the parks to introduce each other's geological features to external audiences.



Figure 5.2. The photograph of the Qinling Youth Camp in Zhuque National Forest Park (photographed by author)

To further strengthen geoeducation, continually updated e-guidebooks are important. These materials must remain scientifically accurate and engage to diverse learner groups, which requires oversight from the Ministry of Education and academic institutions. Additionally, effective study tours should employ thematic routes aligned with specific learning goals. Subsidies or funding partnerships could help reduce

financial barriers for families. For students who cannot attend tours (e.g., students from other provinces), online resources can serve as inclusive alternatives.

The geoeducation framework presented in Figure 5.1 positions Cuihuashan National Geopark as a central coordinator of educational initiatives, effectively uniting stakeholders and resources to create a sustainable program. By emphasizing collaboration among government bodies, universities, local guides, and interpreters, as well as by integrating outdoor and indoor learning opportunities, this framework supports students' scientific literacy and environmental awareness. Sustained engagement, repeated geosites visits, and updated e-guidebooks can further boost student interest and understanding of geoscience. Moreover, ongoing collaboration within the Qinling Zhongnanshan UNESCO Global Geopark network underscores the value of shared learning and resources, which helps each park strengthen its educational offerings.

5.2. Optimizing geoeducation at China's geoparks

Educational professionals consistently engage in efforts to advance the Sustainable Development Goals (SDGs) in an effective way (Henriques et al., 2012; Rosado-González et al., 2020; Silva, 2021). UNESCO Global Geoparks (UGGps) are at the forefront of implementing innovative educational methods and serve as essential instruments for advancing geoscience and sustainable development education. These geoparks not only highlight the intrinsic value of geoheritage but also serve as platforms for fostering environmental awareness and cultural pride. However, a bibliographic review by Martínez-Martín et al. (2023) revealed that, despite the extensive literature associated with UGGps, only a small percentage covers education as a crucial topic. Notably, while China leads in the volume of publications and continuously establishes new UGGps, scholarly output linking geoparks with educational efforts remains limited (Martínez-Martín et al., 2023).

It is crucial for geoparks to develop educational activities for all ages, both in formal school settings and through informal public engagements. Geoeducation plays

a crucial role in societal education by enhancing public understanding of geosites and emphasizing their value as cultural, social, and tourist assets (Zouros, 2004). Employing geoparks for geoeducation can deepen public environmental awareness and strengthen a sense of belonging and pride in local regions is strengthened. Evidence from Chapters 3 and 4 shows that geoparks act as dynamic outdoor classrooms, enrich students' geo-knowledge and their educational significance. As stated before, the programs combining indoor and outdoor learning experiences create opportunities for students to directly apply classroom knowledge in real-world settings, thereby deepening their understanding of geological concepts. The scalability of the Cuihuashan framework across other Chinese geoparks is worth evaluating, given its emphasis on stakeholder collaboration, resource optimization, and educational accessibility.

China's vast network of geoparks offers an important platform for implementing geoeducation programs. The framework developed for Cuihuashan National Geopark, as detailed in Section 5.1, illustrates how diverse stakeholders can collaborate effectively. However, the conditions under which geoparks operate vary significantly across China. The subsequent sub-section will evaluate the adaptability of the Cuihuashan National Geopark geoeducation framework across different geoparks in China and discuss its potential as a scalable model to enhance geoeducation nationwide.

5.2.1. The complete network model for adaptation

In order to adapt Cuihuashan framework to other geoparks, certain critical factors must be addressed. First, active involvement of multiple stakeholders is essential. Government agencies, educational institutions, and local communities must collaborate to foster a comprehensive and inclusive geoeducation program. The financial burden on families, a limiting factor in many existing programs, can be alleviated through government subsidies, supports by private sponsors, and resource reallocation. Such measures would not only increase accessibility but also ensure the long-term sustainability of these initiatives.

Second, the availability and quality of educational materials are important. Materials specifically tailored to the unique features of each geopark can significantly enhance indoor and outdoor learning experiences. Digital resources, such as e-guidebooks, allow for regular updates and cost-effective dissemination. They ensure that content remains relevant and engaging. Collaboration with universities can further improve material quality, as academic expertise can be leveraged to align resources with the latest scientific research. Universities could also provide teacher training, workshops, and field trips, thereby equipping educators with the tools needed to deliver high-quality geoeducation.

Third, collaboration among adjacent geoparks can amplify the impact of educational initiatives. Geoparks located in close proximity to one another can share resources, expertise, and infrastructure to create more comprehensive and interconnected learning experiences. For example, partnerships between Cuihuashan National Geopark and Zhuque National Forest Park or other national forest parks in Qinling Zhongnanshan UNESCO Global Geopark could offer students broader exposure to diverse geological phenomena. This networked approach not only optimizes resource utilization but also enriches the educational content available to students.

Most geoparks in China have access to substantial educational resources, positioning them well to host geoeducation activities and implement educational programs. However, the current lack of emphasis on geoeducation within most national geoparks suggests significant room for improvement. Table 5.1 shows several national geoparks with numerous schools and proximity to other parks. This situation makes these geoparks well-suited for the implementation of the Cuihuashan framework.

Despite these advantages, most national geoparks in China lack official websites, which indicated their bad visibility and shortage of efforts in promoting engagement with geoeducation. Among the ten examples, only the Beijing Shidu and Huanghe Hukou Pubu National Geoparks have independent websites. However, these are tourism-focused rather than geoeducation-oriented. This highlights a systematiced underutilization of geoparks as educational resources.

Moreover, the absence of formal geoeducation programs in many geoparks is a critical gap. Existing efforts, often limited to school-organized study tours, lack comprehensive curricula or detailed educational materials. The limited availability of formal educational materials and the absence of geoeducation programs in many geoparks highlight the need for a unified strategy to address these gaps.

Table 5.1. Examples of China's national geoparks with good suitability to Cuihuashan framework

Geopark name	Universities	Schools	Adjacent geoparks/ forest parks/ national parks
Yunnan Chengjiang fauna national geopark	Kunming University of Science and Technology;Yunnan University	Multiple*	Shilin UNESCO Global Geopark
Sichuan Longmenshan National Geopark	Xihua University; Sichuan Agricultural University	Multiple	Mianzhu Qingping-Hanwang National Geopark
Gansu Liujiaxia Konglong National Geopark	Gansu Agricultural University; Northwest Normal University	Multiple	Linxia UESCO Global Geopark
Huanghehukou Pubu National Geopark	Yanan University	Multiple	Luochuan Huangtu National Geopark
Beijing Shidu National Geopark	Beijing Institute of Technology；China University of Geoscience	Multiple	Beijing Shihuadong National Geopark
Henan Guanshan National Geopark	Henan Polytechnic University；Jiaozuo university	Multiple	Yuntaishan UNESCO Global Geopark
Shandong Qingzhou National Geopark	Shandong University of Technology	Multiple	Shanwang National Geopark
Fujian Dajinhu National Geopark	Fuzhou University	Multiple	Taining UNESCO Global Geopark
Hunan Fenghuang National Geopark	Jishou University	Multiple	Xiangxi UNESCO Global Geopark
Guangxi Dahua Qibainong National Geopark	Guangxi University	Multiple	Duan Dixiahe National Geopark

* There are more than three elementary schools, junior-high schools, and high schools near to the geopark

In regions where geology is not part of the formal curriculum (López-Valentín & Guerra-Ramos, 2013). Supplementary guidebooks designed in collaboration with local universities can present fundamental geoscience concepts in accessible and engaging ways, bridging the gap between theoretical knowledge and real-world application. These resources not only enhance student learning but also empower teachers to deliver more impactful lessons.

The COVID-19 pandemic has further underscored the importance of flexible and adaptive educational resources. Geoparks, as outdoor venues, offer safe and enriching environments for education and complement traditional classroom learning. The rapid adoption of digital tools during this period highlights their potential to revolutionize geoeducation. E-guidebooks, for example, allow for continuous updates and widespread accessibility. By integrating these digital resources into the Cuihuashan framework—Complete Network Model, other geoparks can overcome logistical challenges and reach broader audiences.

By addressing the challenges of stakeholder collaboration, resource availability, and material accessibility, this framework can unlock the full potential of geoparks as educational platforms (Figure 5.3). The integration of digital tools, collaborative networks, and tailored materials will further ensure that geoeducation remains inclusive, impactful, and aligned with the goals of sustainable development.

In this model, local governments provide foundational budgetary support, while tourism-derived revenue—primarily from entrance fees—serves as a critical supplementary funding source, geoparks in educational resource regions benefit from robust stakeholder networks. However, this model's viability is geographically constrained. Geoparks in densely populated or tourism-centric regions (e.g., Beijing Shidu) thrive on high visitor engagement, whereas remote counterparts struggle to attract comparable footfall. While all national geoparks in China charge entrance fees, those in remote areas generate minimal revenue due to low tourist numbers, limiting their capacity to self-fund education programs.

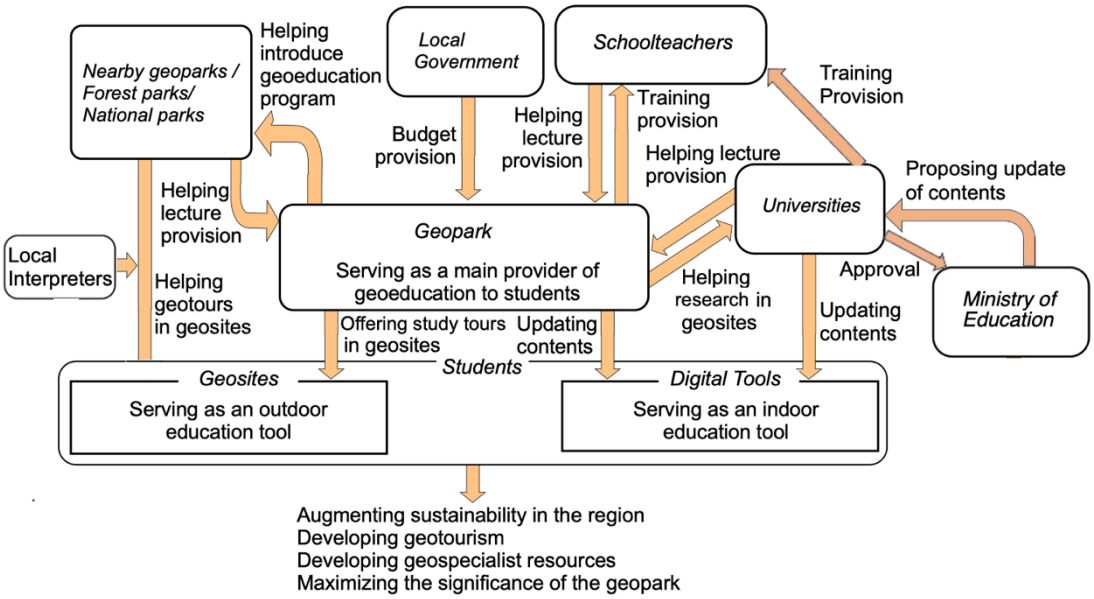


Figure 5.3. The Complete Network Model based on the Cuihuashan Model

5.2.2. The government-led model for geoparks located in remote areas

While the framework for Cuihuashan National Geopark emphasizes collaboration among diverse stakeholders, not all geoparks in China are situated in conditions that facilitate such partnerships. Unlike bottom-up initiatives seen in other countries (e.g. Japan), where local communities and associations play a leading role, China's geoparks are mainly government-managed. This government-led model (Figure 5.4) places the responsibility for funding, technical support, and program implementation squarely on government agencies, particularly for geoparks located in remote or resource-limited areas. These geoparks must focus on developing accessible and impactful geoeducation programs that directly address the needs of students, regardless of logistical constraints.

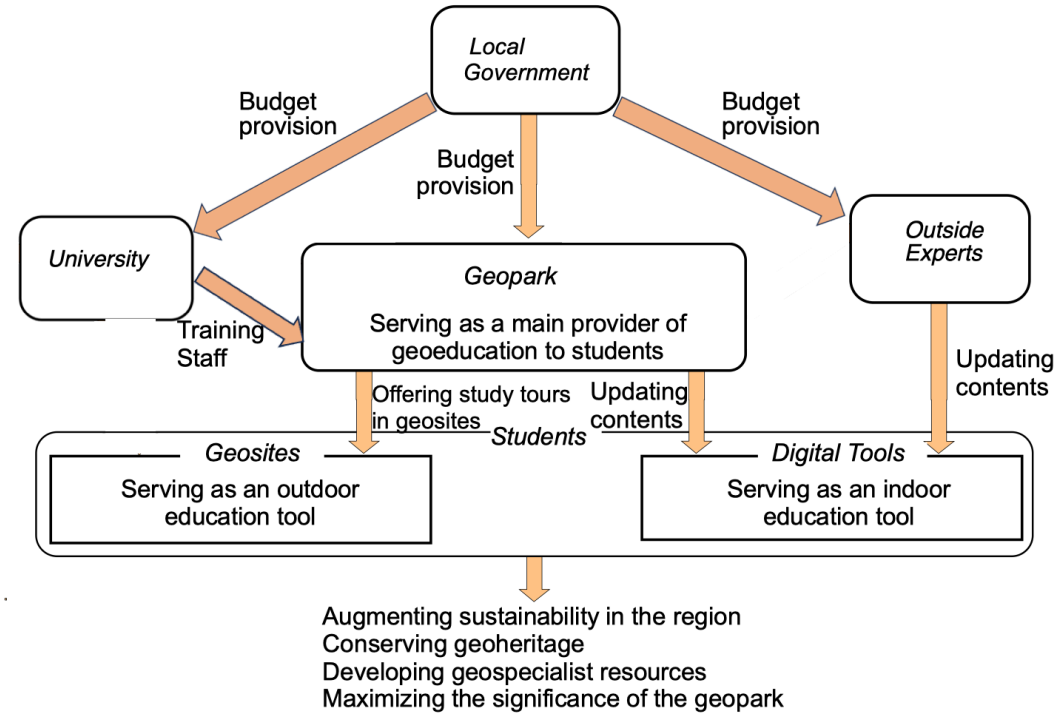


Figure 5.4. The government-led model for China's national geoparks in remote or resource-limited areas

A key challenge facing government-led geoparks in remote areas is their limited digital presence, which hinders their ability to effectively engage in modern geoeducation. While local governments often provide budgetary support, many geoparks still lack an official website—a critical platform for reaching students who cannot visit in person. Notable examples include Kanasi National Geopark, Zhada Shilin National Geopark, and Mohe National Geopark, all of which lack dedicated online portals. This absence limits their ability to connect with schools, educators, and students nationwide, thereby missing valuable opportunities to promote geoeducation.

A robust digital presence, however, could transform these geoparks into hubs of immersive learning. By developing comprehensive websites, geoparks could offer virtual geotours, educational videos, and geological databases, bridging the gap between classroom knowledge and real-world geological settings. Such digital resources not only transcend geographical barriers but also significantly enhance the educational impact of geoparks (Lanara et al., 2021). For instance, virtual platforms

could enable students to explore geological formations and processes remotely, fostering a deeper understanding of Earth sciences.

Beyond basic online platforms, immersive technologies like virtual reality (VR) present further opportunities for student engagement. A "Virtual Geopark" could simulate field visits, allowing students to interact with geological features in a dynamic and engaging manner. Incorporating interactive elements such as quizzes, 3D models, and storytelling can make complex geological concepts easier to understand. This approach is particularly advantageous for remote geoparks, such as Mohe National Geopark and Yangbajing National Geopark, and has gained additional relevance in the wake of the COVID-19 pandemic, which highlighted the need for flexible and remote learning solutions (Lege & Bonner, 2020).

Despite the potential of digital innovations, outdoor education remains a cornerstone of any comprehensive geoeducation strategy. Government-led geoparks should continue to invest in staff training, often through partnerships with universities, to ensure that in-person visits are both informative and engaging. Field-based education allows students to observe geological phenomena firsthand, reinforcing academic learning and fostering a deeper connection to geoheritage. Such hands-on experiences can ignite curiosity and potentially inspire future careers in geoscience.

For remote geoparks with limited access to schools and educational institutions, digital platforms serve as a vital bridge to reach underserved students. These platforms should align with national school curricula to ensure their content meets educational standards, enabling online and face-to-face methods to complement each other and maximize learning outcomes. By integrating digital tools with traditional field-based education, geoparks can create a holistic approach to geoeducation that caters to diverse learning needs.

Ultimately, sustained government support is necessary for the success of remote geoparks (Figure 5.4). Financial support is crucial for maintaining and upgrading these geoparks, ensuring they remain key contributors to China’s geoeducation. For example, government funding could cover travel expenses for university professors to visit remote geoparks, as well as provide training opportunities for staff to enhance their

geoscientific knowledge. Additionally, hiring external experts to design and update digital tools with the latest scientific content could further enrich educational resources.

A case is the Xinjiang Wensu Yanqiu National Geopark, renowned for its unique salt diapir structures—a rare geological phenomenon globally. Located in the northeastern part of Wensu County, Aksu Prefecture, Xinjiang, the geopark lies at the southern foothills of the central Tianshan Mountains and the northwestern margin of the Tarim Basin. Due to its remote location and limited accessibility, annual visitor numbers remain low, and ticket revenues cover only a fraction of operational costs. Therefore, the government plays a key role in sustaining the geopark's educational and geoheritage conservation efforts.

5.3. Model acceptance and bridging local and global sustainability

The adoption of the Complete Network Model and the Government-led Model across China's geoparks is shaped by regional economic disparities and the availability of educational resources. While these two models address distinct challenges—one emphasizing multi-stakeholder collaboration in educational resource-rich regions and the other relying on government support in remote or resource-limited areas—both models offer viable pathways for integrating local geo-knowledge with global sustainability frameworks.

The Complete Network Model is especially relevant for economically developed or tourism-centric regions where multiple stakeholders (local governments, universities, schools, and communities) can collaborate effectively. For example, Zhangjiajie UNESCO Global Geopark reported increased school group visits and stronger ties with universities such as Central South University of China after introducing formal geoeducation programs (Global Geoparks Network, 2024a). This partnership illustrates the economic and educational benefits that can emerge when stakeholders combine their resources. Furthermore, Zhu et al. (2024) highlight the importance of regional coordination and linkages in fostering sustainable development. Adapting these insights to the Complete Network Model means that developed geoparks can leverage

partnerships with adjacent scenic areas or other national geoparks to co-develop regional strategies for sustainable tourism and environmental education. These practices closely align with the Chinese government's national geopark development plans, which underline the importance of public science education (SDG 4) and sustainable cities and communities (SDG 11). As evidenced by Leiqiong UNESCO Global Geopark's successful science popularization activities (Global Geoparks Network, 2024b), multi-stakeholder participation has already gained traction in China, increasing the likelihood that the Complete Network Model will be widely accepted.

In contrast, geoparks located in remote areas or those with limited resources, such as Xinjiang Wensu Yanqiu National Geopark or Heilongjiang Mohe National Geopark, are more likely to adopt the Government-led Model, which relies on the government's budget provision to overcome geographical isolation. Strong government support ensures adequate geoheritage protection, especially when tourism revenue (such as geopark entrance fees) is insufficient. The Chinese government's commitment to reducing regional gaps is evident through infrastructure upgrades and digital platform development in western provinces (China Daily, 2023). For example, Gansu Liujiaxia Konglong Geopark benefits from government initiatives supporting a "Digital Geopark" platform, thereby enhancing educational outreach. Similarly, Xinjiang Wensu National Geopark's 2021–2035 plan envisions significant improvements in on-site facilities and the creation of a digital learning environment (Wensu County Government, 2022). Such government support reduces the barriers that remote geoparks face in building strong partnerships, making government-led strategies both feasible and likely to be accepted.

Both models can help local communities—especially students—relate local geoscientific phenomena to global sustainability challenges. Geoparks act as "living laboratories", where place-based learning fosters critical thinking that connects regional geological processes (e.g., soil erosion, volcanic activity) to broader issues such as climate change, biodiversity loss, and responsible resource management. At Shaanxi Luochuan Loess National Geopark, for example, students explore the root causes of soil erosion and tie this knowledge to global climatic shifts (Wu, 2020), aligning with SDG 13 on climate action (UNESCO, 2016). Likewise, Yunnan Tengchong Geopark's

volcanic formations facilitate discussions on plate tectonics and biodiversity evolution (Li et al., 2020). By linking these local and global perspectives, geoparks encourage active environmental stewardship and broader scientific literacy.

Empirical evidence from Danxiashan UNESCO Global Geopark further supports this place-based, geopark-focused learning approach, As Li and Xu (2023) illustrate, Danxiashan's comprehensive educational tourism system empowers students to connect local environmental phenomena with global Sustainable Development Goals (SDGs). Recognized as one of the "Top 10 Innovative Cases of World Heritage Education," Danxiashan integrates hands-on learning, community engagement, and scientific inquiry—demonstrating the wide-ranging impact of geopark initiatives. By merging quality education (SDG 4) with sustainable land management (SDG 15), Danxiashan showcases how geoeducation can profoundly enhance community well-being and economic development.

Both the Complete Network Model and the Government-led Model provide effective pathways for advancing geoeducation in alignment with the SDGs. In well-funded, tourism-driven geoparks, a multi-stakeholder network approach enables universities, local governments, and geoheritage sites (e.g., geoparks, forest parks, national parks) to share resources, develop high-quality study tours, and enhance digital learning materials. In contrast, resource-limited geoparks rely on strong government support to build essential infrastructure, develop digital platforms, and train specialized staff, helping them overcome geographical and financial challenges.

Ultimately, the success of these models depends on their ability to deliver tangible benefits—economic, educational, and environmental—to local communities. When students understand how soil erosion in their hometowns connects to global sustainability challenges, they are more likely to engage in environmental conservation efforts. Likewise, when geoparks serve as outdoor learning environments, educators and geopark staff can offer experiential lessons that extend beyond traditional classroom knowledge, fostering globally aware and environmentally responsible citizens.

Chapter 6. Conclusions

This study provided an in-depth evaluation of geoeducation programs at the Tokachi-Shikaoi Geopark in Japan and the Cuihuashan National Geopark in China, to offer critical insights into their design, implementation, and outcomes. The findings highlight the transformative potential of geoparks as educational platforms, capable of fostering geoscientific literacy, environmental awareness, and sustainable development. By comparing these two geoparks, this research identifies best practices and actionable strategies to refine geoeducation within China's geopark network.

The Tokachi-Shikaoi Geopark serves as a benchmark which is based on long-term geoeducation integration into school curriculums. Its 15-year geoeducation program, effectively enhanced students' geo-knowledge comprehension, environmental stewardship, and local pride. Although discontinued, the foundational educational outcomes facilitated the proposal of a new partnership framework that provided students with opportunities for hands-on practice alongside traditional classroom settings.

In contrast, the Cuihuashan National Geopark relies on one-day study tours, which have demonstrated substantial geo-knowledge gains, particularly among first-time participants. Students' familiarity with the geopark and their pride in its establishment increased significantly post-tour. However, for students with prior study tour experience, the knowledge and attitudinal gains were less pronounced. This mode suggests that short, infrequent study tours lack the depth, variety, and repetitive reinforcement necessary to sustain long-term engagement. In addition, limitations in teacher involvement, logistical management, and the lack of curriculum integration have constrained the scalability and long-term impact of study tours. Additionally, the financial burden on parents and the large group sizes during study tour further reduce the depth student's learning experiences.

To refine geoeducation in the Cuihuashan National Geopark, insights from the Tokachi-Shikaoi Geopark can provide a valuable foundation. Building on this, this

study proposed two geoeducation frameworks tailored to different contexts to improve geoeducation in China's geoparks:

1. The Complete Network Model—designed for geoparks in educational resource-rich regions, such as those with nearby universities, multiple schools, and adjacent national parks or geoparks. This model emphasizes multi-stakeholder collaboration, ensuring that universities, local governments, and schools work together to enhance curriculum development, teacher training, and digital learning resources. The framework leverages digital tools, and geotour networks to integrate indoor and outdoor education, reducing financial barriers and increasing accessibility.
2. The Government-Led Model—tailored for remote and limited-resourced geoparks that lack local educational institutions or partnerships. These geoparks depend primarily on government support for funding. Given their geographical limitations, a shift toward digital tools, such as virtual geoeducation platforms, can expand access to geoeducation for students who cannot participate in in-person study tours.

This study highlights the critical role of geoeducation in addressing broader societal goals, including the Sustainable Development Goals (SDGs). By fostering geoscientific literacy and promoting environmental stewardship, geoeducation contributes to the creation of informed and engaged citizens capable of addressing global environmental challenges. Specifically, geopark-based programs can advance SDG 4 (Quality Education) by integrating geological principles into school curricula and promoting outdoor experiential learning, as well as SDG 11 (Sustainable Cities and Communities) by encouraging local pride, tourism, and conservation efforts. The findings also underscored the importance of stakeholder collaboration, particularly between geoparks, educational institutions, and local governments, in advancing geoeducation initiatives and ensuring long-term sustainability of these programs. Moreover, this study emphasizes the need for partnership with the government support even for geoparks under the Government-led Model.

While this study provided a foundation for enhancing geoeducation in geoparks, several limitations warrant consideration. For instance, the analysis was limited to two case studies, which may not fully capture the diversity of geoeducation practices across other geopark in China. Additionally, the study's recommendations require further validation through implementation and evaluation. Future research could expand on this work by exploring the effectiveness of digital tools in enhancing geoeducation and examining their applicability across different contexts.

By leveraging the unique resources of geoparks, the proposed frameworks provide a roadmap for creating impactful and sustainable geoeducation programs. These insights offer actionable recommendations for educators, policymakers, and geopark administrators, ensuring that geoparks continue to serve as dynamic platforms for education and community engagement.

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Appendices

Appendix 1. Representative scanned sections of geopark-related content from ‘Shin-Chikyu Gaku’

Elementary school





鹿追ジオパークについて考えよう



ジオパーク

美しい自然の風景や学術的な価値を持つ地質などから、その土地や地球の成り立ちについての理解を深め、私たちの生活との関わりを学び楽しむための自然公園。日本では、日本ジオパーク委員会が中心となって、25の地域がジオパークに認定され活動している。（2012年現在）

「学校のまわりの自然を学習した１年生から、いろいろなことを学んできたわね。鹿追町には、自然や風土を生かしたよさがたくさんあることがわかったわ。」

「鹿追町のいいところを、もっと調べてみたいな。そしていろいろな人にもっと知ってもらいたいな。」

11

「みんなは、『ジオパーク』って知っているかな。現在、世界や日本各地にいろいろなジオパークがつくられて、活動しているんだよ。」

（あなたが思う鹿追のよさを、書いてみましょう。）

「鹿追にはジオサイトがたくさんありそうだね。もっと調べて、ぼくたちのジオパークをつくってみたいな。」

調べてみよう！
- ●鹿追町には、どんなジオサイトがあるか調べよう。
- ●鹿追町の魅力を伝えるために、どんなことができるか考えよう。

ジオサイト

ジオパークに存在する、すばらしい自然の景色（地形）や地層、岩石、湧水、温泉、化石などがある場所。その土地の歴史やくらし、文化に触れて体感できる場所。

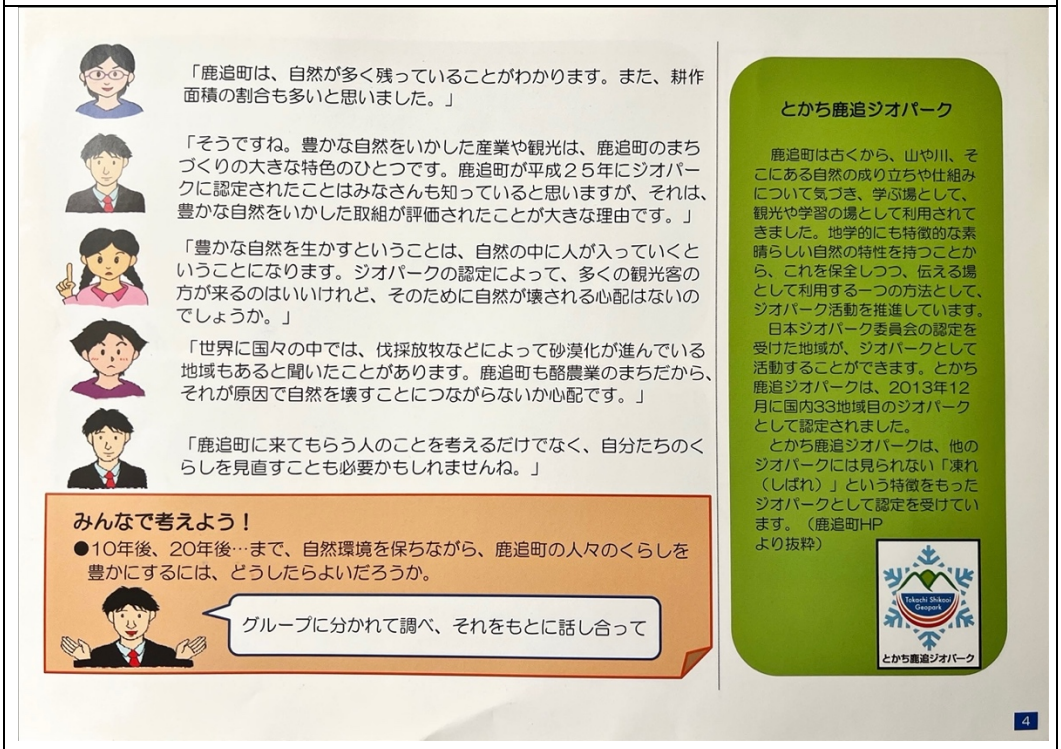
また、その土地で収穫された農作物や海産物、食料品やお菓子、その地域に伝わる民話や歴史、方言なども、ジオサイトを楽しむための大切な要素である。

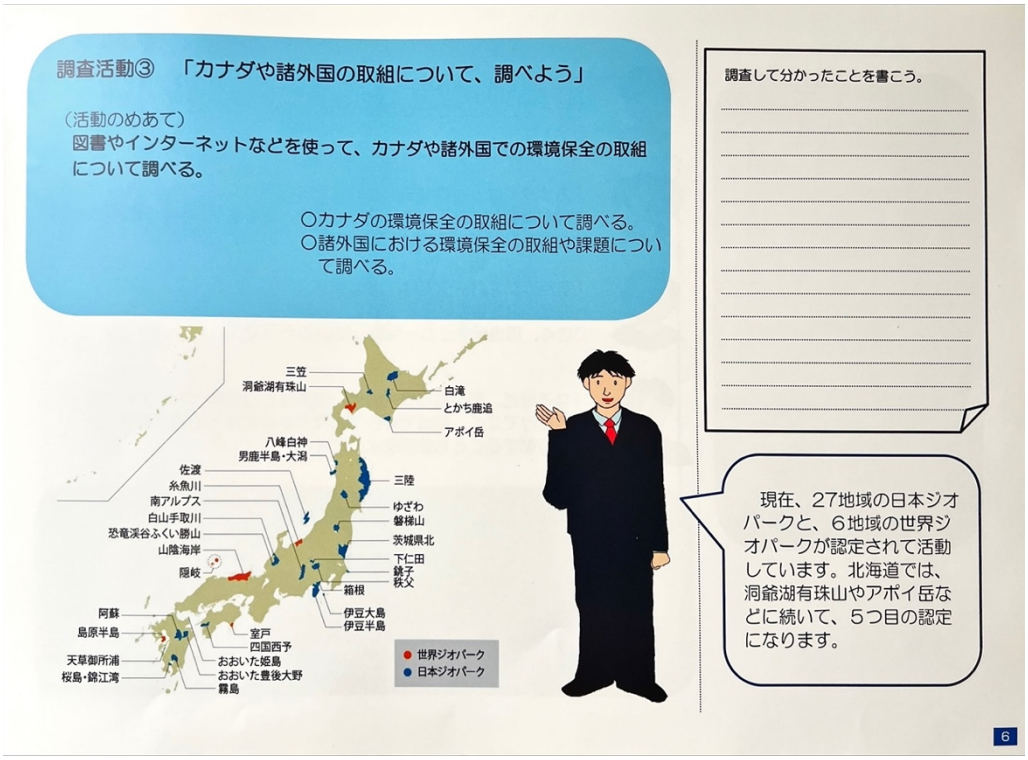
体験活動のめあてを書きましょう。

12

Appendix 1 (continued). Representative scanned sections of geopark-related content from ‘Shin-Chikyu Gaku’

Junior high school





火山と凍れ（しばれ）が育む命の物語

　然別火山群の活動と然別湖の誕生。これらの出来事と北海道内でも特に寒冷な気候が作り出したものは特異な地形とまるで「氷期の博物館」と呼べるような生態系です。現在、鹿追町全域を範囲とする当エリアでは、それらの自然環境を活かしたツーリズムや農業が取り組まれており、その恵みを大切にするための教育も行われています。そのような火山の大地と寒冷地、そして教育や観光などの特色ある町づくりをジオパーク構想のテーマとしています。（鹿追町HPより抜粋）



「鹿追町でも、森林組合などが中心となって、防風林の保全などを行っていることが分かりました。他の地域ではどうなんでしょう？」



「カナダでは、『森林法』という法律があって、自然環境の保全に国が積極的に介入しているそうです。国の許可なく、勝手に土地の開発などが行えない仕組みになっているそうです。」



「室戸のジオパークでは、市民ボランティアの方々が、ジオサイトの案内役をしているそうです。自然のすばらしさを伝えるだけでなく、環境保全にも一役買っているそうです。」



「なるほど。国や地方公共団体、企業などが主体となって自然を守るだけでなく、地域でくらす人々が主体となって自然を守るために行動することも必要なようですね。」

役場の人の話



　「鹿追には、なぜ湖があり、ナキウサギがいて、おいしいジャガイモや牛乳ができるのか？」皆さんは、小学校の頃から新地球学の授業を通して、鹿追の大地の様子から学んでいます。
　このような取組は正にジオパークの活動そのものです。こんな町は全国どこにもありません。是非、皆さんが学んだことを町民の方や町外から訪れた方に、積極的に伝えて欲しいと思います。

Appendix 1 (continued). Representative scanned sections of geopark-related content from ‘Shin-Chikyu Gaku’

High school

第１章　地域の自然・環境と防災

第１節　地域の自然と環境

１．自然保護の発想

①自然環境と人間の関係を様々な視点からとらえ、環境に関する問題意識を深める。
②様々な環境問題について学び、環境に関する問題意識を深める。

①世界最初の国立公園は、間欠泉で有名なアメリカのイエローストーン国立公園である。イエローストーン公園法には現在も「訪れる人々が楽しく過ごすことができる娯楽場として広く一般に開放されなければならない」とある。

②「自然保護の父」と呼ばれるジョン・ミューアは、1892 年に世界で最初の自然保護団体「シエラクラブ」を創設した。「そこにある全てを関連あるものとして考え、そっくりそのまま残す」というミューアの思想は、現在のアメリカやカナダの国立公園の保護活動の基礎となっている。

①国立公園とは

国立公園のはじまり

国立公園（***National park***）とは、それぞれの国が指定し、保護・管理をおこなう公園のことである。優れた自然を国が保護・管理するというこの考え方は、１８７２年にアメリカで誕生した①。

世界初の国立公園に指定されたイエローストーンだったが、当初国による管理は実質的には行われておらず、密猟者や観光客などによる環境の破壊が行われていた。また、その後の国立公園の指定も、経済的に価値が低く、既得権益者のいない地域が指定されるにとどまっていた。

１８００年代後半、シエラネバダ山脈のヨセミテ渓谷に巨大なダムを作る計画が持ち上がった際、シエラネバダで動植物の研究をしていた博物学者**ジョン・ミューア**（***John Muir、1838-1914***）②は反対運動を行った。結果、１８９０年にヨセミテが国立公園に指定され、ダム建設計画は廃止された。これは世界で最初の自然保護運動であると言われている。以降、国立公園という概念は**「優れた自然を開発から守るために国が保護・管理する」**ものとして世界中に広まった。ヨセミテは１９８４年、ユネスコ世界遺産に指定された。

問　次の空欄に適語を補え。
●世界最初の国立公園は、アメリカの（①　　）である。
●「自然保護の父」ジョン・ミューアの発想である（②　　）を実現するために、一番やっかいな敵は（③　　）である。

－５－

日本の国立公園

日本では１９３４年に、**国立公園法**が施行された。同年、北海道内の２か所を含む８か所が国立公園として指定された。１９５７年、国立公園法が**自然公園法**①へと改定された後も指定は続き、２０１４年現在、国内３１か所が国立公園に指定されている。わたしたちが住む鹿追町の然別湖一帯は、大雪山国立公園の一部として、国の管理の元で自然環境の保全が行われている。

それぞれの国立公園は環境省に属する国家公務員である**自然保護官（パークレンジャー；*park ranger*）**や**自然保護官補佐（アクティブレンジャー；*active ranger*）**②によって管理されている。自然保護官は全国に７ヶ所ある地方環境事務所とその出先機関である自然環境事務所・自然保護官事務所などに勤務し、公園管理などの業務にあたっている。

北海道内には札幌にある北海道地方環境事務所、釧路自然環境事務所のほか、１３の自然保護官事務所がある。

大雪山国立公園には３か所（上川・東川・上士幌）の自然保護官事務所が設置されている。それぞれの事務所には自然保護官１名、自然保護官補佐１名が配置され、合計６名で２，２６８ｋｍ^{2}の広大な公園を管理している。然別湖一帯は、上士幌自然保護官事務所の管轄である。

①自然公園法では国立公園・国定公園ともに環境省が指定するとしているが、国立公園は国が直接管理するのに対し、国定公園は都道府県が管理するという違いがある。

②自然保護官補佐は環境省に属する国家公務員であるが、１年更新の非正規雇用である。

問　次の空欄に適語を補え。

●国立公園法が施行された１９３４年、日本国内の８か所が国立公園に指定された。北海道内では（①　　）（②　　）の２か所が指定された。

●国立公園は主に（③　　）に配置されている（④　　）と、それを補佐する（⑤　　）によって管理されている。

【コラム】国立公園と入園料

カナダの国立公園では、入り口のゲートで入園料を徴収していることが多い（ジャスパー国立公園で大人１名１０＄程度）。徴収された入園料は、歩道の整備や環境保全に関わる費用として使われる。

それに対して日本には現在、入園料を徴収している国立公園は存在しない（富士山では２０１４年から入山料徴収を正式に開始している）。

これは、「みんなのもの」である国立公園についての「みんなのものだから、自由に使えるようにしよう」と「みんなのものだから、使った人が責任を持って費用を払おう」という考え方の違いであるといえるのではないだろうか。



①日本国内では、洞爺湖有珠山、糸魚川、島原半島、山陰海岸、室戸、隠岐、阿蘇の７地域が世界ジオパークとして認定されている。

③ジオパークの考え方

世界ジオパーク

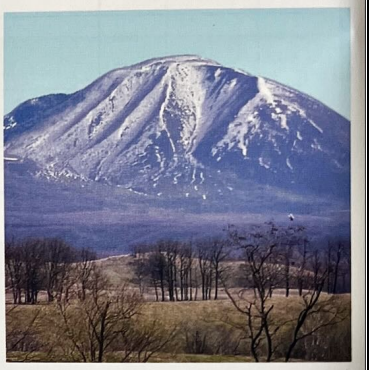
ジオパーク（*geopark*）とは、地球の歴史や地質現象といった地質遺産を中心とした地球活動の遺産を主な見所とする自然公園である。

ユネスコが認定する**世界遺産（*World heritage*）**は保護を目的とするため対象地域の開発を禁じているが、ジオパークはその地域の持続的な経済発展のために、その土地の持っている自然遺産や文化遺産を保全・教育・ツーリズムなどの活動をとおして積極的に利用することを目指している。

世界ジオパークは、ユネスコの支援により２００４年に設立された世界ジオパークネットワークが審査・認証を行っており、２０１４年９月現在、世界３２か国１１１地域が加盟している①。日本国内から世界ジオパークネットワークの審査を受けるためには、国内組織である日本ジオパーク委員会の推薦が必要である。

日本ジオパーク

日本ジオパークは、日本ジオパーク委員会が認定する国内版のジオパークである。２０１４年９月現在で、北海道内５か所を含む３６地域が日本ジオパークに認定されている。世界ジオパークネットワークは、日本ジオパーク委員会が認定した地域が「ジオパーク」を名乗ることを認めている。



ジオパークは、それぞれが貴重で特徴的な地質遺産を持っているが、それらがどう活用されているか、どのような組織で運営されているかも含めて審査の対象となっている。

【他教科との関連】
地理Ａ
・身近な地域からとらえる現代社会

問　次の空欄に適語を補え。

●（①　　）とは、地球の歴史や地質現象といった地質遺産を中心とした地球活動の遺産を主な見所とする自然公園である。その土地の持つ自然遺産や文化遺産を保全・教育・ツーリズムなどの活動をとおして積極的に活用する点が、対象地域の保護を目的とし開発を禁止する（②　　）と異なる。

とかち鹿追ジオパーク

とかち鹿追ジオパークは、２０１３年に全国３３か所目の日本ジオパークとして日本ジオパーク委員会に認定された。

とかち鹿追ジオパークの中心となる地質遺産は、然別湖周辺で一万年前まで活発だった火山活動と、日本最大級の風穴や国内最古とされる永久凍土①といった「寒さ・しばれ②」の要素によって形成された、この地独特の自然環境である。

地域の持つこれらの要素を、保全・教育・ツーリズムなどの活動をとおして地域振興のために積極的に利用することが、とかち鹿追ジオパーク活動の大きな目的である。

自然との積極的な関わり

ジオパークでは、自然環境はもちろん、「そこで暮らす人々がどのように自然と関わり合いながら営みをおくっているか」が重要であるとしている。

とかち鹿追ジオパークでは、十勝有数の生産高を上げる循環型農業はもちろん、然別湖ネイチャーセンター③を始めとする自然体験型ツーリズムに加えて、小中高一貫の教科「新地球学」の存在が、それら「人の営み」の大きな要素としてあげられている。



①夏になっても融けずに凍結したままの状態が続いている土壌をいう。然別湖周辺のものは、大雪山系に多数存在する永久凍土の中で最も古く、およそ４０００年前のものとされている。

②「厳しく冷え込む（凍る）」という意味で、北海道・東北地方の方言。

③正式名称は「（株）北海道ネイチャーセンター然別湖ネイチャーセンター」

【参考】鹿追町バイオガスプラントを中心とした循環型農業の概念図



【グループ学習】ジオツアーをプランニングする

とかち鹿追ジオパークのジオツアー（ジオパークの地質遺産などをガイドと一緒に巡り、様々な体験活動やガイドの現地での解説などをとおして、地域の魅力を学び、楽しむツアー）をプランニングしよう。

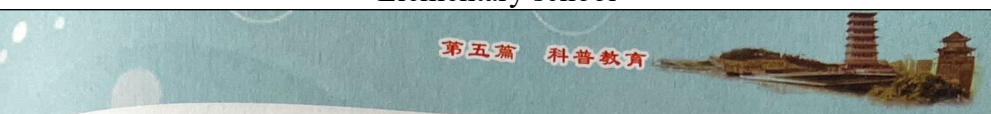




1）ジオツアーで巡る場所（火山活動や永久凍土に関する場所は必須）の候補をピックアップする
2）それぞれの場所で、どのような活動を行うか（何を学ぶのか、体験活動かガイドの解説か、など）を検討する
3）ガイドの準備（必要な知識は※、原稿は、道具は、どこに協力を依頼するかなど）をする

Appendix 2. Representative study tour pages on geopark-related content

Elementary school



主题线路二十

翠华山上探地质 秦岭山中寻文化

目的意义

走进翠华山自然风景区，领略秦岭秀丽旖旎的自然风光，探索自然奥秘，让学生与大自然之间近距离接触。

研学内容

1. 课程链接：人教版《语文》四年级下册《大自然的启示》。

2. 知识准备：了解翠华山自然风景区的形成及主要景点；了解地质文化的相关知识等。

3. 研学设计：了解翠华山自然风景区的形成条件；识别多种花草树木；了解翠华山风景区独特的地质地貌特点。

4. 研学拓展：召开主题班会、队会；进行优秀游记朗诵以及照片展示活动。

活动设计

本活动安排一天为宜。

活动一：寻找植物。在翠华山景区了解景区植物分布后，指定植物种类后寻找相关植物。

活动二：地理问答。了解翠华山风景区的形成过程及其地质地貌后，进行知识竞赛问答活动。

活动三:绘画比赛。观摩翠华山树木后,进行素描比赛。

活动四:歌唱自然。在翠华山景区进行简单的歌唱自然比赛,在互动过程中加深对翠华山的认识。

安全提示

1. 因翠华山景区路面崎岖,所以参观过程中请学生切勿拥挤,有序参观,注意脚下安全。

2. 参观体验以小组活动为宜,一律列队行走,切勿擅自离队,以免丢失。

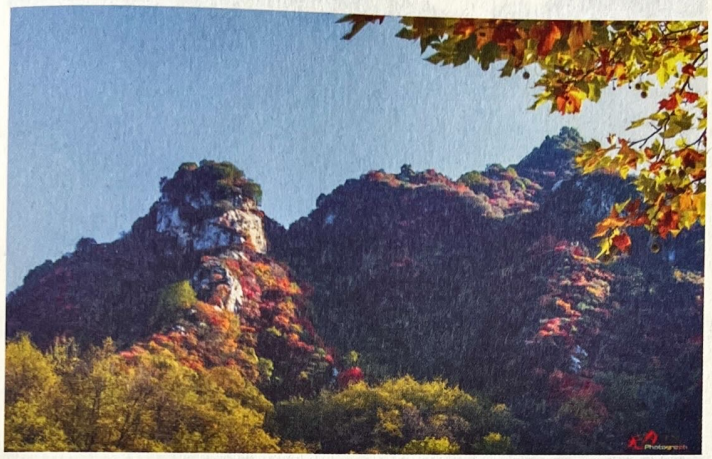
资料介绍

1. 背景知识

翠华山自然风景区位于西安城南 20 千米处秦岭北麓,景区面积 32 平方千米,以世界罕见的“中国山崩奇观”而享誉世界。翠华山原名太乙山,传说有太乙真人在此修炼过,所以得此名。1992 年翠华山自然风景区被国家林业部(现国家林业局)评为“终南山国家森林公园”;1993 年被陕西省政府评为“省



级风景名胜区”;1997 年被西安市评为“西安旅游十大风景之一”;2001 年被国土资源部批准为首批“国家地质公园”;2002 年被国家旅游局评为“AAAA 级旅游景区”;2009 年晋升为“秦岭终南山世界地质公园”。

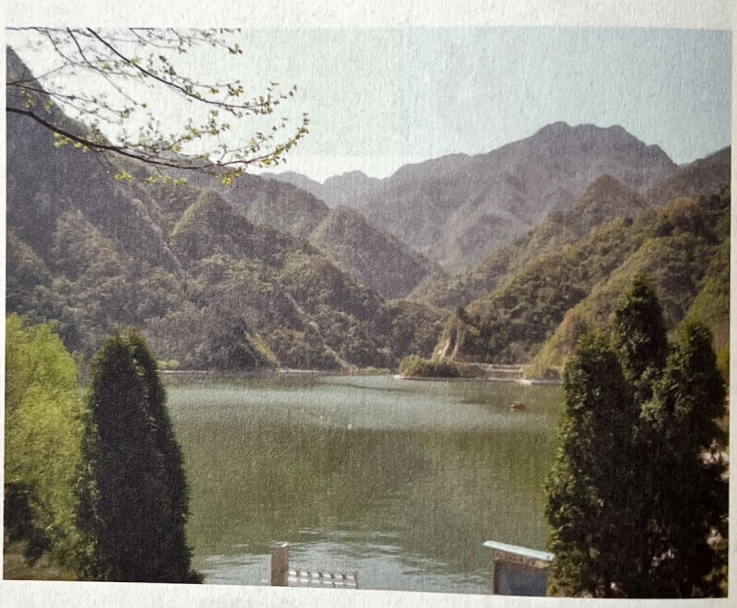


2. 地理位置示意图



3. 研学目的地特色照片





Appendix 2 (continued). Representative study tour pages on geopark-related content

Junior high school



主题线路二十六

徒步太平国家森林公园
领略秦岭地质地貌风光

◎目的意义◎

通过“徒步太平国家森林公园,领略秦岭地质地貌风光”活动,了解秦岭山系的地质资源概况,探究秦岭的地质、地貌特点,让学生认识秦岭得天独厚的地质风貌,将书本知识与自然实际有机结合。

◎研学内容◎

1. 知识准备:了解地质带、岩石等地质、地貌知识。

2. 课题设计:秦岭的地理意义;秦岭与西安。

3. 研学拓展:(1)召开“地质与地球”主题班会,向学生展示地质构造相关图文资料。(2)来回车程中,播放相关视频资料片。(3)辅导员组织学生进行地质知识问答活动。

◎活动设计◎

本活动建议安排一天为宜。

活动一:观看《大美秦岭》宣传片和《太平国家森林公园》宣传片。初步了解秦岭深处的太平国家森林公园的概况,为研学活动的顺利开展做好准备工作。



活动二：开营仪式。(1)太平国家森林公园领导致欢迎辞。(2)讲解活动安全注意事项。(3)辅导员与学生见面。(4)分组。(5)为学生分发午餐。

活动三：徒步拉练。探究秦岭的地质、地貌特点，丰富知识面，提高对地质知识的认知程度。

◎安全提示◎

1. 活动期间，学生须服从老师的管理，严格遵守活动纪律，不能离开所在的小组单独活动。

2. 爱护各项活动设施以及自然环境，不乱扔垃圾。

◎资料介绍◎

1. 背景知识

(1)秦岭：秦岭是地质科学研究的天然实验室和旅游观光的博览园。秦岭典型遗迹众多，地质演化历史悠长，构造强烈复杂，地层岩石发育齐全，岩浆活动频繁，变质类型多样，矿产资源丰富，是世界典型的复合型大陆造山带，具有当代地学发展的丰富前沿信息。





(2)太平国家森林公园:位于陕西省西安市户县太平峪内,分为黄羊坝构造跌水瀑布地貌景群、石门混合岩景群、月宫潭峡谷地貌景群和原始森林景群。太平国家森林公园地处秦岭造山带的二级构造单元——北秦岭构造带,从板块地质构造古环境讲,它位于古海沟以北靠近大陆一侧(现今的板块缝合带以北)。

太平国家森林公园地层主体属于古元古界秦岭群,原岩为陆缘碎屑岩及少量玄武岩和酸性火山岩,形成于22亿年前,是火山岛弧的基底部分。由于古岛弧热流值很高,加之板块俯冲、碰撞、陆内造山等强烈的构造运动,使得秦岭群在古生代曾发生广泛的变形变质作用、混合岩化作用和多期岩浆侵入活动,以加里东期(寒武纪—志留纪,是中国较强烈的岩浆活动期)中高级区域变质作用为主。新生代以来经过断裂构造、风化剥蚀作用,最终形成了今日丰富多彩的地质构造遗迹。

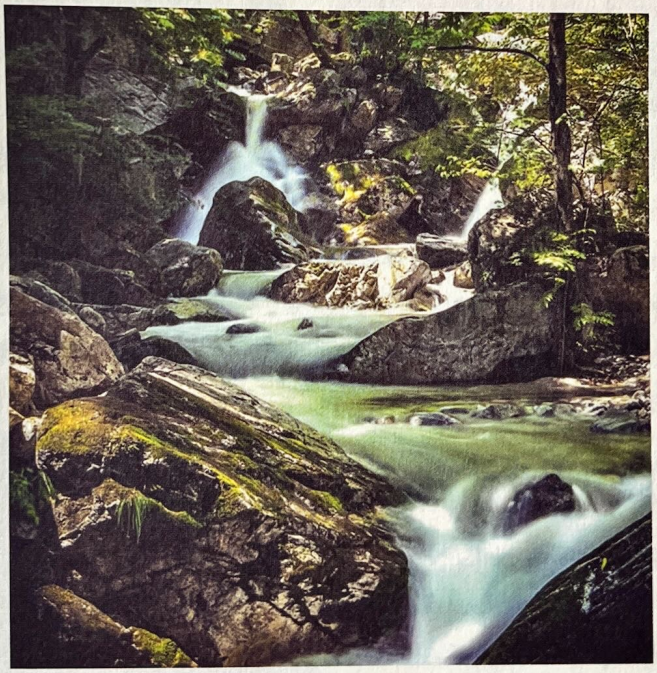
2. 地理位置示意图





3. 活动场地特色照片





Appendix 2 (continued). Representative study tour pages on geopark-related content

High school

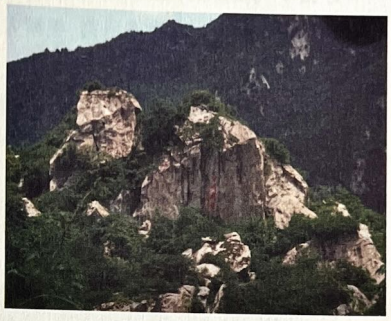


主题线路三十

攀登秦岭翠华山 领略地质大变化

目的意义

攀登秦岭翠华山，领略高峰环列、碧波荡漾、清如明镜的湖光山色和其国内罕见的山崩地貌，探索大自然的奥秘；探寻历史遗迹，参观汉唐两代修建的太乙宫和翠微宫，了解古代帝王祭祀文化；徜徉终南山世界地质公园地质博物馆内，感受秦岭终南山的历史变迁。



研学内容

1. 课程链接

人教版高中地理必修 1《地表形态的塑造》《自然地理环境的整体性与差异性》，人教版高中地理必修 2《人类与地理环境的协调发展》。

2. 知识准备

自然地理环境中的物质运动和能量交换；山地的垂直分异规律；中国古代的祭祀文化；太乙真人的故事。

3. 研学课题

秦岭独特的地理位置和价值；翠华山的轶事趣闻；太乙宫和翠微宫的建筑风格；翠华山的山崩地貌及其形成原因；翠华山的历史古迹。

4. 研学拓展

(1)撰写小论文或其他体裁文章，老师进行点评。参考题目：《翠华山的地貌探究》《翠华山的历史古迹》《我眼中的秦岭翠华山》。

(2)图片展：秦岭翠华山地貌。

活动设计

建议活动时间：一天。

活动一:参观翠华山景区。

老师带领学生参观翠华山碧山湖景区、天池景区和山崩石海景区,领略罕见的山崩地貌。学习山地的垂直分异规律、地表形态的塑造等地理知识。

活动二:终南山世界地质公园地质博物馆之旅。

参观终南山世界地质公园地质博物馆的序厅、地球知识展区、地质公园展区、终南地质展区、秦岭地质珍宝展区、锦绣终南展区、人文终南展区、姐妹公园展区、关怀展望展区九大展区,了解秦岭终南山世界地质公园的整体概况。

安全提示

1. 山中气候多变,应携带衣物及防晒物品。

2. 上山过程中海拔逐步升高,提醒大家不能着急,要注意控制走路节奏。特别是有心血管疾病的学生要十分注意安全。

3. 每年11月至次年4月,部分地区海拔较高,一些山路上会有积雪,并且没有栏杆,一定要注意安全。

资料介绍

1. 背景知识

(1)翠华山



翠华山(又称“太乙山”,传说太乙真人在此修炼,因而得此名)位于太乙峪中,峪口有汉武帝元封二年(公元前109年)修的太乙宫。翠华山是历代王朝皇家的“上林苑”“御花园”。秦始皇在此狩猎休闲,汉武帝设立祭天道场,祭拜太乙真人。秦圣宫是唐王李世民避暑消夏行宫。翠华山旅游景区由碧山湖景区、天池景区和山崩石海景区三部分组成,以“终南独秀”和“中国地质地貌博物馆”著称。

翠华山山清水秀,景色如画,最引人入胜的是峰顶的甘湫池。甘湫池群山环峙,碧波荡漾,清如明镜,纤尘不染。池南的太乙殿,是旧时人们遇到大旱祈雨的地方。更有颇负盛名的八仙洞、吕公洞、黄龙洞、冰洞、风洞等景点。冰洞在盛夏时仍有坚冰垂凌,其东南有飞流直下的瀑布,形态壮观。

翠华山风景优美,清雅幽静,为西安夏日避暑胜地。这里每年农历六月初一至初三,举行翠华庙会,游人如织,十分热闹。



(2)山崩现象

山崩,是山坡上的岩石和土壤快速、瞬间滑落的现象。泛指组成坡地的物质受到重力的作用,产生向下移动的现象。暴雨、洪水或地震可以引发山崩。人为活动,如伐木、破坏植被、开凿峭壁,也能引发山崩。有些山崩现象不是由地震引发的,而是由于山石剥落后受重力作用产生的。山崩也会引发地震。



2. 地理位置示意图

翠华山国家地质公园地理位置示意图



3. 研学目的地特色照片

