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Geoeducation for Schoolchildren in Geopark Areas: Enhancing Awareness in Toba Caldera and Kenyir Geoparks

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ABSTRACT

Geoeducation or geoscience education is an important component in efforts to conserve nature and increase environmental awareness in geopark areas. One example of a geopark area in Indonesia is the Toba Caldera and Kenyir Geopark, the area has extraordinary geological value, as well as the potential to be used as an educational facility for school children. The main problem is that partners, especially schools, still view themselves as not being part of the geopark ecosystem. Therefore, community service activities need to be carried out to encourage partners to contribute, synergize, and benefit from the existence of the geopark. The problem statement that used are how is geo-education in the geopark area today, what is the role of schools/educational institutions in providing education in the geopark area, what steps can be taken to implement geo-education. This study uses a qualitative approach with a library research method. The type of literature study used is a narrative review. The implementation of geoeducation in geopark areas is an important strategy in environmental conservation efforts, strengthening local identity, and increasing awareness of the value of geological heritage from an early age. Schools and educational institutions play a central role in realizing contextual and enjoyable geosite-based education. For this reason, structured steps are needed, starting from identifying geosite potential, developing relevant teaching materials, teacher training, curriculum integration, to direct learning activities in the field. The success of geoeducation is also determined by the availability of adequate educational facilities and strong partnerships between geopark managers, government, schools, local communities, and higher education institutions.
Keywords: Geopark, Geoeducation, Kaldera Toba, Kenyir Geopark

ABSTRAK

Geoedukasi atau pendidikan kebumian merupakan komponen penting dalam upaya pelestarian alam dan peningkatan kesadaran lingkungan di kawasan geopark. Salah satu contoh kawasan geopark di Indonesia adalah Kaldera Toba dan Geopark Kenyir, yang memiliki nilai geologi luar biasa serta potensi besar untuk dimanfaatkan sebagai sarana edukasi bagi anak-anak sekolah. Permasalahan utama yang dihadapi adalah bahwa mitra, khususnya pihak sekolah, masih belum melihat diri mereka sebagai bagian dari ekosistem geopark. Oleh karena itu, perlu dilakukan kegiatan pengabdian kepada masyarakat guna mendorong para mitra agar dapat berkontribusi, bersinergi, dan memperoleh manfaat dari keberadaan geopark. Rumusan masalah yang digunakan dalam penelitian ini adalah bagaimana kondisi geoedukasi di kawasan geopark saat ini, apa peran sekolah/lembaga pendidikan dalam memberikan pendidikan di kawasan geopark, serta langkah-langkah apa yang dapat dilakukan untuk mengimplementasikan geoedukasi. Penelitian ini menggunakan pendekatan kualitatif dengan metode studi pustaka. Jenis studi pustaka yang digunakan adalah tinjauan naratif. Implementasi geoedukasi di kawasan geopark merupakan strategi penting dalam upaya pelestarian lingkungan, penguatan identitas lokal, dan peningkatan kesadaran akan nilai warisan geologi sejak usia dini. Sekolah dan lembaga pendidikan memainkan

peran sentral dalam mewujudkan pendidikan berbasis geosite yang kontekstual dan menyenangkan. Untuk itu, diperlukan langkah-langkah yang terstruktur, dimulai dari identifikasi potensi geosite, pengembangan bahan ajar yang relevan, pelatihan guru, integrasi kurikulum, hingga pelaksanaan kegiatan pembelajaran langsung di lapangan. Keberhasilan geoedukasi juga ditentukan oleh ketersediaan sarana edukasi yang memadai serta kemitraan yang kuat antara pengelola geopark, pemerintah, sekolah, masyarakat lokal, dan institusi pendidikan tinggi.
Kata kunci: Geopark, Geoedukasi, Kaldera Toba, Geopark Kenyir.

1. Introduction

Geoeducation or geoscience education is an important component in efforts to conserve nature and increase environmental awareness in geopark areas[1]. One example of a geopark area in Indonesia is the Toba Caldera and Kenyir Geopark, the area has extraordinary geological value, as well as the potential to be used as an educational facility for school children[2]. By introducing geoeducation from an early age, children around the geopark can understand the importance of nature conservation and the impacts of climate change and human activities on the environment. The Toba Caldera and Kenyir Geopark areas have unique geology and biodiversity that are very valuable. The Toba Caldera, for example, is a giant volcanic crater that has a very important geological history in the evolution of the earth[3]. Meanwhile, Kenyir Geopark located in Malaysia, with its natural wealth, offers great potential for nature-based educational activities[4]. This second area can be a model for geoeducation, by providing information that is easily accessible to school children. This is also supported by the location factor, where the geopark is close to the organization area and educational facilities.

However, there are several challenges that must be faced in implementing geoeducation in the geopark area, including[5]: First: schools around the geopark area are still lacking in teaching earth sciences, both in terms of teaching materials and field teaching. This is due to limited curriculum, supporting facilities, and teacher training. Second, related to accessibility and infrastructure that is limited, both for students and visitors. Inadequate infrastructure can hinder efforts to implement geoeducation effectively. Third, the community around the geopark may not yet fully realize the importance of the geopark as a source of knowledge and tourist attraction that can improve the regional economy.The main partner problem is that partners, especially schools, still view themselves as not being part of the geopark ecosystem. Therefore, community service activities need to be carried out to encourage partners to contribute, synergize, and benefit from the existence of the geopark. The implementation of geo-education in schools in geopark areas has not been able to run optimally due to the lack of geo-science knowledge among teachers, limited resources and infrastructure, and limited budget for implementing geopark-based educational activities.

Based on the explanation above, the formulation of the problem taken in this study is:

1. How is geo-education in the geopark area today?
2. What is the role of schools/educational institutions in providing education in the geopark area?
3. What steps can be taken to implement geo-education?

2. Method

This study uses a qualitative approach with a library research method. The type of literature study used is a narrative review. Narrative review or narrative study is a type of literature study that aims to collect, summarize, and analyze various library sources that are relevant to the research topic descriptively and thematically. Narrative review allows researchers to examine theories, concepts, and previous research results without following strict systematic procedures such as in systematic reviews. In this method, researchers have the flexibility to choose sources, interpret findings, and organize discussion flows based on relevance and analysis needs. The data sources used in this study are textbooks, and scientific references,

[1] Novarlia I, Sukirman O, Sosialisasi Literasi Geotourism Melalui Media Sosial Bagi Peserta Didik Smpn 1 Cimalaka Kabupaten Sumedang. Jurnal Abdimas Bina Bangsa.

[2] Tupang K, Purba RR, Peran Masyarakat Lokal dalam Pengembangan Geosite Geopark Kaldera Toba Silahisabungan menuju Geopark Global UNESCO. Jurnal Ekonomi Dan Industri E-ISSN. 2019;2656:3169.

[3] Chesner CA. The Toba caldera complex. Quaternary International. 2012 May 1;258:5-18.

[4] Baharim NB, Rahman MN, Adriaysah D, Ali MA, Ariffin EH, Atan A. Evaluation of student perspectives and awareness regarding Kenyir Geopark. InBIO Web of Conferences 2024 (Vol. 131, p. 03012). EDP Sciences.

[5] Riyanto DN, Alfirdaus LK. Tantangan Dan Hambatan Collaborative Governance Dalam Pengembangan Pariwisata Di Kabupaten Kebumen (Studi Kawasan Geopark Kebumen). Journal of Politic and Government Studies. 2024 Dec 27;14(1):374-91.

national and international journal articles, theses, theses and dissertations, research reports, government documents or related institutions and trusted online official sources. The data collection techniques used are by tracing literature from physical and digital libraries (campus repositories, Google Scholar, Garuda, ResearchGate, etc.), identifying relevant sources based on topics and keywords, selecting and recording important information from each source.

3. Result and Discussion

3.1. Concepts

A. Legal Regulations on Geopark in Indonesia and Malaysia

A geopark, or earth park, is an area containing internationally recognized geological significance and managed for conservation, education, and sustainable economic development based on geotourism. With increasing global attention to the preservation of geological heritage, many countries, including Indonesia and Malaysia, have developed policies to structure and manage geopark areas. Although both located in Southeast Asia, the two countries have slightly different policy approaches to geopark management[6].

In Indonesia, regulations regarding geoparks have a fairly strong legal basis. The Indonesian government issued Presidential Regulation (Perpres) No. 9 of 2019 concerning the Development of Geoparks. This regulation serves as the primary legal basis for the development of geoparks nationally and internationally[7]. This Presidential Regulation emphasizes the importance of geoparks as a tool for sustainable development and establishes the establishment of the Indonesian National Geopark Committee (KNGI) as a cross-sectoral coordinating body. The regulation explains that geopark development encompasses three main pillars: geological heritage conservation, public education, and improving community welfare through geotourism. In addition, several related ministries such as the Ministry of Energy and Mineral Resources , the Ministry of Tourism, and the Ministry of Environment and Forestry also play a role in the technical aspects and policy implementation through various derivative regulations and supporting programs.

Meanwhile, in Malaysia, regulations regarding geoparks have not been codified in the form of a specific law or deed, but are regulated through national policies and technical guidelines. One of the main documents that underpins geopark policy in Malaysia is the National Geopark Development Plan, managed by the Ministry of Natural Resources, Environment and Climate Change (NRESCC). This document provides comprehensive guidance on geopark development at the national level, including criteria for national geopark recognition, management mechanisms, and the process for submitting applications to UNESCO as a Global Geopark. Furthermore, the Malaysian Department of Minerals and Geosciences also publishes the Malaysian Geopark Management Guidelines, which serve as technical guidelines for geopark managers at both the local and state levels[8].

Although Malaysia does not yet have a specific law, it has established a National Geopark Management Committee (Janatankuasa Geopark Kebangsaan) tasked with evaluating and coordinating geopark development. Geopark management in Malaysia also involves the active participation of the state government and local development agencies, such as the management of the Langkawi UNESCO Global Geopark by the Langkawi Development Authority (LADA).

Overall, both countries demonstrate a commitment to developing and managing geoparks using policy approaches aligned with their respective government structures. Indonesia places greater emphasis on formal legal and cross-ministerial approaches, while Malaysia prioritizes technical policies and inter-institutional coordination. Both recognize geoparks as strategic instruments for conservation and sustainable development based on local potential

B. Geoeducation

Geoeducation is a combination of two basic concepts, namely "geo" which means earth and "education" which means education. In general, geoeducation is a process of education or learning about the earth that includes aspects of geology, geomorphology, natural resources, disasters, and environmental conservation. The goal is to increase public understanding of the condition of the earth and the environment, as well as to build awareness to protect and preserve it. In the context of the geopark area, geoeducation is a very important part because geoparks not only aim to preserve geological heritage, but also to educate the

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[6] Rachmat, Herry. "Geopark Development Policy in Indonesia." Indonesian Journal of Geography 51, no. 2 (2019): 123–132.

[7] Republik Indonesia, Peraturan Presiden Nomor 9 Tahun 2019 tentang Pengembangan Taman Bumi (Geopark), ditetapkan di Jakarta, 25 Januari 2019, diundangkan 31 Januari 2019

[8] Pelan Pembangunan Geopark Negara 2021–2030 ("PPGN 2021-2030"), Kementerian Sumber Asli, Alam Sekitar dan Perubahan Iklim (NRECC) dan Jabatan Mineral dan Geosains Malaysia (JMG), cetakan pertama 2023, hlm. ix–x.

public, especially the younger generation, about geological and environmental values in a sustainable manner. UNESCO states that one of the main functions of a geopark is as an open classroom that allows the education process to take place directly in nature[9].

Geoeducation not only emphasizes the transfer of knowledge, but also the formation of attitudes and behaviors that care about the environment, an understanding of geological risks, and awareness of the importance of disaster mitigation. According to Surono[10], geoeducation that is applied systematically can increase the resilience of individuals and communities in facing the risk of geological disasters such as earthquakes, landslides, or volcanic eruptions. School children who are introduced to the concept of geology from an early age will be more sensitive to environmental changes and understand the actions they can take to preserve nature.

School children are a strategic group in the development of disaster and environmental literacy. Through a geoeducational approach, children can gain relevant and contextual knowledge about the surrounding environment, understand the natural processes that occur, and learn to be responsive and responsible for the earth where they live. This is very important considering that Indonesia is a country with a high risk of geological disasters.

Geology education in schools, especially those in geopark areas, must be designed not only based on classroom theory, but also through active learning methods such as field observations, visits to geological sites, disaster simulations, and environmental conservation projects. A contextual learning model like this can increase students' interest in learning and foster a deeper understanding.

In addition, geoeducation also helps students understand the relationship between geological phenomena and everyday life. For example, by learning about rock types and soil structures, students will learn the reasons why an area is prone to landslides or why it is necessary to maintain slope vegetation. By learning about the water cycle and coastal dynamics, students will understand the importance of maintaining mangroves or avoiding building in tsunami hazard zones. Therefore, geoeducation not only has an impact on the cognitive aspects, but also the affective and psychomotor aspects of students.

An example of an area that has carried out geoeducation is in the Sukabumi area. West Java. This area has unique geological riches, such as rocks hundreds of millions of years old, giant rock cliffs, natural waterfalls, and a long coastline. This area is a successful example of the implementation of community and school-based geoeducation, as well as a national reference in developing contextual earth education.

One of the leading programs implemented is “School Goes to Geopark”, an educational program where students from various levels—from elementary to high school—are invited to visit major geological sites in Ciletuh, such as Puncak Darma, Palangpang Beach, and Curug Sodong. In this activity, students not only observe geological phenomena directly, but also receive explanations from local guides who have been trained to become geotourism interpreters. This approach increases students’ understanding of geological processes such as tectonics, weathering, and erosion, as well as their relationship to potential natural disasters such as landslides and tsunamis. In addition, training programs for teachers and local communities are also carried out periodically. Teachers are invited to prepare geotourism-based learning modules, while communities are trained to become environmental education agents. This creates collaboration between schools, local governments, and communities in making geoeducation a success as part of conservation and disaster mitigation. Several schools have even begun to integrate geopark material into local content curricula and extracurricular activities.

The impact of this program is quite significant. Based on the report of the Sukabumi Regency Education Office, there has been an increase in student and community awareness of the importance of environmental conservation and disaster risk reduction. Mutual cooperation activities, reforestation, and disaster mitigation education have become more routinely carried out around the geopark area[11]. On the other hand, educational visits also help improve the local economy through education and conservation-based tourism. The Ciletuh Geopark case study shows that the implementation of geoeducation not only strengthens earth literacy among students but is also an effective strategy in building collective community awareness of the environment and potential disasters. With an inclusive and participatory approach, this

[9] UNESCO, UNESCO Global Geoparks: Celebrating Earth Heritage, Sustaining Local Communities, 2020, https://unesdoc.unesco.org/ark:/48223/pf0000372986.

[10] Surono, diwawancarai oleh Rizky Noor Alam, *“Surono, Belajar Berdampingan dengan Bencana,”* Media Indonesia, 29 Desember 2018.

[11] Dinas Pendidikan Kabupaten Sukabumi, “Dibangun Disdik, Menengok Pojok Geopark di SDN Tegalcaringin Sukabumi,” *Sukabumiupdate.com*, 30 Mei 2023.

geopark is able to combine nature conservation, community empowerment, and education in a sustainable manner.

C. Geopark Area

Geopark or earth park is a geographical area that has internationally valuable geological wealth that is managed through a conservation, education, and sustainable development approach. In Indonesia, the concept of geopark is growing along with UNESCO's recognition of the geological, ecological, and cultural wealth of various regions. According to Kusnadi, Geopark in Indonesia acts as a vehicle for environmental conservation as well as a medium for public education in disaster mitigation and community empowerment efforts[12].

One real example of the implementation of geopark in Indonesia is the Ciletuh-Palabuhanratu Geopark in Sukabumi, West Java. This area has developed the School Goes to Geopark program, which involves schools in educational visits to geological sites. Through this activity, students learn directly about geological structures, rock types, and the risks of natural disasters such as landslides and tsunamis. This experience-based education strengthens their understanding of nature and increases conservation awareness from an early age. However, challenges remain, especially in terms of coordination between stakeholders and limited human resource capacity at the local level.

Meanwhile, in the Gunung Sewu Geopark which covers the areas of Yogyakarta, Central Java, and East Java, community participatory innovation is the main strength of area management. Sulistyo noted that local communities, through tourism awareness groups, actively initiated various conservation activities such as tree planting, karst site preservation, and geotourism interpretation. This grassroots innovation plays a major role in maintaining the sustainability of the area and strengthening community ties to the geological identity of their region.

In eastern Indonesia, the Raja Ampat Geopark is an example of how geological heritage is closely linked to local biodiversity and culture. Septiana explained that geological education in Raja Ampat is carried out with a cultural approach, where local narratives and coastal community wisdom are used to convey geoscience information. In addition to being a contextual education strategy, this approach also strengthens community participation in preserving the marine and terrestrial environment in the geopark area.

However, not all geoparks in Indonesia have been running optimally. Kusuma's study of the Silokek Geopark in West Sumatra revealed that the area still requires improved management, educational infrastructure, and community involvement in order to meet UNESCO Global Geopark standards. Limited funding, inter-agency coordination, and low public awareness are the main challenges that must be overcome.

In general, geopark areas in Indonesia play a strategic role in conservation efforts, education, and local economic development. Geoparks not only protect geological heritage, but also play an important role in geoeducation and disaster mitigation. Through synergy between the government, academics, schools, and local communities, geoparks can become a model for sustainable development based on nature and cultural conservation.

North Sumatra is one of the provinces in Indonesia that has extraordinary geological wealth, which is recognized nationally and internationally through the existence of the Toba Caldera Geopark. This area is one of Indonesia's leading geopark destinations that has been designated as a UNESCO Global Geopark (UGG) in 2020[13]. The Toba Caldera Geopark not only holds unique geological values, but also reflects the integration of geological heritage, biodiversity, and local culture.

The Toba Caldera was formed from a supervolcano eruption around 74,000 years ago which produced the largest volcanic lake in the world, Lake Toba. According to research by Sinaga and Lubis, this area has great geotourism potential and can be developed through an educational and conservative approach. Important geological sites in the Toba Caldera Geopark include: Holbung Hill, Sipinsur, Bakkara Valley, and Samosir Island which were formed from post-eruption caldera uplift.

Although it has UNESCO Global Geopark status, challenges remain in managing this area. Lack of supporting infrastructure, low geological awareness among the community, and limited training for tourism actors are obstacles in maximizing the potential of the geopark. Therefore, synergy is needed between local governments, local communities, academics, and the private sector to develop this geopark sustainably.

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[12] Iwan Henri Kusnadi, "Environmental Policy Implementation in West Java (Studies in the Ciletuh Geopark Tourism Area)," *Journal of Governance* 8, no. 2. 2023

[13] Toba Caldera inscribed on List of UNESCO Global Geoparks," Antara News (English), 8 Juli 2020.

D. Government support for Geopark

Geoparks or earth parks are areas that integrate the preservation of geological heritage, education, and sustainable development. In Indonesia, the existence of geoparks is not only a conservation tool but also a strategic educational medium. The Indonesian government, through various ministries and institutions, has an important role in supporting the progress of geoparks, especially in the fields of education and increasing public awareness of the importance of geodiversity and environmental conservation.

One form of real government support is through the Ministry of Tourism and Creative Economy (Kemenparekraf) which promotes geoparks as educational-based tourist destinations. This ministry actively encourages the development of geological educational tourism in geopark areas such as Ciletuh-Palabuhanratu, Gunung Sewu, and the Toba Caldera. The educational tourism includes school visit programs, training for local guides, and the preparation of geological interpretive materials for visitors. This support is in line with the government's efforts to build sustainable tourism based on science and environmental education[14].

In addition, the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) also plays a role through the integration of geopark materials into the education curriculum, especially in geography and science subjects. Several schools in the geopark area have become part of the "Geopark Friend School" program which aims to educate students about the importance of preserving local geological, cultural, and biodiversity heritage. This strengthens disaster and conservation literacy from an early age, as well as creating a young generation that cares about the environment (Siregar, 2021).

The local government also plays a strategic role in implementing geopark education. For example, the North Sumatra Provincial Government has formed the Toba Caldera Geopark Management Agency which is not only responsible for conservation and tourism aspects, but also developing community-based education programs. Teacher training, geotourism workshops, and programs to involve local youth as geopark ambassadors are carried out routinely as a form of knowledge transfer and community empowerment.

However, geopark education efforts in Indonesia still face various challenges, such as limited human resources, lack of relevant teaching materials, and unequal understanding of the geopark concept among educators and students. Therefore, the government continues to encourage collaboration between academics, geopark managers, and educational institutions to develop interesting and contextual educational content, as well as strengthen the training of educators in geopark areas. Overall, government support for geopark education reflects a commitment to building sustainable environmental awareness. Through synergy between ministries, educational institutions, local governments, and local communities, geoparks in Indonesia are expected to not only become tourist destinations, but also as centers for geoscience learning that empower communities and preserve the nation's natural heritage.

3.2. Geoeducation Of School Children In The Geopark Area

Geoeducation is one of the main pillars in the development of areas based on conservation, education, and sustainable tourism. School children, as part of the next generation, are an important target in the implementation of geoeducation in this area[15]. Geoeducation in the Toba Caldera is carried out through formal and non-formal approaches. Formally, schools around the geosite area such as Silahisabungan, Parapat, Balige, and Muara have integrated local content about geoparks and geodiversity into thematic learning. Teachers work together with geopark managers and local governments to prepare modules, student worksheets, and teaching materials that are tailored to the age of the students. On several occasions, students are invited to visit geological sites directly, such as rocks from supervolcanic eruptions or caldera lakes, to experience contextual learning. Activities like this have proven effective in increasing students' understanding of geological processes, as well as the importance of preserving the area. According to the results of a study conducted at the Silahisabungan Geosite, the increase in student knowledge after participating in the geoeducation program reached 56% compared to before the activity was carried out.

In addition to the formal approach, the non-formal approach also plays an important role. The North Sumatra Provincial Government through the Disbudparekraf has launched a mass education program through an online platform, targeting all elementary to high school students. This program aims to instill values of

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[14] "Kemenparekraf Tekan Geopark Dalam Pengembangan Pariwisata Daerah," *Dinamika Sultra*, 18 Desember 2022.

[15] UNESCO Global Geoparks Network, Top 10 Focus Areas – Education for Sustainability & Geological Hazards Risk Reduction, n.d., diakses 15 Juli 2025.

love for the environment and pride in local geological heritage from an early age. In addition, several local churches around Toba have also initiated "eco-literacy" activities as part of religious-based character education. This shows that synergy between sectors is very important in forming a culture of geological literacy among school children.

To support the effectiveness of geoeducation, the Toba Caldera Geopark also provides child-friendly interpretation facilities, such as information boards, visitor centers with interactive media, and children's geotourism guidebooks. Children are invited not only to recognize rocks or volcanic eruptions, but also to understand the relationship between geology, ecosystems, and human life. Involving students in reforestation activities, cleaning geosites, and disaster simulations are also integral parts of the action-based learning approach.

Overall, the implementation of geoeducation in the Toba Caldera has shown positive results in increasing children's awareness and understanding of the importance of preserving geological heritage. This education not only enriches knowledge but also forms an attitude of caring for the environment which is the basis for the sustainability of the geopark area. In the context of national education policy, the integration of geoeducation is also in line with the Merdeka Curriculum which emphasizes contextual, project-based, and environmental conservation-oriented learning.

Schoolchildren's knowledge of geoparks is an important indicator in measuring the success of environmental education programs and the preservation of geological heritage. In many geopark areas in Indonesia, including the Toba Caldera, efforts to increase this knowledge are carried out through contextual and place-based learning approaches. However, in the early stages of implementation, most students only had a limited understanding of what a geopark is, its geological value, and its relevance to everyday life.

The results of a study by Muzambiq, Walid, and Ganie at the Silahisabungan Geosite showed that before the education program was carried out, the average student understanding of the geopark concept was only around 11%. This indicates that terms such as "geopark", "geodiversity", or "geological conservation" are still relatively foreign among students. However, after participating in training and educational visits, their understanding increased drastically to 67%. This shows that the right educational approach, such as field visits, the use of visual media, and interactive dialogues, are very effective in building school children's understanding of geoparks.

In addition to formal school activities, children's knowledge of geoparks can also be strengthened through non-formal programs such as community, church, or family activities. For example, churches around the Lake Toba area also organize environmental education activities (eco-theological literacy) that introduce children to the importance of preserving creation, including the geological heritage and ecosystems of the area[16]. This broadens the scope of geopark education beyond the academic realm and enriches children's learning experiences.

However, there are still challenges such as limited teaching resources, minimal teacher training on geoparks, and the uneven distribution of geopark-specific teaching materials. Therefore, there needs to be support from the government, geopark managers, and schools to integrate geopark content sustainably into the curriculum and student activities.

3.3. The Role Of Schools/Educational Institutions In Providing Education On Geopark Areas

Schools and educational institutions play a strategic role in increasing the understanding of the younger generation about geoparks, especially in the context of environmental conservation, geological heritage, and disaster risk reduction. As formal learning centers, schools have the ability to integrate geopark materials into the curriculum through thematic, contextual, and cross-disciplinary approaches. Geopark education provided from an early age is important to form sustainable environmental awareness and a love for local potential.

In the Toba Caldera Geopark area, for example, several schools have begun to integrate materials about geological formations, caldera lakes, and local wisdom into Natural Science, Geography, and local content lessons. Teachers are trained to develop geosite-based learning media, such as student worksheets, documentary videos, and thematic maps, so that learning becomes more interesting and relevant to the surrounding environment. Schools also conduct field visits to geopark sites as part of an out-of-class learning model that directly strengthens students' understanding of geological and conservation values.

In addition to formal schools, non-formal educational institutions such as community training centers, reading parks, and religious organizations also contribute to providing geopark education. Programs

[16] Bestian Simangunsong, “Spiritualitas Ramah Alam: Upaya Pelestarian Alam di Kawasan Danau Toba,” *Jurnal Teologi Cultivation* 8, no. 2, Desember 2024.

such as geotourism-based teacher training, environmental education camps, and nature schools enable children and adolescents to understand the interconnectedness of geology, culture, and their lives. In some areas, synergy between geopark managers, local governments, and universities is also carried out in the form of developing geopark education modules and involving students in community service programs that carry the theme of geoeducation.

In addition to increasing student knowledge, schools also play a role in forming environmental awareness and conservative behavior. For example, the Adiwiyata school program can be collaborated with the geopark theme, where students are involved in conservation activities such as planting trees, managing waste, and making educational posters about local geotourism. Through these activities, educational values and real action can go hand in hand.

However, to realize maximum geopark education, government policy support is still needed, such as integrating geopark content into the national curriculum, increasing teacher capacity, and providing adequate educational facilities. In addition, it is also important to form networks between schools in the geopark area to create collaboration and exchange of good practices in developing geopark learning.

3.4. Step For Implemening Geoeducation In The Geopark Area

The implementation of geo-education in geopark areas aims to increase public awareness, especially the younger generation, of the importance of preserving geological heritage, biodiversity, and local culture. To ensure that geo-education is implemented effectively, several stages or strategic steps are required as follows:

1. Identification of Geosite Potential as a Learning Resource

The initial step is to identify and map geosites or locations of geological value in the geopark area that have high educational value. This potential can be in the form of unique rock sites, volcanic lakes, faults, or evidence of historical volcanism. Each geosite is analyzed for its suitability as a learning medium for various age levels, especially school children. For example, in the Toba Caldera Geopark, sites such as Sipinsur, Holbung Hill, and Bakkara Valley are used as locations for field geology learning.

2. Development of Educational Materials and Modules

The second step is to compile geo-education-based teaching materials that are in accordance with the national and local education curriculum. This material includes basic geology, environmental conservation, disaster mitigation, and local wisdom. Modules can be developed thematically for elementary, junior high, and senior high school levels, and adjusted to local characteristics. The involvement of teachers and geologists is very important in developing materials that are easy to understand and applicable.

3. Teacher and Education Facilitator Training

Teachers and educators need to receive special training on geopark concepts, geosite interpretation techniques, and open nature-based learning methods. This training can be facilitated by geopark managers, universities, or government institutions such as the Education Office. The goal is for teachers to be able to deliver materials with an interesting and in-depth approach.

4. Integration of Geoeducation into the School Curriculum

Another important step is to integrate geoeducational materials into the school curriculum, either as part of the main subjects (science, social studies, geography) or through extracurricular activities. For example, themes about rocks and geological processes can be taught in 7th grade science lessons, while the natural history of the region can be included in local content.

5. Organizing Field Activities and Educational Practices

Activities such as field visits to geosites, conservation practices, or disaster mitigation simulations are effective ways to strengthen students' understanding. With the experiential learning method, students learn directly from the environment and build emotional attachment to the geopark area. This also creates a meaningful and enjoyable learning experience.

6. Development of Interesting Educational Facilities

Facilities such as geopark information centers, interpretation boards, mini museums, educational videos, and interactive maps can help convey information in a visual and fun way. The presence of these facilities makes the geosite more friendly for children's education and general visitors.

7. Partnerships with Local Communities and Institutions
The involvement of local communities, youth organizations, and religious institutions is very important so that geoeducation programs do not only take place in schools, but also in the community. Joint activities such as environmental competitions, student camps, or conservation training can expand the reach and impact of education.

8. Program Monitoring and Evaluation
Every geoeducation program needs to be evaluated periodically to determine its effectiveness. Monitoring can be done through student questionnaires, teacher observations, or assessments of participant understanding. This data can be the basis for improving materials and implementation strategies.

4. Conclusion

The implementation of geoeducation in geopark areas is an important strategy in environmental conservation efforts, strengthening local identity, and increasing awareness of the value of geological heritage from an early age. Schools and educational institutions play a central role in realizing contextual and enjoyable geosite-based education. For this reason, structured steps are needed, starting from identifying geosite potential, developing relevant teaching materials, teacher training, curriculum integration, to direct learning activities in the field. The success of geoeducation is also determined by the availability of adequate educational facilities and strong partnerships between geopark managers, government, schools, local communities, and higher education institutions. Periodic evaluation and monitoring are needed to assess the effectiveness of the program and make continuous improvements. Thus, geoeducation not only enriches the formal learning process, but also strengthens the role of local communities in maintaining the sustainability of geopark areas as valuable earth heritage.

Reference

Azman N, Halim SA, Liu OP, Saidin S, Komoo I. Public education in heritage conservation for geopark community. Procedia-Social and Behavioral Sciences. 2010 Jan 1;7:504-11.

Baharim NB, Rahman MN, Adriaysah D, Ali MA, Ariffin EH, Atan A. Evaluation of student perspectives and awareness regarding Kenyir Geopark. InBIO Web of Conferences 2024 (Vol. 131, p. 03012). EDP Sciences.

Bestian Simangunsong, "Spiritualitas Ramah Alam: Upaya Pelestarian Alam di Kawasan Danau Toba," *Jurnal Teologi Cultivation* 8, no. 2. Desember 2024.

Bestian Simangunsong, "Spiritualitas Ramah Alam: Upaya Pelestarian Alam di Kawasan Danau Toba," *Jurnal Teologi Cultivation* 8, no. 2. Desember 2024.

Chesner CA. The Toba caldera complex. Quaternary International. 2012 May 1;258:5-18.

Cheung LT, Fok L, Fang W. Understanding geopark visitors' preferences and willingness to pay for global geopark management and conservation. Journal of Ecotourism. 2014 Jan 2;13(1):35-51.

Ginting, D. (2020). Tantangan dan Peluang Pengelolaan Geopark Kaldera Toba sebagai UNESCO Global Geopark. *Jurnal Pengembangan Wilayah*, 6(3), 121–130.

Kementerian Pariwisata dan Ekonomi Kreatif (2022). *Geopark Sebagai Destinasi Edukasi dan Pariwisata Berkelanjutan*. www.kemenparekraf.go.id

Kusnadi, I. H. (2023). Environmental Policy Implementation in West Java (Studies in the Ciletuh Geopark Tourism Area). *Journal of Governance*.

Kusuma, D. W. (2019). Geopark Silokek Sijunjung Menuju UNESCO Global Geopark. *Jurnal Pembangunan Nagari*.

Novarlia I, Sukirman O. SOSIALISASI LITERASI GEOTOURISM MELALUI MEDIA SOSIAL BAGI PESERTA DIDIK SMPN 1 CIMALAKA KABUPATEN SUMEDANG. Jurnal Abdimas Bina Bangsa. 2024 Oct 10;5(2):1618-22.

Patzak M, Eder W. " UNESCO GEOPARK". A new programme-a new UNESCO label. Geologica Balcanica. 1998;28:33-6.

Prihantini P. Bimbingan Teknis Penyusunan Kurikulum Muatan Lokal Berbasis Geopark kepada Tim Pengembang Kurikulum Dinas Pendidikan Kabupaten Sukabumi. Jurnal Pengabdian kepada Masyarakat Nusantara. 2023 Sep 30;4(3):2990-8.

Riyanto DN, Alfirdaus LK. Tantangan Dan Hambatan Collaborative Governance Dalam Pengembangan Pariwisata Di Kabupaten Kebumen (Studi Kawasan Geopark Kebumen). Journal of Politic and Government Studies. 2024 Dec 27;14(1):374-91.

Septiana, A. R. et al. (2022). Geological Heritage, Biodiversity and Culture Linkage in Raja Ampat Geopark. *International Journal of Geotourism Science and Development*.

Simatupang K, Purba RR. Peran Masyarakat Lokal dalam Pengembangan Geosite Geopark Kaldera Toba Silahisabungan menuju Geopark Global UNESCO. Jurnal Ekonomi Dan Industri E-ISSN. 2019;2656:3169.

Siregar, F. M. (2021). Implementasi Edukasi Geopark di Sekolah Dasar di Kawasan Kaldera Toba. *Jurnal Pendidikan Lingkungan dan Pembangunan Berkelanjutan*, 3(1), 45–52.

Sulistyo, A. et al. (2021). Environmental Politics: Grassroots Innovations in Conserving Geopark Environment. *Politik Indonesia: Indonesian Political Science Review*.

Toba Caldera inscribed on List of UNESCO Global Geoparks," *Antara News* (English), 8 Juli 2020.

UNESCO Global Geoparks Network, *Top 10 Focus Areas – Education for Sustainability & Geological Hazards Risk Reduction*, n.d., diakses 15 Juli 2025.

Widyasari R, Santi TK, Wahyudiono A. Integration of Local Culture and Ijen Geopark in Early Childhood Education Student Learning in Banyuwangi. Santhet (Jurnal Sejarah Pendidikan Dan Humaniora). 2024 Nov 15;8(2):2193-203.