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Knowledge ecoliteracy of junior high school students towards Toba Caldera UNESCO Global Geopark

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ABSTRACT

This study aimed to determine the level of knowledge ecoliteracy of junior high school students towards Toba Caldera UNESCO Global Geopark (TCUGGp) was conducted. The research respondent was 78 people, including 28 students from Toba regency and 25 students each from North Tapanuli and Samosir regencies. The research instrument comprised 30 questions and was developed from five indicators, namely factual issues of environmental problems, the impacts, the factors causing environmental problems, efforts that can be made to minimize the impact of environmental degradation, flora-fauna biodiversity and the name of geosites. Data analysis used descriptive and inferential methods. The research results indicated that the knowledge ecoliteracy of junior high school students remains relatively low ($\bar{X}$ = 58.28). ANOVA test results showed a significant difference in students'knowledge ecoliteracy among the three regencies (F = 3.24; P = 0.04). Further findings revealed that junior high school students have limited understanding in the factors causing environmental problems, efforts to minimize the impacts of environmental degradation, and more specifically in the diversity of rare and endemic of flora and fauna, as well as in geosite names. This research finding recommends that IPA-biology learning in junior high schools especially at the topic biodiversity, interactions between living organisms and the environment, and environmental changes should be conducted by using more innovative learning models, as well as its media, learning resources, and assessments that refers to local social scientific issues so that ensuring the creation of meaningful learning.

Keywords: Junior high school, knowledge ecoliteracy, Toba Caldera UNESCO Global Geopark (TCUGGp)

INTRODUCTION

The Lake Toba region, now known as the Toba Caldera, is designated as a Global Geopark by UNESCO during its 209th session on July 7, 2020, under the name Toba Caldera UNESCO Global Geopark (TCUGGp) (Pardede et al., 2024). Prior to this, the Government of the Republic of Indonesia had also designated it as a National Geopark. The designation of the Toba Caldera as both a National and Global Geopark is closely related to its five unique characteristics, one of which is its biodiversity. The Toba Caldera region is home to unique and even endemic flora and fauna that cannot be found in any other ecosystem on Earth. Some notable examples include andaliaman or sichuan pepper (*Zanthoxylum acanthopodium*), kemenyan or incense (*Styrax* spp), sweet toba and samosir mangoes (*Mangifera indica*), karo oranges (*Citrus* spp), *Nepenthes*, Orchids, Pinus Toba (*Pinus* sp), ihan batak (*Neolissochillus thienemanni*), samosir white goat (*Capra aegragus hircus*), *Ceriodaphnia* (zooplankton), and many more (Bappelitbang Provinsi Sumatera Utara, 2024; Manurung et al., 2023).

As a Global Geopark and also a National Geopark, the Toba Caldera must be protected, preserved, and utilized for the well-being of the local community. Therefore, its sustainability must be maintained so that its existence can be enjoyed not only by the present generation but also by future generations (Sinaga, 2025).

In this regard, as a Geopark, UNESCO recommends that the three pillars of geoparks be implemented in the Toba Caldera area through a holistic approach encompassing conservation, education, research, and community empowerment. Furthermore, in the field of education, the UNESCO Executive Board recommends fostering interactive education within the Toba Caldera area, even in schools, by establishing a Toba Caldera Corner. The purpose of these efforts is to develop ecoliteracy (environmental awareness) among children in the Toba Caldera region from an early age. Ultimately, this will lead to the formation of a highly ecoliterate society, a community with strong environmental awareness. As a result, the Toba Caldera Geopark can be preserved for generations to come (Sinaga, 2025; UNESCO Global Geopark, 2023).

In relation to the designation of the Toba Caldera as a UNESCO Global Geopark, and in response to the recommendations provided by the UNESCO Executive Board, the Government of the Republic of Indonesia, specifically the Provincial Government of North Sumatra, has established the Toba Caldera UNESCO Global Geopark (TCUGGp) Management Agency through Governor of North Sumatra Decree No. 188.44/656/KPTS/2021. Within its organizational structure, the Toba Caldera Management Agency consists of four divisions, one of which is the Education, Research, and Development Division. Furthermore, through the "Goes to School" program, efforts to promote awareness of the Toba Caldera have been carried out across various educational levels, including junior high schools within the Toba Caldera region (Gubernur Sumatera Utara, 2021).

The Toba Caldera Geopark currently faces several environmental challenges and issues, which directly or indirectly indicate that the local community still has low ecological literacy. Simanjorang and Simanjorang (2022) and Simanjorang and Kennedy (2023) have reported several environmental problems affecting the Toba Caldera region, including forest fires, scattered solid waste, untreated household and hotel wastewater flowing directly into Lake Toba, the presence of floating net cages (KJA), rampant logging activities, excessive sand and gravel mining, floods, landslides, and the sap tapping of pine trees, which has led to their deterioration and death.

In order to minimize the environmental problems mentioned above, efforts that lead to increasing community ecoliteracy, including for students living in the Toba Caldera area, must be implemented, because only by having good ecoliteracy will the community become a society that behaves in a way that protects, maintains and utilizes the Toba Caldera area wisely and sustainably.

According to Wardaniah et al. (2019), the development of ecoliteracy or environmental awareness is supported by three key components: cognitive (knowledge), affective (attitudes and concerns), and psychomotor (actions or behaviors). The desire to protect, maintain, and preserve the environment is driven by knowledge, pro-environmental attitudes, and active participation in environmental conservation. These three aspects (knowledge, attitude, and behavior) interact with one another in shaping an ecoliterate individual. Therefore, good ecoliteracy or strong environmental awareness is the cumulative result of an individual's knowledge, behavior, participation, actions, and initiatives (Munawar et al., 2019). In line with this, Nadiroh & Siregar (2019) stated that knowledge and behavior play a crucial role in developing strong eco-literacy. Furthermore, Paryanti et al. (2021) emphasized that low ecoliteracy among students leads to poor

environmental awareness, on the contrary students with the high ecoliteracy can provide a good understanding in ecological actions towards environmental problem (Ha et al, 2023).

Investigation into student ecoliteracy has been done by some researchers. Wardani et al (2018) has done on one senior high school in Karanganyar regency (Middle Java) and its result showed that student ecoliteracy was inadequate category. Gustria and Fauzi (2019) have reported the low of attitude ecoliteracy of senior high school students in Sungai Penuh (Jambi). Furthermore, Fetiana et al (2022) has investigated the ecoliteracy of junior high school students in Bogor and its result showed the ecoliteracy of the students were also low.

As part of the community living in the Toba Caldera area and also considering the importance of the role of education in forming students who are ecoliterate which ultimately leads to behavior to maintain, protect or preserve the environment in the Toba Caldera Geopark area, as well as on the recommendation of the UNESCO executive board to present the Toba Caldera corner and also to develop interactive learning in each school, a study on students' ecoliteracy regarding the Toba Caldera UNESCO Global Geopark has been conducted in three junior high schools within the Toba Caldera Geopark area. Until now, investigation about ecoliteracy of junior high school students towards Toba Caldera ecosystem are still very limited. Rosdiana et al (2023) has done preliminary study at one junior high school that be found in Samosir regency and has reported its result that ecoliteracy of the students was very low. Meanwhile, Pardede et al (2024) has investigated the ecoliteracy of senior high student that be found in Toba regency and furthermore reported that students ecoliteracy were still in medium category.

The aim and objectives of this study are to obtain empirical data regarding students' knowledge ecoliteracy towards Toba Caldera UNESCO Global Geopark based on five indicators (Liang et al. 2018; McBride et al., 2013; Utami et al., 2023; Wardani et al. 2018). The results of this study will be used as a basis for designing learning resources, media, assessments, approaches, strategies, and learning models in biology science education at junior high schools to shape students and communities who are ecoliterate in the Toba Caldera Geopark (Amin et al, 2020; Arga & Rahayu, 2019; Aufa et al., 2021; Suryawati et al. 2020).

METHOD

Research design and participants

This ecoliteracy study was conducted in three public junior high schools across three regencies within the Toba Caldera Global Geopark (TCGGp). The selected schools were SMP Negeri 1 Porsea in Toba Regency, SMP Negeri 3 Muara in North Tapanuli Regency, and SMP Negeri 1 Harian in Samosir Regency. The schools were selected based on its closing into the geosite and Toba Lake. SMP Negeri 1 Harian is close to Pusuk Buhit geosite and Toba Lake, SMP N 3 Muara into Hutaginjang geosite and SMP N 1 Porsea towards Toba Lake and Taman Eden 100. The study took place from November 2024 to February 2025. This research is part of ex-post facto research method with retrospective design (Rukminingsih et al, 2020). The study sample consisted of one seventh-grade class (Grade VII) from each school. The sampling was determined using purposive sampling, where students were selected based on their prior learning experience with ecosystem topics, including biodiversity, interactions between living organisms and the environment, and environmental changes. The total sample comprised 78 students (37 girls and 41 boys), consisting of 28 students from SMP Negeri 1 Porsea and 25 students each from SMP Negeri 3 Muara and SMP Negeri 1 Harian.

Data collection, instruments and procedures

The knowledge ecoliteracy data of students was collected using a learning outcome test consisting of 30 questions, including 28

multiple-choice questions and 2 essay test questions. The test used has met validity requirements in terms of both content and construct validity (rxy = 0.38–0.56), reliability (r11 = 0.86), difficulty level (P = 0.22–0.82), and discriminatory power (DP = 0.34–0.51). For multiple-choice questions, a correct answer was given a score of 1, while an incorrect answer received a score of 0. For essay questions, a correct and complete answer was awarded 5 points. The total score obtained by each student was then converted to a scale of 0–100. To justify the level of ecoliteracy knowledge, the following scoring approach was applied: 0-59 (bad, low), 60-70 (enough, medium), 71-85 (good, high), 86-100 (very good, very high) (Riduwan, 2015).

The knowledge ecoliteracy test was based on modified indicators proposed by Utami et al. (2023), Wardani et al. (2018), Liang et al. (2018), McBride et al. (2013), NAAEE (2011), and McBeth & Volk (2010). These indicators cover factual issues related to environmental problems occurring in the Toba Caldera area, the impacts caused by these environmental problems, the factors contributing to the occurrence of environmental problems, efforts that can be made to minimize environmental issues, and rare and endemic flora (plants) and fauna (animals) found in the Toba Caldera, along with the names and locations of geosites near students' residences or schools. For the factual issues, environmental impacts, and efforts to minimize environmental problems, each consists of six questions, while factors contributing to environmental problems consist of seven questions, and flora, fauna, and geosites consist of five questions.

Data processing and analysis

Data analysis was conducted descriptively (mean, minimum and maximum values, standard deviation) and inferentially using an F-test (one-way ANOVA), followed by a post hoc test using the least significant difference (LSD) test (Zar, 2013). Prior to the F-test, prerequisite tests were performed, including a homogeneity test (Levene's test) and a normality test (skewness and kurtosis). The prerequisite test results indicated that the knowledge ecoliteracy data obtained were homogeneous (Levene's statistic value = 2.11; P = 0.12) and normally distributed (skewness statistic value = 0.004–1.84 and kurtosis statistic value = 0.34–1.11, meaning still < 2.00).

RESULTS AND DISCUSSION

Based on the data analysis conducted, the level of knowledge ecoliteracy among students in three junior high schools across three regencies within the Toba Caldera area falls into the low or inadequate category, with an average score of 58.28. Furthermore, it can be stated that the knowledge ecoliteracy score of students in Samosir Regency, represented by SMP Negeri 1 Harian, is higher ($\bar{X}$ = 60.42) compared to students in Toba Regency (SMP Negeri 1 Porsea, $\bar{X}$ = 57.39) and North Tapanuli Regency (SMP Negeri 3 Muara, $\bar{X}$ = 57.14) (Table 1). In this case, the lowest ecoliteracy knowledge is observed among students in North Tapanuli, followed by those in Toba Regency.

Table 1. Knowledge ecolitery of three junior high school students in Toba caldera area

	Descriptive data								Level
	N	Min	Max	Mean	Std. Dev	School name	N	Mean	
Ecoliteracy	78	50.0	75.0	58.28	5.25	SMP N 1 Porsea	28	57.39	low
						SMP N 3 Muara	25	57.14	low
						SMP N 1 Harian	25	60.42	medium

The results of the One-Way ANOVA statistical test showed that the knowledge ecoliteracy of Toba Caldera among students from the three schools in three regencies within the Toba Caldera area differs significantly (F = 3.24; P = 0.04) (Table 2).

Table 2. One-way Anova of knowledge ecoliteracy of three junior high schools in Toba Caldera area

	Sum of squares	df	Mean square	F	Sig.
Between Groups	169.374	2	84.687	3.241	.045
Within Groups	1960.009	75	26.133		
Total	2129.383	77			

Furthermore, the results of the post hoc LSD test indicated that the knowledge ecoliteracy of students at SMP Negeri 1 Harian (Samosir Regency) was significantly different from that of students at SMP Negeri 1 Porsea (Toba Regency) (Mean difference = 3.03; P = 0.03) and SMP Negeri 3 Muara (North Tapanuli Regency) (Mean difference = 3.28; P = 0.02). Meanwhile, the knowledge ecoliteracy between students of SMP Negeri 1 Porsea in Toba Regency was not significantly different from students at SMP Negeri 3 Muara in North Tapanuli Regency (Mean difference = 0.25; P = 0.85) (Figure 1).

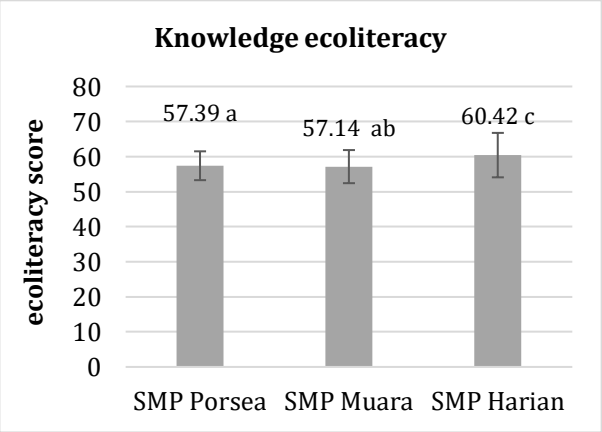

Figure 1. The differences in junior high school students' ecoliteracy knowledge of the Toba Caldera Geopark across three regencies.

The higher level of knowledge ecoliteracy of students at SMP Negeri 1 Harian regarding the Toba Caldera UNESCO Global Geopark may be closely related to the "Goes to School" program conducted by the Toba Caldera Geopark Management Agency, which has carried out several socialization activities at SMP Negeri 1 Harian. In this case, the Coordinator of the Education and Research Development Division of the Toba Caldera UNESCO Global Geopark Management Agency, Dr. Wilmar Simanjorang, Dipl.E., M.Si, along with his team, has visited SMP Negeri 1 Harian several times, whereas the other two schools have not yet been visited. The content of the "Goes to School" program consisted of the occurring of Toba Caldera (erruption history and updoming samosir island), the meaning of geopark, biodiversity, geosites name in Toba Caldera and conservation program of Toba Caldera Ecosystem. These results indicated that the socialization of the Toba Caldera that has been carried out so far through the "Goes to School" program has contributed to increasing students' ecoliteracy knowledge, although its result still is not optimal. This means that improvements into the "Goes to School" program are still necessary in order to reach the high level in knowledge ecoliteray. The improvement could be done in approach and strategy, media or learning resources and socialization time. In this regard, Charleton-Hug & Hug (2010) have stated and confirmed that good ecoliteracy knowledge formed through formal education contributes for shaping a character that loves and cares for the environment. Similarly, Syah et al. (2021) and Kavaz et al. (2021) pointed out that a high level of knowledge ecoliteracy among students can improve their attitudes and behaviors toward environmental management and protection. Nadiroh and Siregar (2019), as well as Koçoğlu et al. (2023), emphasized that ecoliteracy knowledge plays an important role in shaping students' environmental awareness. Meanwhile, Sasea et al. (2023) and Febriasari and Supriatna (2017) argued that students with good environmental knowledge will develop a sense of responsibility for environmental sustainability. Liu et al. (2020), Wahyuni et al. (2022), and Wardani et al. (2018) further stressed that ecoliteracy knowledge interacts with attitudes and behavior in shaping a character that cares for the environment.

The findings of low or inadequate ecoliteracy among students have previously been reported by Paryanti et al. (2021) in junior high schools located in Bogor City. Wardani et al. (2018) also reported low ecoliteracy among senior high school students in grades X, XI, and XII in Karanganyar Regency, Central Java Province. Similarly, low ecoliteracy levels among university students in Taiwan were documented by Liang et al. (2018). Meanwhile, studies indicating a moderate or medium level of ecoliteracy have also been reported. Muliana et al. (2018) found that pre-service teacher students at Syiah Kuala University in Banda Aceh had ecoliteracy levels categorized as enough. Additionally, Fetiana et al. (2022) reported a medium level of knowledge ecoliteracy among junior high school students in Bogor. For senior high school students, Pardede et al. (2024) documented medium knowledge ecoliteracy among students of public senior high schools in Toba Regency, North Sumatra Province, regarding Lake Toba. Regarding findings of low or medium ecoliteracy levels, Spinola (2020) stated that this phenomenon is influenced by several factors, including situational factors, personality, desire to act, student background, gender, and adopted norms.

This research result that showed that ecoliteracy of junior high school students in Toba Caldera area are still in low or medium category implicates that the improvement and innovation in Biology science instruction must be done as in its approach or strategies, media, learning resources, curriculum content (toba caldera ecosystem as learning resources) and in its evaluation or assesment. Some trainings, especially into the Biology science teachers regarding biodiversity and conservation of rare/endemic flora and fauna that be found in Toba Caldera area must also be done.

The results of quantitative descriptive data analysis on the five indicators that shape knowledge ecoliteracy (namely environmental fact issues, environmental impact on living organisms, causes of environmental problems, efforts to minimize environmental problems, and flora-fauna and geosite names) among students from the three schools that participated as respondents in this study can be described as follows:

1. Factual issues of environmental problem

The level of students' knowledge regarding factual issues of environmental problems occurring in the Toba Caldera Area is still categorized as medium, with scores ranging from 60 to 68 (Figure 2). The understanding of students at SMP Harian-Samosir ($\bar{X}$ = 68.00) regarding these factual issues is better compared to their peers at SMP Porsea-Toba ($\bar{X}$ = 60.7) and SMP Muara-Tapanuli Utara ($\bar{X}$ = 62.4). Referring to Simanjorang et al. (2022 & 2023), several factual environmental issues affecting the Toba Caldera include frequent forest fires, floods, and landslides, as well as scattered solid waste and household and hotel liquid waste directly entering Lake Toba. Additionally, the presence of floating net cages (KJA), rampant illegal logging, extensive excavation activities, and improper of pine sap tap, which leads to tree mortality, are also major environmental concerns in the area.

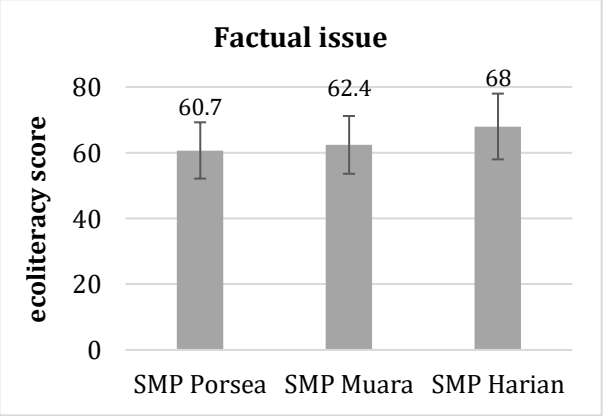

Figure 2. The comparison of student scores in three junior high schools in the Toba Caldera area on the indicator of factual issues of environmental problems

Analysis of the six indicators of questions related to factual issues shows that, in general, students in the three junior high schools are still unable to provide correct answers to questions regarding soil and water pollution issues in relation to the various types of solid waste found

on land and in the waters of the Toba Caldera area. These include plastic waste in the form of bottled mineral water packaging, instant noodle wrappers, snack packaging, and styrofoam. Students at Muara Junior High School still lack in understanding of the existence of Floating Net Cages (KJA) in Lake Toba, which are not yet well-organized or properly zoned. This issue is one of the current local scientific factual issues in the Toba Caldera area, particularly in Lake Toba, as a source of water pollution (Lukman et al., 2021; Simanjorang & Kennedy, 2023).

2. Impact of environmental problems on living things and the environment

Regarding the indicator of the impact of environmental problems on living organisms and the environment in the Toba Caldera area, the scores obtained by students in the three public junior high schools in the Toba Caldera region are still relatively low (56.6–60.57). It appears that, for this indicator, students from all three schools have relatively similar levels of understanding regarding the impact of environmental issues on both living and non-living things. An analysis of the six indicators related to the impact of environmental issues on living organisms and the environment shows that students are still unable to answer questions about the impact of increased carbon dioxide levels from motor vehicles passing through the Toba Caldera area on the rise in Earth's surface temperature (global warming), including in the Toba Caldera region. Many students at Muara Junior High School and Harian Junior High School are still unable to correctly answer questions about the impact of improper or rule-violating tapping of pine tree resin by local farmers on the survival of pine trees and their surrounding environment. In this regard, Pandiangan et al. (2019) stated that improper of pine sap tap that do not follow the applicable regulations threaten the sustainability of pine trees and pine forests. Specifically, for pine trees located in the hilly areas of Lake Toba, particularly in the Simalungun region, as many as 75.29% of the pine trees have been tapped improperly, not adhering to the established regulations.

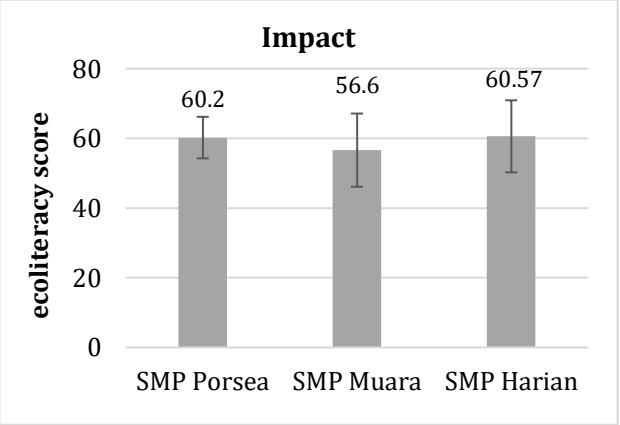

Figure 3. The comparison of students' scores at three junior high schools in the Toba Caldera Area on the indicator "impact of environmental problems on living things and the environment."

3. Causes factor of environmental problem

For the indicator of the factors causing environmental problems in the Toba Caldera area, students' learning outcomes are still classified as low, with an average score ranging from 53.33 to 59.33 (Figure 4). Analysis of the seven indicator questions related to the causes of environmental problems shows that students are still unable to identify the main factors behind the recurring forest fires in the hilly areas of the Toba Caldera. Likewise, they struggle to determine the causes of the disappearance or extinction of flora and fauna in the Toba Caldera region. Most students at SMP Muara-Tapanuli Utara and SMP Harian-Samosir could not answer questions regarding the factors causing landslides and flash floods, which have repeatedly occurred in the Toba Caldera area, even near their residences. For instance, landslides and flash floods struck the Harian Boho-Samosir areas in 2023, as well as Simangulampe village in Humbang Hasundutan regency at the end of the same year. The causes of flooding can be attributed to both natural factors and human activities. Natural factors include rainfall, soil type, land-use changes, slope gradients, erosion, sedimentation, reduced water

absorption areas, earthquakes, waste accumulation, and settlements along riverbanks. Human-induced factors include deforestation, improper waste disposal, and illegal sand and gravel mining (Naryanto et al., 2019; Nugroho & Handayani, 2021).

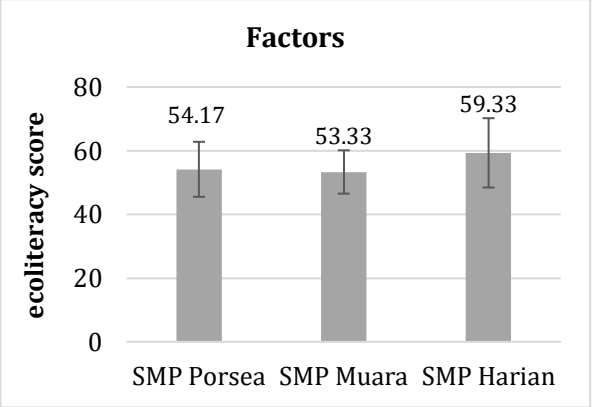

Figure 4. The comparison of students' scores at three junior high schools in the Toba Caldera area on the indicator causes factors of environmental problems.

4. Efforts to minimize environmental problem

In terms of knowledge ecoliteracy, particularly the indicator related to efforts to minimize environmental problems, the average scores obtained by students in the three junior high schools remain in a low category, ranging from 58.40 to 60.8 (Figure 5). The student's understanding of this indicator across the three schools is relatively similar. In this aspect, students from all three schools participating in the study struggled to answer questions regarding the necessary efforts to mitigate environmental problems affecting the Toba Caldera area, including those related to education. Individuals with strong environmental awareness or concern for the environment can be shaped through education. Therefore, educational efforts significantly contribute to shaping individuals, including students and university students, who possess a high level of environmental consciousness. The role of education in fostering environmentally conscious individuals or those with good ecoliteracy has been emphasized by several researchers, including Amin et al. (2020), Arga & Rahayu (2019), Aufa et al. (2021), Pratama et al. (2020), and Suryawati et al. (2020). Most students at SMP Harian-Samosir provided incorrect answers regarding the actions or activities a student could take to minimize the impacts of environmental degradation.

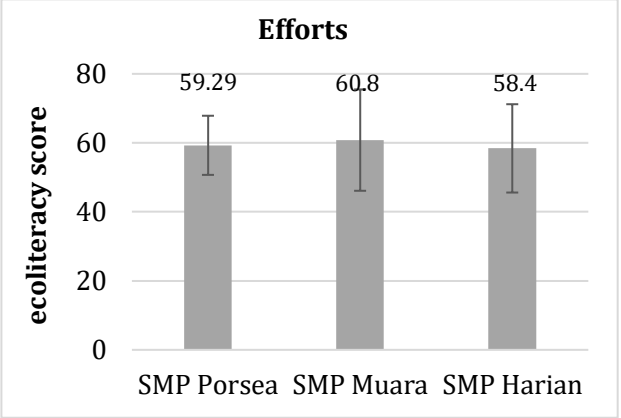

Figure 5. The comparison of student scores at three junior high schools in the Toba Caldera area on the indicator of efforts to minimize environmental problems.

5. Flora-Fauna biodiversity and Geosite of Toba Caldera

The scores of students from the three junior high schools in the Toba Caldera Area on the indicator of flora and fauna biodiversity, particularly regarding rare and endemic species in the Toba Caldera Area, remain very low, with an average score ranging from 52.14 to 56.00 (Figure 6). Almost all students struggled to identify rare and endemic plant and animal species found in the Toba Caldera. The same applies to their knowledge of geosites or geological sites that have been designated by UNESCO as part of the Toba UNESCO Global Geopark, which must be preserved and maintained. In reality, these geosites are located not far from their schools, and on their way to and from school, they actually pass by these geosite locations. This indicates that they are still unfamiliar with the names and locations of geosites within their region, even those close to their schools.

The student's lack of knowledge or understanding of the flora and fauna inhabiting the Toba Caldera area, particularly rare and endemic species, may be due to the suboptimal implementation of innovative teaching approaches by biology science teachers. Methods such as discovery learning, inquiry-based learning, group investigation, exploration of the surrounding environment (JAS), problem-based learning (PBL), project-based learning (PJBL), and contextual learning are not optimally utilized in biology science lessons. The learning resources used by students when studying ecosystems, particularly on the topic of biodiversity, may also be a contributing factor. Biology science teachers might not enrich the standard textbooks with content of local flora and fauna, especially rare, unique, and endemic species. For instance, rare plant species that grow in the Toba Caldera, as identified by Manurung et al. (2023), include nephentes, kingswood, damar, edelweiss, orchids, harp and red palm. These species are seemingly not introduced effectively in the classroom, making students unfamiliar with them. Similarly, rare and endemic animal species such as ihan batak (*Neolissochillus thienemanni*), samosir white goat (*Capra aegragus hircus*), tekukur bird (*Spilopelia* sp.), tullik bird (*Mixornis* sp.), ambaroba bird (*Pycnonotus* sp.), enggang bird (*Buceros* spp.), and even zooplankton *Ceriodaphnia* are not widely known among students. This situation highlights the urgent need for supplementary biology textbooks that incorporate local biodiversity content, especially focusing on local flora and fauna. Furthermore, the UNESCO Global Geopark assessors' revalidation report on the Toba Caldera in 2023 also recommended conducting a comprehensive inventory and documentation of the region's flora and fauna (UNESCO Global Geopark, 2023).

Furthermore, the student's lack of understanding of the names and locations of geosites within the Toba Caldera, especially those near their schools or residences, indicates that the socialization of the 16 geosites designated as part of the Toba Caldera UNESCO Global Geopark by the Toba Caldera UNESCO Global Geopark Management Board has not significantly impacted students' awareness. This may be due to the lack of informational panels at these geosite locations, making them less visible and accessible to students. The limited visibility of geosites within the Toba Caldera was one of the key recommendations made by UNESCO assessors to the Toba Caldera Management Board during the revalidation process in July–August 2023. A similar recommendation was also issued earlier, in 2020, when the Toba Caldera was first accepted as part of the UNESCO Global Geopark with a green card status. At that time, it was advised that interactive learning about the Toba Caldera be implemented in schools across the region. This includes establishing Toba Caldera Corners in schools to ensure that knowledge about Toba Caldera is effectively integrated into education and widely disseminated at the school level (UNESCO Global Geopark, 2023).

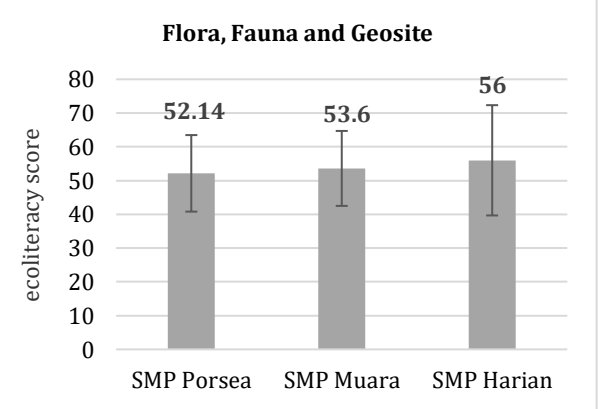

Figure 6. The comparison of student scores at three junior high schools in the Toba Caldera area on the indicator of flora-fauna biodiversity and geosites of the Toba Caldera.

CONCLUSION

The ecological literacy of junior high school students in the three regencies of Toba, North Tapanuli, and Samosir regarding the Toba Caldera UNESCO Global Geopark (TCUGGp) remains low. This applies to indicators such as factual issues of environmental problems, impacts, causative factors, efforts to minimize

problems and environmental damage, biodiversity of flora and fauna living in the Toba Caldera, as well as the names and locations of geosites in their surroundings where the students live and study. For this reason, Biology science learning in junior high schools within the Toba Caldera UNESCO Global Geopark area must be innovated through approaches, strategies, media, learning resources, and assessments based on social scientific issues and local realities occurring in the Toba Caldera, ensuring more meaningful learning. In addition, the presence of the Toba Caldera UNESCO Global Geopark must be further instilled among students, including through the establishment of Toba Caldera corners in every school. Thus, the expectation of producing junior high school graduates who are environmentally conscious towards the Toba Caldera, adopt a sustainable lifestyle, and embody the Pancasila profile can be realized.

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