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School Proximity to the Pongkor Mining Area and Students' Sustainability Awareness

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Abstract: This study aimed to examine junior high school students' sustainability awareness in the West Bogor mining area based on schools' geographical proximity to the Pongkor Gold Mining Area. A quantitative descriptive comparative design was employed involving 90 students from three junior high schools located 9 km, 13 km, and 16 km from the mining site. Data were collected using a validated and reliable Sustainability Awareness Questionnaire covering environmental, social, and economic dimensions and were supported by semi-structured interviews. The results showed that students from the nearest school (9 km) achieved the highest sustainability awareness score (72.6%, high category), while students from schools located 13 km and 16 km away obtained moderate scores (61.5% and 63.6%, respectively). Environmental and social dimensions consistently scored higher than the economic dimension across all schools. The findings indicate that sustainability awareness is influenced not only by geographical proximity but also by learning experiences, family and community involvement, and the implementation of Education for Sustainable Development (ESD). In conclusion, geographical proximity provides meaningful contextual experiences that support students' sustainability awareness, while integrating local mining issues into ESD-based science learning can strengthen environmental, social, and economic awareness.

Keywords: Education for Sustainable Development; Geographical proximity; Mining area; Sustainability awareness

Introduction

Sustainable development is a global agenda that continues to be strengthened through the Sustainable Development Goals (SDGs) as an effort to address various 21st-century challenges, from environmental, social, and economic perspectives (UNESCO, 2014). One important factor in achieving sustainable development is sustainability awareness, because through sustainability awareness individuals can understand the importance of maintaining a balance between present and future needs, and are encouraged to make responsible decisions and take responsible action toward the environment, society, and the economy (Olsson et al., 2016)

Sustainability awareness among the younger generation can be cultivated through education (Wahyuni et al., 2026). Education does not only function as a means of transferring knowledge, but also as a vehicle for shaping the values, attitudes, and behaviors that support environmental sustainability and community life (Amaliyah et al., 2021; Khoerunisa, 2024). Through education, students are expected not only to understand the concept of sustainability theoretically, but also to develop genuine concern and real action in addressing various sustainability issues occurring in their surrounding environment (Susiloningsih et al., 2023;

Wahyu et al., 2020). Therefore, schools play an important role in shaping students into agents of change capable of supporting sustainable development (Ghafur & Alviansyah, 2025; Mujidiatama & Husamah, 2024 ; Nhamo & Chapungu, 2024).

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One factor presumed to influence the development of students' sustainability awareness is the environment. The environment provides direct experiences that allow students to observe various phenomena firsthand (Hastika et al., 2024 ; Raehanah et al., 2025). From the perspective of place-based education, experiences gained through interaction with the surrounding environment can shape individuals' perceptions, values, and awareness of sustainability issues (Nugroho & Fajeriadi 2026; Rescia et al. 2023). Thus, students who live in an environment with particular environmental problems potentially have a different level of sustainability awareness compared with students in environments with different characteristics. Mining areas represent an environment of high complexity in the context of sustainable development. On one hand, mining activity contributes to economic growth through increased investment, regional revenue, and job creation for the community (Sidayat et al., 2026). However, mining activities also have the potential to generate various environmental and social impacts, including land degradation, biodiversity loss, declining soil fertility, environmental pollution, adverse health effects, inequality, and social conflicts in communities surrounding mining areas (Budi et al. 2020 ; Chen et al., 2022 ; dos Reis et al. 2026) This condition makes mining areas a relevant context for examining how students build understanding and awareness of sustainability issues through the experiences they encounter in their daily lives. Several previous studies have examined environmental awareness among students in various contexts.

Research by Anjuani et al. (2025); Boca & Saraçli (2019), showed that environmental education contributes to increasing students' awareness and interest. Other studies have also found that direct engagement with local environmental issues can improve students' understanding of and concern for poverty-related problems (Arifin & Rahman, 2026; Hopwood & Dunlop, 2025; Larasati & Wardani, 2025). Furthermore, the community proximity to mining activity enables the formation of direct experience with various social and environmental impacts, thereby potentially increasing awareness of social and environmental issues.

Although numerous studies have explored students' sustainability awareness in various educational contexts, limited attention has been given to examining the influence of school proximity to mining areas on junior high school students' sustainability awareness, particularly in Indonesia. Moreover, the integration of mining areas as contextual learning resources to support Education for Sustainable Development (ESD) in science education has received insufficient scholarly attention. Therefore, this study investigates the sustainability awareness of students from schools located at varying distances from the Pongkor Mining Area and examines the potential integration of mining contexts in supporting ESD-oriented science learning.

West Bogor is one of the regions with fairly intensive mining activity located close to residential areas and schools. This condition provides an opportunity to examine the relationship between students' geographical proximity to mining areas and their level of sustainability awareness. In this study, students' sustainability awareness was analyzed at three junior high schools located at different distances from the mining area, so that students' level of exposure to mining activity was presumed to vary according to the schools' geographical proximity to the mine site.

This study aims to examine the sustainability awareness profile of junior high school students in the West Bogor mining area based on differences in schools' geographical proximity to the mining site and to analyze the implications of these findings for the development of ESD-oriented science learning by utilizing local mining contexts as learning resources.

Method

This study employed a quantitative approach with a comparative descriptive design to examine junior high school students' sustainability awareness based on schools' geographical proximity to the Pongkor Gold Mining Area in West Bogor. Semi-structured interviews were also conducted to complement the quantitative findings and provide deeper insights into factors influencing students' sustainability awareness.

The population consisted of junior high school students located around the Pongkor Gold Mining Area. Using purposive sampling, three schools were selected based on the following criteria: (1) located within the same sub-district as the mining area, (2) representing different geographical proximities to the mining site, and (3) situated along routes affected by mining activities. A total of 90 students participated in this study, with 30 students selected from each school located approximately 9 km, 13 km, and 16 km from the mining site. The overall research procedure is presented in Figure 1.

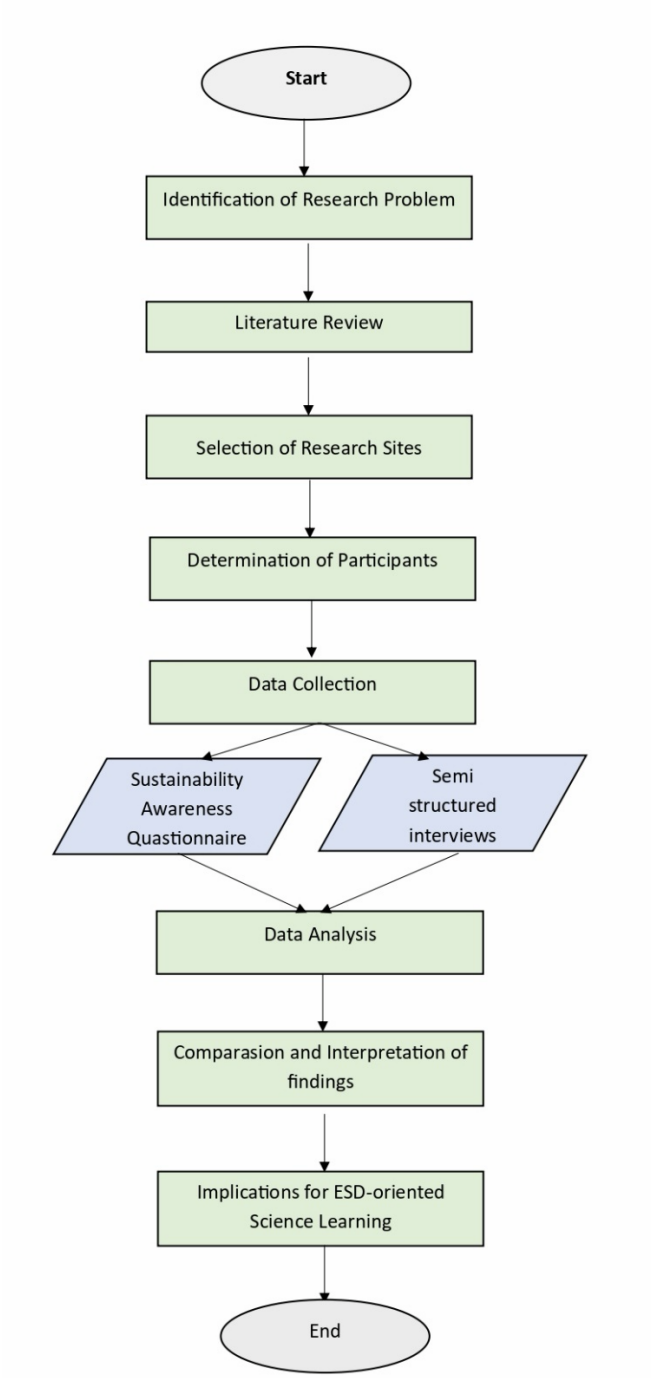


Figure 1. Flowchart of Research Method

Data were collected using a Sustainability Awareness Questionnaire developed based on three indicators: Sustainability Practice Awareness (SPA), Behavioral and Attitude Awareness (BAA), and Emotional Awareness (EA), covering the environmental, social, and economic dimensions of sustainability, as presented in Table 1. The questionnaire consisted of 36 items that were subjected to validity and reliability testing before being administered to the participants.

The questionnaire was validated using the Pearson Product-Moment correlation test involving 30 students. Of the 36 items, 23 met the validity criteria (Taherdoost, 2018). The reliability of the valid items was subsequently examined using Cronbach's Alpha, resulting in a coefficient of 0.872, indicating high internal consistency. Therefore, the questionnaire was considered suitable for data collection. Semi-structured interviews were conducted with selected students to explore factors influencing sustainability awareness, including learning experiences, family support, community involvement, and students' interactions with the surrounding mining environment.

The quantitative data were analyzed using descriptive statistics by calculating percentage scores and mean values for each sustainability awareness indicator. The categorization of sustainability awareness levels was carried out based on the ideal mean (Mi) and the ideal standard deviation (SDi), referring to (Azwar, 2021). The research instrument consisted of 23 statement items using a four-point Likert scale (scores 1–4), resulting in an ideal minimum score of 23 and an ideal maximum score of 92. The ideal mean (Mi) and ideal standard deviation (SDi) were calculated as follows:

$$\text{Mi} = \frac{Smax - Smin}{2} \quad (1)$$

$$\text{SDi} = \frac{max - Smin}{6} \quad (2)$$

Based on the score range of the instrument, the ideal mean (Mi) was 57.5, while the ideal standard deviation (SDi) was 11.5. The sustainability awareness levels were then classified into five categories based on the Mi and SDi criteria proposed by Azwar (2021), namely Very High, High, Moderate, Low, and Very Low, as presented in Table 1.

Table 1. Sustainability Awareness Score Categories

Category	Score Interval
Very High	75–92
High	64–74
Moderate	52–63
Low	41–51
Very Low	23–40

These categories served as the basis for interpreting the level of sustainability awareness obtained by the respondents.

Result and Discussion

The findings show a difference in the level of sustainability awareness among the three schools with different geographical distances, examined based on the environmental, social, and economic dimensions across three main indicators: sustainability practice awareness, behavioral and attitude awareness, and emotional

awareness. The distribution of students' sustainability awareness categories at the three schools is presented in Table 2.

Table 2. Distribution of Students' Sustainability Awareness Scores

School Category	Distance to Mining Area	Percentage	Qualification
School 1	9 km	72.6%	High
School 2	13 km	61.5%	Moderate
School 3	16 km	63.6%	Moderate

The table 2 shows that the sustainability awareness score at School 1 is higher than at Schools 2 and 3. Nevertheless, variation exists in the detailed scores for each sustainability awareness indicator at each school, as shown in Figure 2, with the indicators sustainability practice awareness (SPA), behavioral and attitude awareness (BAA), and emotional awareness (EA) presented in the Figure 2.

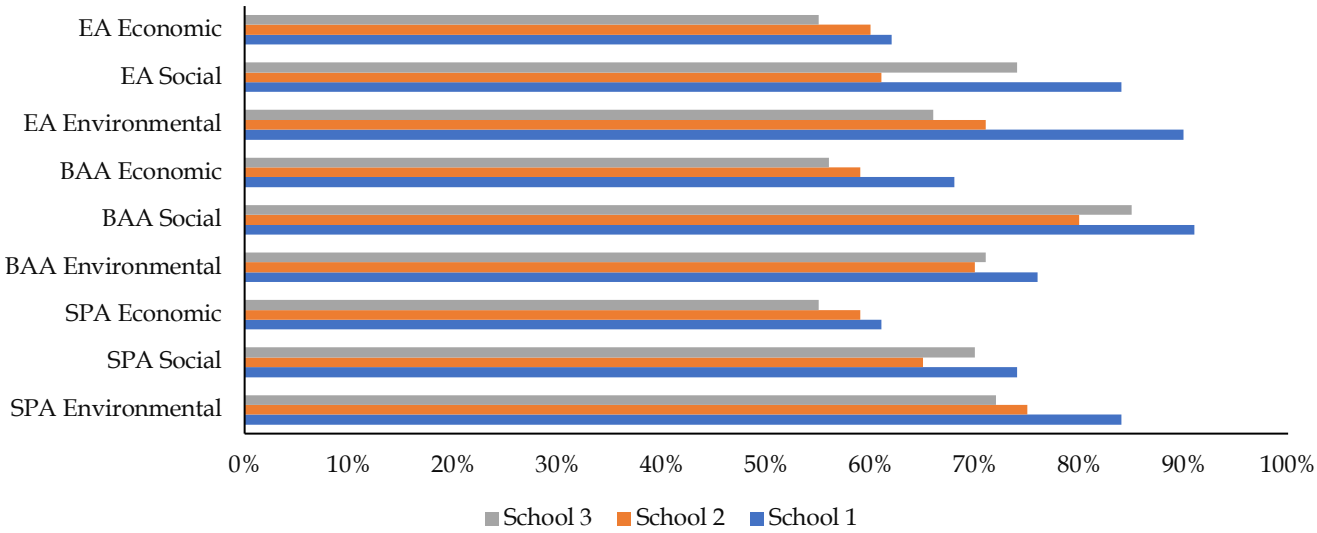


Figure 2. Chart of Scores for the Indicators and Dimensions of Sustainability Awarenes

The Figure 2 shows variation in scores across schools in terms of the dimensions and indicators of sustainability awareness. On the Sustainability Practice Awareness indicator, School 1 obtained the highest scores on the environmental and social dimensions compared with Schools 2 and 3. This result indicates that students have a better understanding and practice of sustainability related to environmental and social issues in the mining area.

Olufemi et al. (2016) showed in their study that awareness of environmental pollution among students in mining areas is strongly influenced by proximity, so that geographical closeness to mining activity enables students to gain contextual experience and deeper awareness of environmental and social practices. In Education for Sustainable Development (ESD), direct experience with and exposure to real issues occurring in the surrounding environment is one important factor in building students' understanding, values, and sustainability-oriented action, enabling them to connect the concept of sustainability with everyday life. (Brundiers et al., 2010; Douglas et al., 2024; Saragih et al., 2025).

Further data collection showed that at School 1, besides being located close to the mining site, most students have family members or relatives directly engaged in mining activity. In addition, School 1 also integrates mining issues into its learning activities, one of which is the social studies (IPS) subject. These factors indicate that, besides geographical proximity, the involvement of people in the surrounding community and education enable students to gain broader knowledge, experience, and information regarding the impacts of mining activity.

This is consistent with the research of Boca & Saraçli (2019) showing that knowledge, attitudes, and behavior related to sustainability are influenced by the interaction between the family environment, the community, and educational institutions. The social education plays a role in increasing awareness of pollution in mining

communities, so that social education has an important role in improving understanding of environmental impacts. Thus, geographical proximity to mining activity, involvement in the social environment, and the integration of mining issues into learning enable students to gain broader knowledge, experience, and information regarding the social, economic, and environmental impacts of mining activity, contributing to the high sustainability practice awareness of students, particularly on the environmental and social (Lutfi et al., 2025).

Furthermore, the Behavioral and Attitude Awareness (BAA) indicator shows that the social dimension obtained the highest score across all three schools. In contrast, the economic dimension was identified as the aspect with the lowest score at all schools. These findings indicate that students have developed positive attitudes toward sustainability, particularly in social aspects such as cooperation, concern for the community, and social responsibility related to mining issues. These values are likely influenced by school culture and rural community life, which continues to uphold mutual cooperation (gotong royong) and social solidarity.

Compared with Sustainability Practice Awareness, the higher score for Behavioral and Attitude Awareness indicates that students already hold attitudes supportive of sustainability, but these attitudes have not yet been fully translated into actual practice. This finding is consistent with Khoiri et al,. (2023) research on vocational high school students in Semarang Regency, which also found a low gap between attitudes and sustainability practices, indicating that awareness of attitudes is not always followed by concrete actions. This is known as the attitude–behavior gap, in which individuals hold positive attitudes toward sustainability issues but have not consistently applied them in daily life. In addition, the high score on the social dimension at all three schools indicates that the presence of a mining area does not always have a negative impact on community social relations. On the contrary, it can actually strengthen students' awareness of the importance of cooperation in maintaining environmental and community sustainability.

On the Emotional Awareness indicator, School 1 obtained the highest scores on the environmental and social dimensions, while obtaining a moderate score on the economic dimension. School 2 obtained moderate scores across all dimensions, while School 3 obtained a high score on the social dimension but moderate scores on the environmental and economic dimensions.

Further data collection showed that students at all three schools feel disturbed by the mining activity that passes by every day. Heavy vehicles, dust, and noise are a significant source of discomfort. At School 1, some students reported feeling disturbed by environmental changes caused by mining activity, such as polluted rivers and increasingly hot air conditions. They also expressed concern about the sustainability of their village, fearing that resources would run out and harm their future. This is consistent with the study of Ekamilasari & Pursitasari (2021), in which students who witness mining activity on a daily basis have a greater likelihood of feeling concern, worry, and responsibility toward the environmental conditions around them.

From the perspective of environmental psychology, direct experience of changing environmental conditions can heighten risk perception and psychological proximity, whereby the closer an individual is to a phenomenon, the higher their perception of the risks they may face. As a result, individuals tend to be more aware of potential impacts and become more sensitive to sustainability issues (Ubaidillah et al., 2025). The high level of emotional awareness at School 1 can be understood as the result of students' perceived interaction with the mining environment.

As shown in Table 2, the level of sustainability awareness among students at the three schools falls into a good category. School 1 obtained a high qualification, while Schools 2 and 3 fell into the moderate qualification. Nevertheless, School 3 showed a sustainability awareness score slightly higher than School 2. Variation in achievement was also evident across each dimension and indicator. Consistently, the economic dimension obtained lower scores than the environmental and social dimensions at all schools. Further data collection showed that most students regard economic activity as the responsibility of parents, the government, companies, or industry actors rather than their own responsibility. This condition indicates that students' understanding of the relationship between everyday economic behavior and sustainable development remains suboptimal compared with environmental and social issues, which are more easily observed in daily life, making the economic dimension the sustainability aspect most difficult for students to understand. In addition, learning at school often focuses students on environmental and social aspects rather than economic aspects, so that students' knowledge of the economic dimension of sustainable awareness remains limited.

In contrast, an interesting difference was found in the social dimension. Although located farther from the mining area, School 3 consistently obtained higher scores on every indicator than School 2. Further data collection showed that School 3 integrates mining issues into IPS (social studies) learning, similar to School 1. In addition, the school actively carries out various programs that support the reinforcement of sustainability values, such as the Adiwiyata program through communal environmental clean-up activities, social service, and project-based learning, which give

students the opportunity to actively identify, analyze, and solve real problems in their surrounding environment (Selasmawati & Lidyasari, 2023). These learning experiences can also foster social concern, empathy, and behavior that supports sustainability, contributing to the high achievement on the social dimension at School 3. This finding is consistent with the Education for Sustainable Development (ESD) framework, which emphasizes the importance of a whole-school approach, namely the integration of sustainability values through the curriculum, school culture, co-curricular activities, and the active participation of all members of the school community (Fathurohman et al., 2023; Zulkarnaen et al., 2023).

The gap in achievement across the sustainability awareness dimensions at each school indicates that students' understanding of the various aspects of sustainable development still requires strengthening. Therefore, integrated learning efforts are needed to develop the environmental, social, and economic dimensions through the implementation of Education for Sustainable Development (ESD) (Setiawan et al., 2023).

Overall, the findings of this study show that students' level of sustainability awareness regarding mining issues is influenced not only by geographical proximity to the mining area, but is also shaped by the interaction of various factors, such as learning experiences at school, the family and community environment, exposure to real conditions in the surroundings, and the habituation of sustainability values through school culture. These findings also carry important implications for the development of science (IPA) education. Based on observations, mining issues at the three schools have so far been integrated mainly into IPS (social studies) learning, while their use in IPA (science) learning remains relatively limited. This condition indicates a substantial opportunity to develop mining-context-based science learning as a means of integrating scientific concepts with sustainable development issues.

As demonstrated by Wahyuni et al. (2026) authentic environment-based science learning effectively enhances students' sustainability awareness while fostering higher-order thinking skills. Through this approach, students not only gain a conceptual understanding of science concepts but are also able to holistically analyze the interconnections between mining activities and their environmental, social, and economic aspects, thereby enhancing their sustainability awareness

Conclusion

This study concludes that junior high school students' sustainability awareness in the West Bogor mining area differs based on schools' geographical proximity to the Pongkor Gold Mining Area. Students from the school closest to the mining site (9 km) demonstrated a high level of sustainability awareness (72.6%), whereas students from schools located 13 km and 16 km away showed moderate levels of awareness (61.5% and 63.6%, respectively). Across all schools, the environmental and social dimensions consistently achieved higher scores than the economic dimension. These findings highlight the importance of integrating local mining contexts into ESD-oriented science learning to strengthen students' understanding of sustainability issues, particularly across environmental, social, and economic aspects.

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Authors Contribution
All authors were directly involved in every stage of this research.

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Conflict of Interest
Authors declare no conflict of interest.

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