
Exploring Next Generations for a Sustainable Future: A Systematic Literature Review on Sustainability Awareness among High School Students in Indonesia

Lintang Auliya Kurdiati, Apit Fathurohman*

Physics Education Study Program, Universitas Sriwijaya, South Sumatera, Indonesia.

*Corresponding author's email: apit_fathurohman@fkip.unsri.ac.id

Article History:

Received date: May 31 2024

Received in revised from: June 14 2024

Accepted date: June 20 2024

Available online: June 30 2024

Citation:

Kurdiati, L.A. & Fathurohman, A. 2024.
Exploring next generations for a sustainable future: a systematic literature review on sustainability awareness among high school students in Indonesia. *JIPI (Jurnal IPA dan Pembelajaran IPA)*, 8(2):168-182.

Abstract. Environmental damage is increasingly evident, from rising global average temperatures and melting polar ice caps to the increasing frequency of extreme weather. This study aims to conduct a literature review related to sustainability awareness among students at the high school level in Indonesia. The research method chosen in this study is a systematic literature review. Data collection is done by documenting all articles that have similar research in this research report. The articles used in this study were 11 articles published in the 2020–2024 period and then used as a reference for review. Based on this literature review research, several important findings were found, namely: (1) sustainability awareness can be identified in various aspects, such as instruments with the distribution of seven articles, gender differences with one article, and the existence of a sustainability awareness category covered in three articles from the total articles reviewed; (2) there are fluctuating trends in sustainability awareness research among high school students in Indonesia; and (3) the distribution of research on sustainability awareness has not been evenly distributed in all provinces in Indonesia, and so far it is still dominated by research conducted in West Java Province. These findings point to the need for equitable distribution of research in different regions to get a more comprehensive picture of the level of sustainability awareness across Indonesia.

Keywords: Sustainability Awareness, High School Students, Systematic Literature Review

Introduction

Climate change and environmental degradation are two major issues that threaten the sustainability of life on earth (Malihah, 2022, Mardani, 2023, Utomo et al., 2023, Afifah et al., 2024). In recent decades, signs of environmental damage have become increasingly apparent, ranging from rising global average temperatures and melting polar ice caps to the increasing frequency of extreme weather (Aisyah et al., 2022, Astriana et al., 2023, Bunyamin et al., 2023, Fitriani et al., 2023). The IPCC report outlines some evidence of climate change occurring, based on reports in 2014 that the earth's surface temperature increased by 0.8°C over the last 3 centuries (Panggabean, 2021). In the last three centuries, the earth's surface temperature has warmed continuously (Syafitri & Putri, 2022).

Indonesia is also experiencing a fairly rapid change in climate change trends (Mingshen et al., 2023, Raharjo & Mulyatni, 2023). The Meteorology, Climatology, and

Geophysics Agency (BMKG) noted that temperature trends in Indonesia generally have a positive trend with a magnitude of 0.03°C every year. Based on data from 91 BMKG observation stations, the normal air temperature for the 1981–2010 period in Indonesia is 26.6°C and the average air temperature in 2020 is 27.3°C (Fakhrudin & Fatoni 2022). As an archipelagic country with high biodiversity, the impact of climate change in Indonesia is felt quite significantly (Rosyada et al. 2021, Sinaga & Yusril, 2021, Nikmah and Saputra 2023, Rudjua et al., 2024). Sea level rise, shifting rainfall patterns, and natural disasters such as floods and landslides pose serious challenges to national development (Nurhayati et al. 2020, Shabrina & Karyadi 2023).

The Sustainable Development Goals, often known as the SDGs, are an extension of the millennium progress goals (MDGs) and a programme for sustainable development that aims to address the requirements of global stakeholders while balancing economic, social, and environmental progress (Larionova 2020, de Jong & Vijge 2021, Díaz-López et al. 2021, Kushnir & Nunes 2022). The issue of the phenomenon of global warming is closely related to the goals of the SDGs contained in goal 13, namely handling climate change. Goal 13 of the SDGs pays special attention to climate change by identifying actions to urgently address climate change and its impacts (Wicaksono 2023, Fauzia and Makarim 2024). One of the objectives of this goal is to increase education, awareness, and human and institutional capacities in mitigation, adaptation, impact reduction, and early warning of climate change (Alfalah Natur Rahman et al. 2023, Idrus and Usi 2024, Rohma et al. 2024, Thoriq et al. 2024, Zaky et al. 2024). The SDGs goals can be well realized if each individual has a profile of sustainability awareness.

Sustainability awareness refers to understandings, attitudes, and behaviors that reflect concern for the environment, as well as a commitment to play an active role in environmental conservation efforts and the achievement of SDGs (Mahat et al. 2020, Javan 2022). According to research by Hassan et al. (2010), there are three categories of sustainability awareness: sustainability practice awareness, behavioral and attitude awareness, and emotional awareness. Therefore, efforts to increase awareness and understanding of sustainability are becoming increasingly urgent to minimize the increasingly severe impact of climate change, especially on students at the high school level, because later they will contribute to environmental preservation and the achievement of sustainable development.

The level of sustainability awareness in high school students has been discussed in previous studies. Research conducted by Urbańska et al. (2022) shows that students lack awareness of problems related to the environment where there is quite a large difference between students' level of knowledge about climate change or air and water pollution and issues related to land cover and vegetation. Similar research conducted by Ali et al. (2017) also showed similar results, namely that high school students in Kano had a low level of environmental awareness. Based on previous research that has been carried out, it shows that the level of sustainability awareness really needs to be paid attention to as an effort to minimize climate change at the individual level, especially among high school students.

Nevertheless, systematic and comprehensive research is still required to assess Indonesian students' knowledge, attitudes, and behaviour addressing sustainable concerns, particularly at the high school level. Meanwhile, based on the author's monitoring of research that discusses and reviews systematically, the level of sustainability awareness among high school students in Indonesia is still very limited. Given the limitations and gaps of the study, it can be a reinforcement of this study. Researchers think it is very necessary to conduct research that reviews systematically and in more detail than previous reviews and identifies factors that influence sustainable awareness, effective educational methods, and challenges and opportunities in the implementation of environmental education at the senior high school level. This study aims to explore previous studies that have been

conducted to measure the level of sustainability awareness among high school students in Indonesia.

Methods

This qualitative research uses a content analysis approach with systematic literature review techniques to analyze the sustainability awareness of high school students in Indonesia. Data comes from published research reports that systematically synthesize existing information and knowledge on a particular issue, find gaps, and draw conclusions about a problem (Møller and Myles 2016). This research adopts a review process with sustainability awareness in Indonesia as the object of research, which is explained as follows: (1) formulating research questions; (2) determining inclusion criteria (Table 1); (3) searching for articles in various databases (Google Scholar, ERIC, DOAJ, Science Direct); (4) typing the keywords "Sustainability Awareness" and "Indonesia"; (5) coding articles using the Paper Classification Form (PCF); identifying patterns throughout the article; and (6) synthesizing these patterns to answer research questions. The filter phase resulted in 11 articles that met the inclusion criteria (Table 2).

Table 1. The Inclusion Criteria

Category	Inclusion Criteria
Journal specifications	National peer-reviewed journal accredited minimum grade 4 (Sinta 4)
Publication year	2020-2024
Research setting	Indonesia
Researcher's nationality	Indonesian; the combination of Indonesian and foreigners
Independent variable	Sustainability Awareness and all kinds of application patterns
Type of study	Empirical and theoretical
Research subject	Students at junior high school and senior high school level

Furthermore, articles that fit the inclusion criteria are further categorized based on six moderation variables, namely journal index, year of publication, type of research, education level, sample size, and research location related to sustainability awareness. The first aspect is the instrument. A good instrument is one that has been validated to become a standard for measuring sustainability awareness. The second aspect is gender. Gender differences certainly cause differences in the level of sustainability awareness of the students themselves. While the last or third aspect is about the categorization of sustainability awareness, this aspect contains a description of the sustainability awareness category, namely high, medium, and low. The distribution of articles based on journal identity can be seen in Table 2 below.

Table 2. The distribution of articles based on the journals' identity

Criteria		Aspects of Sustainability Awareness		
		Instrument	Gender	Category
Journal Index	Sinta 2	0	1	4
	Sinta 3	3	0	1
	Sinta 4	0	0	2
Year of Publication	2024	0	0	1
	2023	0	1	2
	2022	0	0	1
	2021	1	0	2
	2020	2	0	1

Types of Research	Quantitative	1	1	4
	Mix Method	0	0	2
	Development	2	0	1
Education Level	Junior High School	1	0	5
	Senior High School	2	1	2
Sample Size	< 50	0	0	3
	≥ 50	3	1	4
Research Location	Riau	1	0	0
	Jakarta	0	1	0
	West Java	3	0	4
	East Java	0	0	2

Results and Discussion

The results of the research data included in this literature review are an analysis and summary of documented articles related to sustainability awareness among high school students. The mapping of sustainability awareness research results on high school students in Indonesia based on these three aspects can be seen in Table 3 below.

Table 3. Mapping Research Results

No	Aspects	Researchers	Journal Name	Research Results
1	Instrument	(Amelia et al. 2020)	WaPFI (Wahana Pendidikan Fisika)	The instrument developed by sustainability awareness was able to explain 42.6% of the variance in the respondent group. Based on this, measuring sustainability awareness in general can be done with this instrument.
2		(Kurnia et al. 2020)	WaPFI (Wahana Pendidikan Fisika)	The findings of this research are that there are four invalid items out of the 21 instrument items. Invalid items are not used or discarded to measure the sustainability awareness profile. The overall reliability of the instrument is in the good category, which means that the instrument can be used to measure the sustainability awareness profile on the subject of optical equipment for senior high school level.
3		(Bunga Ghieny et al. 2021)	WaPFI (Wahana Pendidikan Fisika)	The results of the research show that the average content validity value is 0.98 (very good), the item content validity for the level of item suitability of all items is acceptable, the overall construct validity value is acceptable, and the rating scale validity value for scales 1 to 4 is understandable. respondents. The

				Cronbach alpha reliability value is 0.63 (fair), item reliability is 0.98 (very good), and respondent reliability is 0.63 (fair).
4	Gender	(Setiawan et al. 2023)	JPBI (Jurnal Pendidikan Biologi Indonesia)	The results show that there are gender differences where women have much higher environmental knowledge than male students. Female students also have a higher awareness in all areas of sustainability, and statistically, they have higher sustainability behavior than male students.
5	Categorization	(Clarisa, Danawan, Muslim, et al. 2020)	JNSI: Journal of Natural Science and Integration	The research results show that the application of the flipped classroom in the ESD context can improve students' cognitive abilities and build sustainability awareness after learning activities.
6		(Ekamilasari, Permanasari, and Dwi Pursitasari 2021)	IJOMR: Indonesian Journal of Multidisciplinary Research	Based on the results and discussion, it can be concluded that ESD learning is expected to increase students' sustainability awareness and critical thinking skills.
7		(Ekamilasari, Permanasari, and Pursitasari 2021)	JSER: Journal of Science Education Research	The research results show that the average student sustainability awareness is 3.65, which is at a medium level. The results for each component of sustainability awareness were awareness of sustainability practices (37.95%), awareness of behavior and attitudes (70.63%), and emotional awareness (86.92%).
8		(Damayanti and Surjanti 2022)	Buana Pendidikan	Based on the research results, the experimental group (ESD context PBL model) obtained higher results than the control group (conventional model) with a significant difference of 11.6. Then, the sustainability awareness profile of students is in the high category with an average of 71%, and the highest average score is in the emotional awareness category at 98%.
9		(Zulkarnaen et al. 2023)	JPPIPA: Jurnal Penelitian Pendidikan IPA	The results of this research include the average value and percentage of students' awareness of sustainability in general, based on indicators. The mean value of

			positive statements about students' sustainability awareness was 3.14 and negative statements were 1.89, which was included in the high category.
10	(Suryawati et al. 2023)	JPBI (Jurnal Pendidikan Biologi Indonesia)	The results of the sustainability awareness analysis show that students in the experimental class obtained a higher average of 76% in the high category. Meanwhile, students in the control class obtained an average of 65% in the medium category. The sustainability awareness T test analysis obtained a significance value of $0.002. \leq 0.05$, which indicates that there is a significant difference between the experimental class and the control class.
11	(Putri et al. 2024)	JPSI: Jurnal Pendidikan Sains Indonesia	The results of the N-gain test in the post-test control class showed low criteria, while those in the experimental class showed medium criteria. The effect size test results in the control and practice class post-tests showed high criteria. This research shows that the module developed is valid and effective for increasing students' understanding and awareness of sustainability.

According to the results of these studies, sustainability awareness still has to be increased by using various approaches and learning models, as well as effective learning tools. Apart from that, there are several studies that say that sustainability awareness in learning provides a positive contribution to children, namely that children become environmentally concerned. The development of sustainability awareness instruments can be done in various ways, but the research that has been done can be supported through several technological devices, in the sense of using IT (Amelia et al. 2020, Bunga Ghienny et al. 2021).

Studies Based on Journal Index

Details of the distribution of studies based on journal indices related to sustainability awareness among high school students in Indonesia are presented in Figure 1.

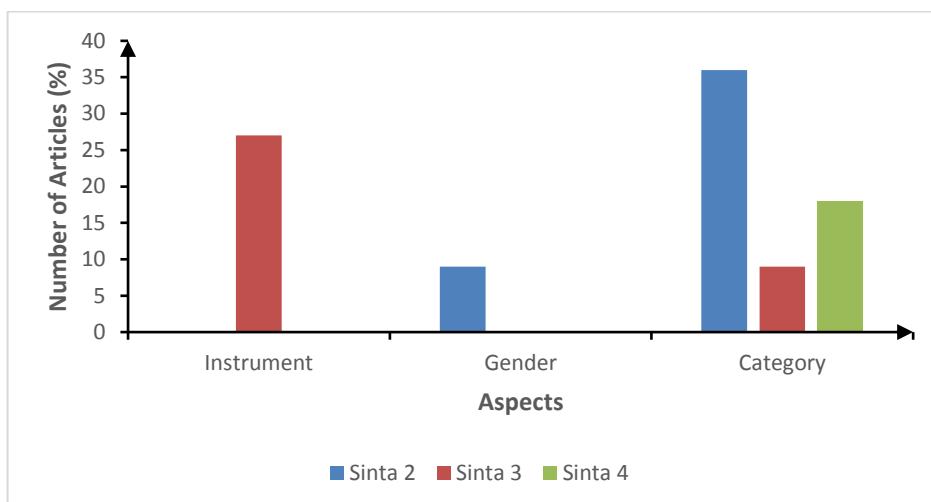


Figure 1. Data Based on Journal Indeks

From figure 1 above, it can be seen that publications in Sinta about sustainability awareness among high school students in Indonesia are most commonly found in articles published in Sinta 2 accredited journals, as many as five pieces, followed by those published in Sinta 3 and Sinta 4 accredited journals. Based on figure 1, it can be seen that in articles published in accredited journals (Sinta 2), there are more points for categorization of student sustainability awareness than other points. As for articles published in accredited journals such as Sinta 3, there are more points for sustainability awareness instruments than other points. Articles published in Sinta 1 accredited journals and indexed by Scopus were not found to fit the inclusion criteria, so based on this, it can be a consideration for further researchers to improve and deepen their research on sustainability awareness among high school students in Indonesia so that their articles can be published in journals indexed by Scopus.

Studies Based on Year of Publication

Grouping based on the year of the study is given a limitation, namely the period from 2020 to 2024. In the period of the year, the following data was obtained:

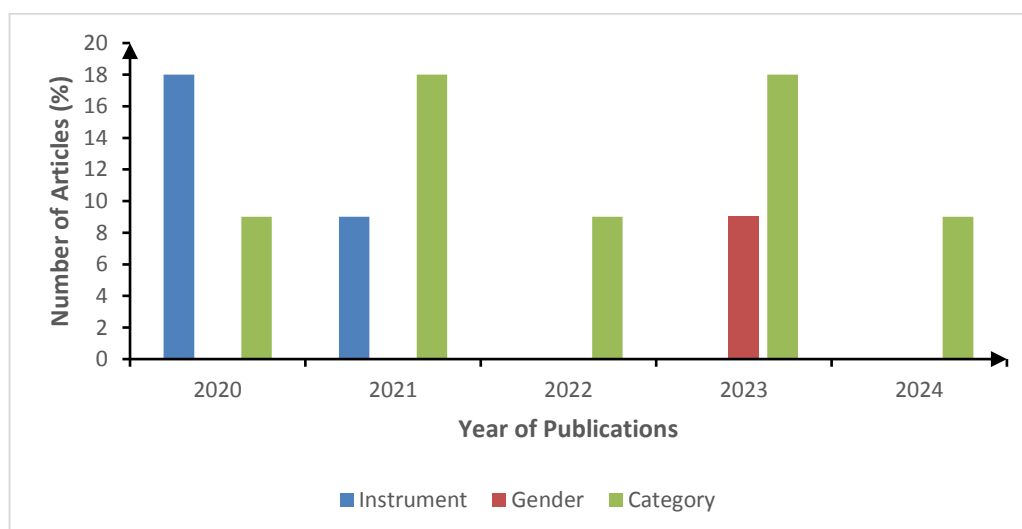


Figure 2. Data by Year of Research

Based on Figure 2, it can be concluded that research on sustainability awareness among high school students in Indonesia related to instruments, gender, and categorization shows fluctuating trends. In the categorization point, sustainability awareness is the most researched point compared to the other three relationships. This shows that researchers have a higher interest in sustainability awareness related to the categorization of sustainability awareness owned by students at the high school level in Indonesia. These results show that there are still problems at the level of categorization of sustainability awareness owned by students.

Based on the results of the research that has been collected, I have received a positive response from students. The implementation of learning models and approaches such as SSCS, PBL, ESD, and ESD-PjBL can positively affect the categorization of sustainability awareness among students. However, qualified teacher insight is needed in applying or combining learning models so as to support fun learning and achieve the expected results. This is with the intention that various kinds of learning models can also function to attract student interest so as to increase the level of student sustainability awareness. Therefore, the selection of the right model or approach has a positive contribution to the learning process. Thus, although the level of sustainability awareness increased after being given treatment, it still remained at a moderate level. However, research and studies that discuss the effect of the application or use of teaching devices such as learning media and teaching materials on student sustainability awareness are still very lacking, so further research is needed on this.

Studies Based on Research Type

Grouping based on the type of research, there are three types of research with distribution: quantitative, mix method (mixed), and development. The number of studies by type of research is presented in Figure 3.

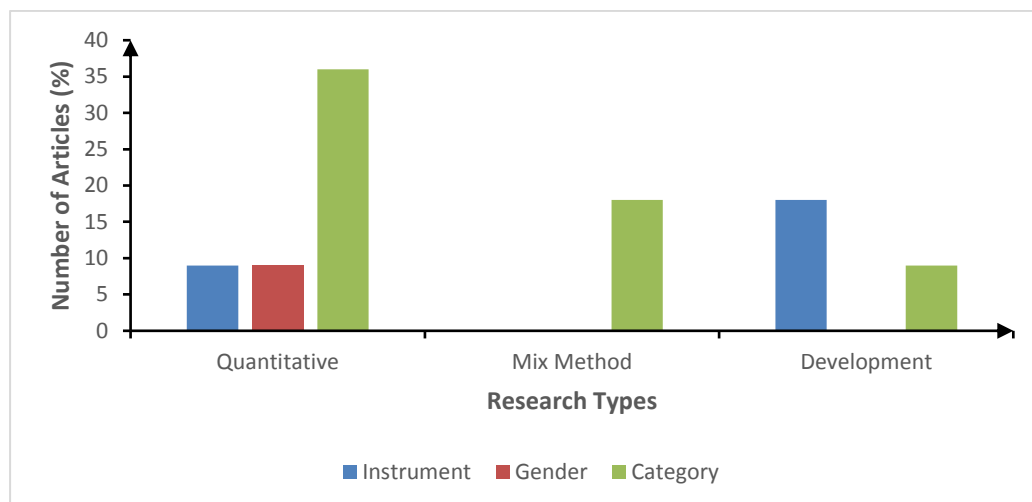


Figure 3. Data by Type of Research

Based on Figure 4, it can be seen that this type of quantitative research dominates sustainability awareness research among high school students in Indonesia. This type of quantitative research is dominated by sustainability awareness categorization points because it involves numerical data, namely the value of student sustainability awareness. Apart from the value obtained from students, if researchers examine the level of sustainability awareness categories in students, they are also required to validate in advance the instruments used by the experts concerned and must be tested first with

respondents, which of course also requires quantitative procedures. Furthermore, if validation and trials have been fulfilled, the instrument is suitable for general use.

Studies Based on Education Level

Grouping based on education level is divided into two categories, namely junior high and senior high school. The amount of research by education level is presented in Figure 4.

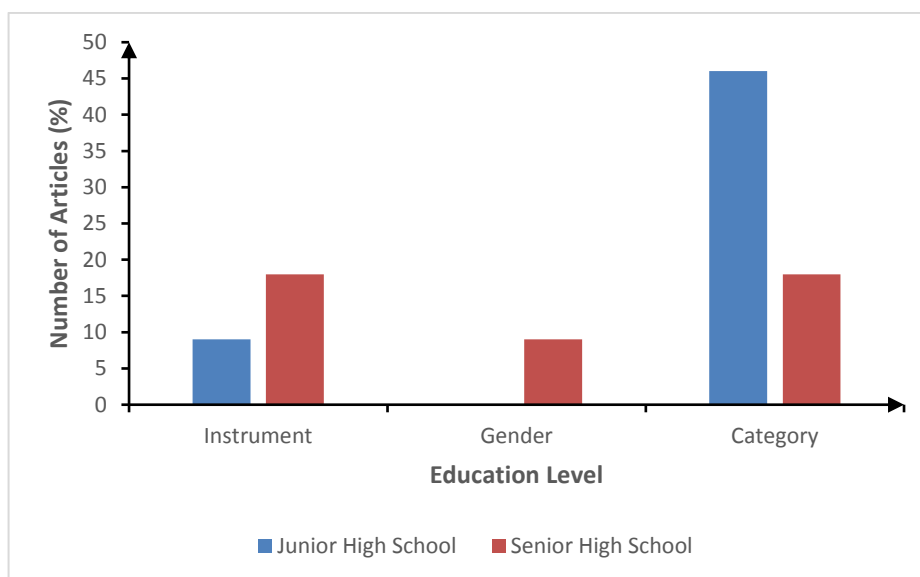


Figure 4. Data By Education Level

Based on Figure 4, it can be seen that all points related to sustainability awareness, especially in the categorization of sustainability awareness among students, are more researched at the junior high school level, except for instrument points that are more researched at the high school level. The junior high school education level is where students go through the adult process. Development towards adulthood requires attention from teachers and psychological, pedagogical, and sociological approaches to student development, including their awareness and behavior towards the environment. In the research, sustainability awareness related to gender at the high school level is still very minimal. The research currently being conducted focuses more on the junior high school level. Even though gender differences in students affect the way students learn and also sustainability awareness, including at the high school level, In their article, Setiawan et al. (2023) stated that the various differences found in men and women certainly cause differences in mindset and in how to deal with various problems around them. So that the awareness of male and female students in responding to the problem of global warming or climate change that they feel certainly has many differences.

Studies Based on Sample Size

Grouping based on sample size is divided into two categories, namely sample size less than 50 and sample size more than equal to 50. The number of studies based on sample size is presented in Figure 5.

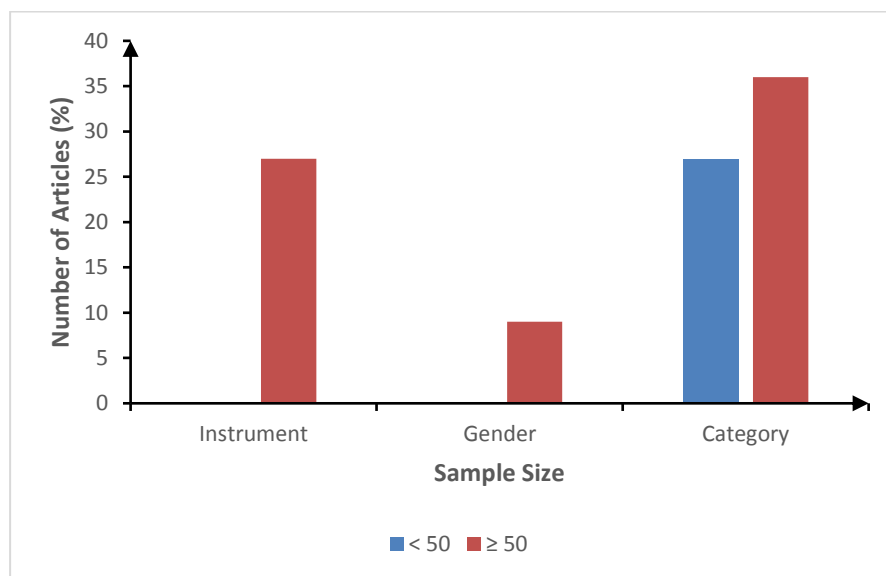


Figure 5. Data Based on Sample Size

Based on Figure 5, it can be concluded that in the 2020–2024 period, all research on sustainability awareness among students at the Indonesian high school level is dominated by research with 50 samples or more. Categorization points have the highest percentage in studies with 50 or more samples, and similarly, in studies with samples under 50, "categorization" items have the least percentage among other points. This implies that researchers need 50 or more samples for sustainability awareness research on students.

Studies Based on Research Locations

The number of studies on sustainability awareness in high school students conducted in Indonesia can be seen in Figure 6.

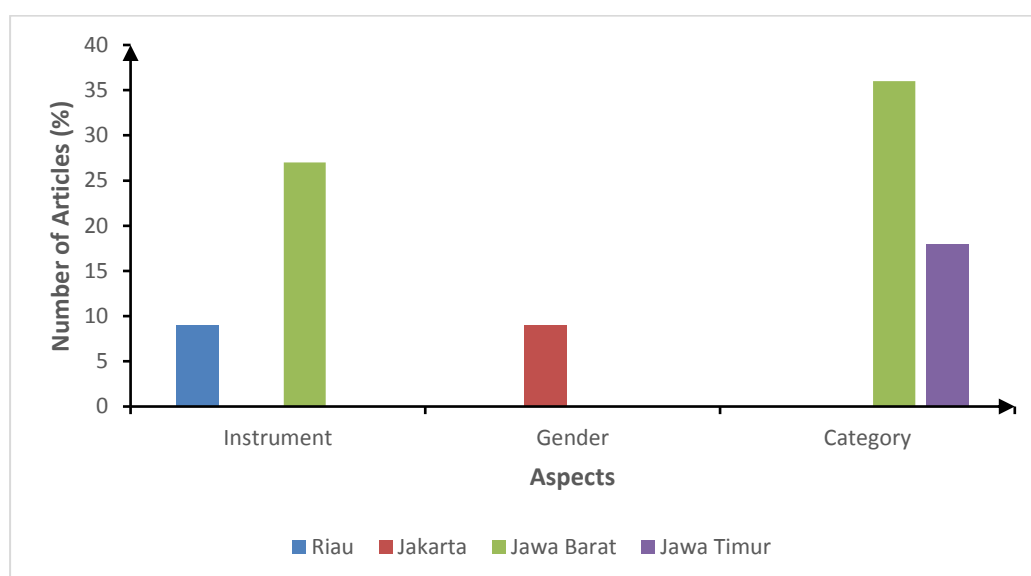


Figure 6. Data Based on Research Location

From the data above, it can be seen that sustainability awareness research on high school-level students in Indonesia is mostly carried out in West Java Province, followed by East Java Province. For West Java Province, this research is spread in several areas, including Bogor City and Bandung City. Based on this, it can be seen that research on sustainability awareness among high school-level students in the territory of Indonesia, most of which is still carried out in Java, is still very minimal. So based on this, more in-depth research is needed on sustainability awareness among students in provinces outside Java, especially in areas that are vulnerable to being carbon contributors to global warming.

Based on this literature study, it was found that some students at the high school level already have sustainability awareness in themselves with a good category, and some still have sustainability awareness with a poor category, even though it still needs to be improved. Meanwhile, the research conducted by Saad et al. (2023) revealed the level of sustainability awareness of high school students based on gender. The results showed that there was a difference in the level of sustainability awareness in the gender aspect, where women had much higher environmental knowledge than male students. According to the study, women also have higher awareness in all areas of sustainability, and statistically, female students also have higher sustainability behaviours than male students. Most of the research related to students' sustainability awareness refers to the instruments and indicators developed by Hassan et al. (2010). Although several other studies have developed instruments and indicators that are tailored to the material, such as research conducted by Amelia et al. (2020), which develops sustainability awareness instruments on global warming materials; Kurnia et al. (2020), on optical devices materials; and Ghienny Flower et al. (2021), on energy materials.

Innovative learning approaches and specially designed teaching models can increase ongoing awareness among learners (Zhang et al. 2020, Braßler and Sprenger 2021, Llach and Bastida 2023). As the research conducted by Ekamilasari, Permanasari, and Dwi Pursitasari (2021), who implement education for sustainable development (ESD) learning in science subjects; Suryawati et al. (2023), which implement the search, solve, create, and share (SSCS) model; Damayanti and Surjanti (2022), who apply the PBL model in the context of ESD; and Clarisa, Danawan, Fani, et al. (2020), who apply the flipped classroom in the context of ESD, show that some of these learning models and approaches are proven to increase the level of sustainability awareness of high school students. As such, these innovative learning models and approaches play an important role in shaping a generation that is more aware, caring, and ready to face future environmental challenges.

Sustainability-focused learning modules typically include interactive materials, real-life case studies, and practical activities that allow learners to understand the concept of sustainability in depth and applicatively (Fortmann et al. 2020). As the research conducted by Daughter et al. (2024) which developed a global warming learning module based on ESD learning which showed that there was an increase in sustainability awareness among the students. The application of learning modules or teaching materials can also motivate students to engage in pro-environmental activities (Schneiderhan-opel and Bogner 2020, Suarez-Perales et al. 2021, Wichmann et al. 2022), such as recycling programmes and greening projects, which reinforce their knowledge through hands-on experience. The success of this learning module is also supported by innovative pedagogical approaches, such as problem-based learning, which not only increase awareness but also critical thinking skills in the context of sustainability. Thus, the learning module plays an important role in shaping the younger generation, which is more aware and concerned about sustainability, which in turn will have a positive impact on future environmental conservation efforts.

Through this literature study research, it is hoped that it can provide information on the level of sustainability awareness among high school students in Indonesia. This information is important to understand the extent to which students are aware of and

understand environmental and sustainability issues. Then this research can also identify gaps in current sustainability education, providing direction for further research so that the level of sustainability awareness of high school students can be further developed. With a good understanding of this sustainability awareness, strategic measures can be designed to improve sustainability education so that future generations are better prepared to face environmental challenges and can contribute positively to global sustainability efforts.

In general, research on student sustainability awareness in the last 5 years has increased. This is because several key factors, including global environmental issues such as climate change, deforestation, and plastic pollution, have received greater attention, supported by global campaigns and extensive media coverage. In addition, education systems in some countries are beginning to integrate sustainability topics into their curricula and educational programmes, providing learners with a more holistic understanding of these issues. However, there is a very prominent difference in the number of student sustainability awareness research studies conducted on the island of Java, especially in West Java province, compared to the other four islands, which causes unevenness in the conclusions of the primary study.

Conclusion

Sustainability awareness is one type of awareness that students must have when contributing to preserving the environment to achieve SDGs at a time when the phenomenon of global warming is getting worse. Through the SLR method, articles related to the sustainability awareness of students from junior high to high school were found. The existence of these articles shows that sustainability awareness should receive considerable attention every year. Because there are still few publications about the sustainability awareness of high school students in Indonesia, further studies need to be carried out to analyze sustainability awareness in depth. This research can also help teachers find the best approach, method, model, or teaching tool to give to students in order to increase student sustainability awareness. In addition, research in cities in Indonesia must be carried out more, especially in cities outside Java that have the urgency to become useful research subjects to fill research gaps in student sustainability awareness studies.

References

- Afifah, A., Putri, M., Rahmawati, A.V., & Kamal, U., 2024. Perubahan iklim dan krisis lingkungan: tantangan hukum dan peran masyarakat. *Deposisi: Jurnal Publikasi Ilmu Hukum*, 2(2):364–375.
- Aisyah, A., Rizky, F.K., Laksamana, B., & Al Fajar, M.D., 2022. Diseminasi hukum penanganan perubahan iklim dan pemanasan global ditinjau berdasarkan perspektif hukum lingkungan internasional di Kelurahan Padang Bulan Selayang I Kecamatan Medan Selayang. *Community Development Journal: Jurnal Pengabdian Masyarakat*, 3(3):1401–1411.
- Ali, A.R., Endut, A., & Embong, R., 2017. Investigating the Environmental Awareness Level of Secondary School Students: Effects of Race, School Type, and Location. *Journal of Science and Technology*, 9(4):30–36.
- Allfalah Natur Rahman, Viani, F.O., & Nelviana Sitanggang, 2023. Implementasi Program Sustainable Development Goals (SDG's) dalam Upaya Penanganan Perubahan Iklim di Provinsi Kepulauan Riau. *Aufklarung: Jurnal Pendidikan, Sosial dan Humaniora*, 3(3): 341–350.
- Amelia, A., Muslim, & Chandra, A.F., 2020. Karakteristik Instrumen Non-Tes Sustainability Awareness Menggunakan Analisis Rasch Model Materi Pemanasan Global untuk Siswa Sekolah Menengah. *WaPFI (Wahana Pendidikan Fisika) 2021*, 5(2):49–56.

- Astriana, B.H., Perdana Putra, A., & Junaidi, M. 2023. Edukasi Mengenai Dampak Perubahan Iklim Terhadap Lingkungan Laut Bagi Kelompok Pelajar Saka Kalpataru, Pramuka, Kabupaten Sumbawa. *Jurnal Abdi Insani*, 10(4):2728–2738.
- Braßler, M. & Sprenger, S. 2021. Fostering Sustainability Knowledge, Attitudes, and Behaviours through a Tutor-Supported Interdisciplinary Course in Education for Sustainable Development. *Sustainability*, 13(3494).
- Bunga Ghienny, H., Imansyah, H., & Liliawati, W. 2021. Karakterisasi Instrumen Sustainability Consciousness pada Topik Energi Dengan Analisis Model Rasch. *WaPFI (Wahana Pendidikan Fisika)*, 6(1):82–95.
- Bunyamin, B., Kurniasari, F.D., Hady, M., Pramanda, H., & Idroes, I., 2023. Peran Masyarakat Dalam Rangka Mengatasi Pemanasan Global. *Ikhlas: Jurnal Pengabdian Kepada Masyarakat*, 1(1):1–7.
- Clarisa, G., Danawan, A., Fani, A., & Wijaya, C. 2020. Penerapan Flipped Classroom dalam Konteks ESD untuk Meningkatkan Kemampuan Membangun Sustainability Awareness Siswa. *Journal of Natural Science and Integration*, 3(1):13–25.
- Clarisa, G., Danawan, A., Muslim, M., & Wijaya, A.F.C. 2020. Penerapan Flipped Classroom dalam Konteks ESD untuk Meningkatkan Kemampuan Kognitif dan Membangun Sustainability Awareness Siswa. *Journal of Natural Science and Integration*, 3(1):13.
- Damayanti, F.A. & Surjanti, J., 2022. Penerapan Model PBL dengan Konteks ESD dalam Meningkatkan Hasil Belajar dan Sustainability Awareness Peserta Didik. *Buana Pendidikan*, 18(1):93–105.
- Díaz-López, C., Martín-Blanco, C., De la Torre Bayo, J.J., Rubio-Rivera, B., & Zamorano, M. 2021. Analyzing the scientific evolution of the sustainable development goals. *Applied Sciences (Switzerland)*, 11(18).
- Ekamilasari, E., Permanasari, A., & Pursitasari, I.D. 2021. Critical Thinking Skills and Sustainability Conciousness of Students for The Implementation Education for Sustainable Development. *Journal of Science Education Research*, 6(2):75–80.
- Ekamilasari, Permanasari, A., & Dwi Pursitasari, I. 2021. Students' Critical Thinking Skills and Sustainability Awareness in Science Learning for Implementation Education for Sustainable Development. *Indonesian Journal of Multidiciplinary Research*, 1(1):121–124.
- Fakhrudin, M. & Fatoni, A. 2022. Pengaruh Perubahan Iklim Terhadap Konsumsi Listrik Rumah Tangga Provinsi Banten. *Ekonomi, Keuangan, Investasi dan Syariah (EKUITAS)*, 4(1):269–274.
- Fauzia, A. & Makarim, M.N. 2024. Studi literatur : restorasi lahan pascatambang batu bara di Kalimantan Timur. *PACC: Peatland Agriculture and Climate Change Journa*, 1(1):52–70.
- Fitriani, V., Gandri, L., Indriyani, L., Manan, A., & Bana, S. 2023. Peningkatan Kapasitas Masyarakat Pesisir Terhadap Perubahan Iklim dan Adaptasinya: Coastal Communities Capacity Building Regarding Climate Change and its Adaptation. *AKSILAR: Akselerasi Luanan Pengabdian Masyarakat*, 1(1):1–8.
- Fortmann, L., Beaudoin, J., Rajbhandari, I., Wright, A., Rowe, P., Fortmann, L., Beaudoin, J., Rajbhandari, I., & Wright, A. 2020. Teaching modules for estimating climate change impacts in economics courses using computational guided inquiry. *The Journal of Economic Education*, 51(2):143–158.
- Hassan, A., Noordin, T.A., & Sulaiman, S. 2010. The Status on the Level of Environmental Awareness in the Concept of Sustainable Development Amongst Secondary School Students. *Procedia Social and Behavioral Sciences*, 2(2):1276–1280.
- Idrus, M.R.H. & Usi, U.A.N. 2024. Realisasi penanganan perubahan iklim di indonesia melalui implementasi sustainable development goals (sdgs): tujuan-13.1.3. *Indonesian Journal of International Relations*, 8(1):77–100.
- Javan, K. 2022. Investigating Awareness, Attitudes, and Behaviors of Geography Student's

- toward Sustainable Development. *Quarterly Journal of Environmental Education and Sustainable Development*, 10(4):85–96.
- de Jong, E. & Vijge, M.J. 2021. From Millennium to Sustainable Development Goals: Evolving discourses and their reflection in policy coherence for development. *Earth System Governance*, 7:100087.
- Kurnia, N.D., Chandra, A.F., & Tarigan, D.E. 2020. Pengembangan Instrumen Sustainability Awareness Dalam Materi Alat-Alat Optik Pada Siswa Sekolah Menengah Atas. *WaPFI (Wahana Pendidikan Fisika)*, 5(2):16–23.
- Kushnir, I. & Nunes, A. 2022. Education and the UN Development Goals Projects (MDGs and SDGs): Definitions, Links, Operationalisations. *Journal of Research in International Education*, 21(1):3–21.
- Larionova, M. 2020. The Challenges of Attaining the Millennium Development Goals (MDGs). *International Organisations Research Journal*, 15(1):7–30.
- Llach, M.C. & Bastida, M.L. 2023. Exploring innovative strategies in problem based learning to contribute to sustainable development: a case study. *International Journal of Sustainability in Higher Education*, 24(9):159–177.
- Mahat, H., Hashim, M., Saleh, Y., Nayan, N., Suhaili, S., Norkhaidi, S.B., Pendidikan, U., Idris, S., & Malim, T. 2020. The Integration Of Attitude And Behavior In Environmental Sustainability Awareness Among Young Malaysians Department of Social and Citizenship Studies , Faculty of Humanities ,. *International Journal of Advanced Science and Technology*, 29(12):32–42.
- Malihah, L. 2022. Tantangan Dalam Upaya Mengatasi Dampak Perubahan Iklim Dan Mendukung Pembangunan Ekonomi Berkelanjutan: Sebuah Tinjauan. *Jurnal Kebijakan Pembangunan*, 17(2):219–232.
- Mardani, D.A. 2023. Wakaf dan Ekonomi Hijau: Upaya Mengurangi Perubahan Iklim dan Emisi Gas Karbon. *La Zhulma: Jurnal Ekonomi Syariah*, 2(1):23–34.
- Mingshen, Boediarto, Y.M., & Sinaga, S.P. 2023. Perubahan Iklim: Tinjauan Holistik Sektor Batubara. *Parahyangan Economic Development Review*, 1(2):116–130.
- Møller, A.M. & Myles, P.S. 2016. What makes a good systematic review and meta-analysis? *British Journal of Anaesthesia*, 117(4):428–430.
- Nikmah, F.H. & Saputra, A.J. 2023. Evaluation of the Impact of Increasing Population Density Against Water Resources in Coastal Areas. *LEADER: Civil Engineering and Architecture Journal*, 1(3):211–218.
- Nurhayati, D., Dhokhikah, Y., & Mandala, M. 2020. Persepsi dan Strategi Adaptasi Masyarakat terhadap Perubahan Iklim di Kawasan Asia Tenggara. *Jurnal Proteksi*, 1(1):39–44.
- Panggabean, B.T.G.B. 2021. Kesiapan Indonesia Dalam Memenuhi Nationally Determined Contribution (NDC) Sebagai Implementasi Paris Agreement Terkait Restorasi Lahan Gambut. *Dharmasiswa*, 1(1):59–68.
- Putri, S.T., Fardhani, I., Mulyati, Y., Kurniawan, R., & Putri, A.A. 2024. Developing Global Warming Module Based on Education for Sustainable Development to Increase Middle School Students' Understanding and Sustainability Awareness. *Jurnal Pendidikan Sains Indonesia*, 12(2):247–263.
- Raharjo, A.S.S. & Mulyatni, A.S. 2023. Tuntutan Ekologi Berkelanjutan dan Implementasi Pertanian Organik Nasional. *Jurnal Analis Kebijakan*, 7(2):153–168.
- Rohma, M.N., Priyansyah, A., Irmawati, F., and Munna, S. 2024. Pelatihan dan Sosialisasi Kesadaran Limbah Fast Fashion pada Santri Madrasa Mahasiswa Muamalat Yogyakarta. *Jurnal Abdimas Madani dan Lestari (JAMALI)*, 6(1):19–24.
- Rosyada, K., Trismadi, & Ras, A.R. 2021. Potensi blue carbon dalam penanganan perubahan iklim guna menunjang keamanan maritim Indonesia. *Jurnal Maritim Indonesia*, 9(3):299–311.
- Rudjua, S., Bempah, I., & Saleh, Y. 2024. Mitigasi Perubahan Iklim Terhadap Usahatani

- Padi Sawah Desa Molombulahe Kecamatan Paguyaman Kabupaten Boalemo. *Economics and Digital Business Review*, 5(2):525–536.
- Schneiderhan-opel, J. & Bogner, F.X., 2020. The Relation between Knowledge Acquisition and Environmental Values within the Scope of a Biodiversity Learning Module. *Sustainability*, 12(5).
- Setiawan, H., Kusnadi, K., Koosbandiah, H., & Riandi, R. 2023. Gender differences and the correlation of environmental knowledge with sustainability awareness after ESD-PjBL implementation. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 9(3):371–386.
- Shabrina, A.N. & Karyadi, B. 2023. Integrasi Mitigasi Bencana Global Warming pada Materi Pembakaran Hidrokarbon melalui Pendekatan RBL-STEAM. *Hydrogen: Jurnal Kependidikan Kimia*, 11(6):995.
- Sinaga, M. & Yusril, Y. 2021. Dampak Perubahan Iklim di Pasifik Selatan: Ancaman Naiknya Permukaan Air Laut Terhadap Eksistensi Negara dan Penduduk Kiribati. *Papua Journal of Diplomacy and International Relations*, 1(1):29–43.
- Suarez-Perales, I., Valero-gil, J., Leyva-de, D.I., Rivera-torres, P., & Garc, C. 2021. Educating for the future : How higher education in environmental management affects pro-environmental behaviour. *Journal of Cleaner Production*, 321:128972.
- Suryawati, E., Yennita, Y., Afwa, S.R., Dianti, P.R., & Syafrinal, S. 2023. Real action based on search solve create and share (SSCS) model to improve sustainability awareness of junior high school students. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 9(3):271–281.
- Syafitri, R. & Putri, E. 2022. Masalah Global: Global Warmingdan Hubunngannya Dengan Penggunaan Bahan Bakar Fosil. *Jurnal Bakti Sosial*, 1(1):149–200.
- Thoriq, R.A., Sari, V.R., & Rachman, I.F. 2024. Menuju Masa Depan Yang Berkelanjutan: Mengoptimalkan Media Sosial Untuk Meningkatkan Kesadaran SDGs 2030. *Inspirasi Dunia: Jurnal Riset Pendidikan dan Bahasa*, 3(2):162–175.
- Urbańska, M., Charzyński, P., Gadsby, H., Novák, T.J., Sahin, S., & Yilmaz, M.D. 2022. Environmental Threats and Geographical Education : Students ' Sustainability Awareness — Evaluation. *Education Sciences*, 12(1).
- Utomo, D.T.B., Dewi, M.A., & Kuswarini. 2023. Penegakan Hukum Lingkungan Dalam Mewujudkan Pembangunan Berkelanjutan. *Ganec Swara*, 17(4):2034.
- Wicaksono, A.P.N., 2023. Eksplorasi Sustainable Development Goals (SDGs) Disclosure Di Indonesia. *Jurnal Akademi Akuntansi*, 6 (1):125–156.
- Wichmann, C., Fischer, D., Maria, S., Honorato-zimmer, D., Knickmeier, K., Kruse, K., Sundermann, A., & Thiel, M. 2022. Promoting pro-environmental behavior through citizen science? A case study with Chilean schoolchildren on marine plastic pollution. *Marine Policy*, 141:105035.
- Zaky, F.A., Al-Dzahabi, M.A., Taqwim, M.H.A., Fil'ardiani, N.U., & Agustin, Y.S., 2024. penerapan sdgs dalam program hibah mbkm untuk mewujudkan pembangunan berkelanjutan di kelurahan sumber. *Jurnal Ekosains*, XVI(1):16–29.
- Zhang, T., Shaikh, Z.A., Yumashev, A. V., & Chład, M., 2020. Applied Model of E-Learning in the Framework of Education for Sustainable Development. *Sustainability*, 12:1–15.
- Zulkarnaen, Riandi, and Amprasto, 2023. Analysis of Students' Sustainability Awareness of the Environment. *Jurnal Penelitian Pendidikan IPA (JPPIPA)*, 9(9):6750–6756.