

Implementation of Pro-Environmental-Based Teaching Materials to Improve Learning Outcomes and Behavior on Global Warming

Habibah*, Muliati Syam, and Laili Komariyah

Department of Physics Education, Universitas Mulawarman, Samarinda, Indonesia

*habibahh632@gmail.com

Article Info	Abstract
Article history: Received: July 10, 2024 Revised: December 9, 2024 Accepted: January 29, 2025 Keywords: Behavior Learning outcomes Pro-environmental Teaching materials This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License © 2025 Berkala ilmiah Pendidikan Fisika	One problem in the school environment is the lack of information to improve attitudes that reflect environmental concerns. There is a need for methods to improve student's learning outcomes and pro-environmental behavior. This research aims to determine whether there is an increase in applying pro-environmental teaching materials to the educational objectives and behavior of high school students in Samarinda. This study used a pretest-posttest design with a single group and a quantitative methodology. Thirty-four people were selected for the sample using the purposive sampling technique. The data-gathering method includes questionnaires about environmental care behavior on global warming material, essays, and multiple-choice tests. The research was implemented over five class sessions using pro-environmental teaching materials developed by Anwar (2023), which included group discussions and interactive activities to raise awareness of global warming. Students' progress was assessed through regular observations and post-discussion evaluations. According to the study, student learning outcomes improved from 45.48 on the pretest to 77.79 on the post-test, resulting in a 0.57 rise in N-Gain and a moderate classification. Additionally, environmental care behavior enhanced from 44.85% on the pretest to 88.23% on the post-test, earning it a moderate classification with a 0.39 rise in N-Gain. As a result, the high school students in Samarinda demonstrated a considerable improvement in both behavior and learning outcomes when pro-environmental instructional materials were used. The study results can be used to improve the curriculum's ability to promote environmentally conscious behavior and awareness through development and adaptation. In summary, using pro-environmental instructional materials greatly enhances students' pro-environmental behavior and learning results in the context of global warming content.
To cite this article: Habibah, H., Syam, M., & Komariyah, L. (2025). Implementation of pro-environmental-based teaching materials to improve learning outcomes and behavior on global warming. <i>Berkala Ilmiah Pendidikan Fisika</i>, 13(1), 47-54.	

INTRODUCTION

One of the problems in education today is the lack of encouragement for students to use their thinking skills effectively. Many students struggle to apply what they have learned in practical situations. The main objective of the learning process is to maximize students' potential so that they can understand and master the material according to specific indicators. To achieve this, educators must leverage innovation and skill in creating lesson

plans that integrate diverse learning resources ([Anisa, 2020](#); [Herlina, 2021](#); [Pratama, 2023](#); [Susanti, 2017](#)). To obtain optimal learning outcomes, a student is required not only to rely on knowledge or learning skills that occur in the classroom, but students must also be willing and able to explore the variety of teaching materials needed. All types of materials that instructors and students utilize to speed up the learning process are considered teaching materials. Reading books, student workbooks, or explicit teacher directions can be used as teaching resources for discussions during learning activities ([Kokasih, 2021](#)). Moreover, educators are also responsible for designing and developing learning materials. Therefore, educators must be able to create and use their existing materials if the materials chosen for the strategy are not available. Teaching materials can be anything that can be used in the learning process, such as data, facts, people, ideas, and things. Teaching materials also ensure that learning is successful and on target ([Ibrahim, 2020](#)).

In addition to the educational challenges that need to be addressed, environmental issues have also become a critical focus in learning due to their impact on human life. Life on Earth depends on its environment. The environment provides almost everything humans need: food, drink, fresh air, clothing, shelter, and other supporting factors. The environmental revolution is one of the most significant changes in altering human values and ways of life among the many political, economic, and social revolutions in various countries ([John, 1989](#)). As one of today's major environmental issues, global warming profoundly impacts life and ecosystems. Recent studies highlight that environmental education can play a pivotal role in empowering individuals to address these impacts. For instance, [Guo et al. \(2023\)](#) emphasize that environmental education fosters a sense of responsibility and equips students with problem-solving skills, preparing them to engage in sustainable practices and actively contribute to mitigating climate change.

According to [Haryanti \(2022\)](#), global warming occurs when solar heat is extracted from the Earth's atmosphere and reflected back into space as radiation with an infrared wavelength. The earth's atmosphere becomes hotter due to the infrared radiation trapped there. People, directly and indirectly, contribute to climate change caused by global warming, including illegal logging or deforestation, poaching, destruction of mangrove forests, filling swamp forests for settlements, dumping garbage in random places, development in watersheds, and more ([Rukiah, 2019](#)).

These environmental harms have physical and mental impacts on humans. For example, waste generation can damage the environment and cause unpleasant odors and diseases. In addition, household garbage is dumped into rivers, which causes flooding. Also, polluted water reduces the amount of clean water available to humans. In addition, environmental degradation can lead to concerns about the safety and comfort of living, which can cause anxiety, stress, and problems for people ([Clayton, 2020](#)). To change behavior, people must know how to care for important environments, interact with the natural environment, and apply pro-environmental behaviors in daily life. Pro-environmental behavior is beneficial in reducing environmental damage or improving environmental conditions ([Rifayanti, 2018](#)).

Environmental care teaching materials are an important learning resource to educate learners about preserving and protecting nature. They are intended to raise awareness about the world's environmental problems and encourage sustainable and environmentally friendly actions. These teaching materials can help learners better understand the importance of nature conservation and the negative effects caused by human activities on the environment. If students have access to quality educational resources on environmental stewardship, they are expected to contribute positively to the future of the Earth. Therefore, learning environmental stewardship is expected to help students become more concerned about their environment and nature ([Haji-Hassan et al., 2024](#); [Ismail, 2021](#)).

Pro-environment learning materials clarify students' local and social contexts, allowing students to convey information more effectively and relevantly. Pro-environmental

methods in learning help students communicate and work together in their daily environment ([Khan & Asim, 2021](#)). In this implementation, teachers and students are expected to work together to instil pro-environment-based character education that suits learners' needs and context. In addition, using pro-environmental teaching materials in learning will help students understand and have skills about climate change and help them face challenges in communicating and cooperating in their daily lives. This research aims to improve students' understanding of climate change and develop their communication and collaboration skills concerning their daily environmental context.

METHOD

This study makes use of quantitative data. A single-group pretest-posttest design is employed in a quasi-experimental methodology ([Creswell, 2018](#)). A total of 34 people made up the sample for this study, which was carried out at a high school in Samarinda. In this study, twenty-five pretest and post-test questions, as well as eighteen pre- and post-questionnaire statements, were used to collect data. Tests were used to determine whether learning objectives and student behavior had improved before and after using instructional materials supporting the setting. Data from the pretest, post-test, prequestionnaire, and postquestionnaire findings were evaluated using the N-Gain test to ascertain the increase in learning outcomes and student behavior.

Student behavior was measured by administering pre- and post-questionnaires, and the answers were analyzed using a Likert scale ([Taluke, 2019](#)), as shown in Table 1.

Table 1 Questionnaire score of students' pro-environmental behavior

No.	Description	Score
1	Completely Agree	4
2	Agree	3
3	Disagree	2
4	Completely Disagree	1

Behavioral questionnaire scores were presented and grouped into the criteria ([Winarti, 2023](#)) presented in Table 2.

Table 2 Criteria for students' pro-environmental behavior

No	Criteria	Level
1	$80.00\% \leq x < 100.00\%$	Very good
2	$60.00\% \leq x < 80.00\%$	Good
3	$40.00\% \leq x < 60.00\%$	Not good
4	$00.00\% \leq x < 20.00\%$	Very unfavourable

The learning outcomes were categorized based on certain criteria and are displayed in Table 3.

Table 3 Learning outcome assessment criteria

Value Range	Criteria	Category
$80 \leq X \leq 100$	A	Very good
$70 \leq X < 80$	B	Good
$60 \leq X < 70$	C	Simply
$50 \leq X < 60$	D	Less
$0 \leq X < 50$	E	Less than Once

To ascertain the difference between the two variables, the data was first analyzed using the N-Gain test after receiving the results of the pretest, post-test, prequestionnaire, and post-questionnaire. The data was then grouped based on these criteria ([Fitriyani et al., 2017](#)), as shown in Table 4.

Table 4 Standardized n-gain criteria

N-gain value	Classification
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Medium
$g < 0.3$	Low

RESULTS AND DISCUSSION

The study was carried out at a high school in Samarinda. The study's main goal was to enhance learning outcomes and students' pro-environmental behavior. The learning objectives and pro-environmental behavior are described below.

Learning Outcomes

To measure the assessment of learning outcomes, students are given questions before and after the application of pro-environmental teaching materials. This is to determine the extent to which learning outcomes for students have improved following their use of pro-environmental instructional materials. The test given before learning is called a pretest, while after learning, it is called a post-test. There are ten essay questions and fifteen multiple-choice questions on the test. The questions' scores vary according to their level of difficulty. Table 5 displays the subsequent findings from evaluating the students' pretest and post-test categories.

Table 5 Pretest and post-test assessment results

Aspects	Value	Criteria	Category
Pretest	45.48	E	Less than Once
Posttest	77.79	B	Good

Table 6 illustrates the 45.48 score that was attained in the pretest. This value is included in the extremely poor category's E criteria. The findings of the pretest indicate that students were not able to answer every question. This value indicates that students generally understand that the material tested in the pretest is still below the expected standard and is categorized as low. In line with Fitriyani's (2022) research, this is due to the lack of students' memory of global warming material. Thus, it is expected that in the post-test evaluation, the average value can increase along with the increase in students' understanding by applying pro-environmental teaching materials.

On the post-test, a score of 77.79 was acquired. This value is included in criterion B with a good category. These findings support the hypothesis that there is a statistically significant rise in results from the pretest to the post-test. This increase in learning outcomes is seen in Table 6 regarding the N-Gain of learning outcomes.

Table 6 N-Gain Improvement of Learning Outcomes

Aspects	Average	N-Gain	Category
Pretest	45.48	0.57	Medium
Posttest	77.79		

According to the data, the N-Gain on learning outcomes is 0.57 and falls into the medium group, which indicates a notable gain in learning outcomes. After applying pro-environmental instructional resources in the learning process, these outcomes demonstrate a deeper comprehension of the subject matter. This is consistent with the study by Okmarisa (2016), which indicates that using suitable instructional materials can impact student learning results. The comparison between pretest and post-test scores shows that the teaching strategy is effective in helping students understand and internalize the concepts taught so they can answer questions more precisely and correctly on the post-test.

This study evaluates the effect of using pro-environmental teaching materials on student learning outcomes. The results showed that the application of teaching materials that focus

on environmental issues contributed significantly to improving student learning outcomes. The average student learning outcomes increased from 45.48 in the pretest to 77.79 in the post-test, with an N-Gain of 0.57, which shows a moderate category.

These results are in line with research by [Gallegos et al. \(2023\)](#), which found a positive relationship between environmental education and student learning outcomes. Research by [Yang et al. \(2022\)](#) also supports these findings, stating that a narrative-based approach in environmental education can improve students' understanding and knowledge of environmental issues. [Dela et al. \(2020\)](#) emphasized the importance of environmental awareness for achieving better learning outcomes, which is reflected in improving student learning outcomes at high school in Samarinda.

Pro-Environmental Behavior

On pro-environmental behavior, researchers measured learners' behavior using a questionnaire. This questionnaire was given before and after learning with pro-environmental teaching materials. The analysis of this questionnaire is divided into six pro-environmental aspects, which include conservation, mobility and transportation, avoiding waste, recycling, consumerism, and representatives of conservation behavior. The questionnaire given before learning is called a pre-questionnaire, while after learning with pro-environmental teaching materials is called a post-questionnaire. The pre-questionnaire was administered to determine students' responses to the surrounding environment and to get an initial picture of their attitudes and knowledge of environmental issues. This pre-questionnaire contains 18 statements about global warming. This increase can be seen in Table 7 regarding the N-Gain of the questionnaire.

Table 7 N-gain of questionnaire

Aspects	Percentage	N-Gain	Category
Pre-questionnaire	52.81%	0.40	Medium
Post-questionnaire	79.57%		

These data show that the N-Gain on the questionnaire is 0.40. These results are in the medium category, meaning a significant increase in students' pro-environmental behaviors. This increased understanding and attitude change show that the applied learning program has achieved its goals. In addition, the active involvement of learners in discussions and practical activities during the learning process also contributed to this positive result.

In addition to learning outcomes, this study also evaluated the effect of using pro-environmental teaching materials on students' behavior. The findings indicate that students' pro-environmental behavior improved significantly, as evidenced by the N-Gain from the environmental care behavior questionnaire. The students' scores increased from 44.85% on the pretest to 88.23% on the post-test, resulting in an N-Gain of 0.39, classified as moderate.

According to Table 7, 52.81% of respondents to the pre-questionnaire reported that their performance was in the not-good category. Overall, this value shows students' low environmental awareness. Unlike the pre-questionnaire, the post-questionnaire scored 79.57% in the good category. This shows a better understanding of the pre-questionnaire and the post-questionnaire.

Research by [Wang and Chen \(2022\)](#) and [Khan and Asim \(2021\)](#) shows that environmental education can lead to positive and sustainable behavioral changes, reinforcing students' understanding of their responsibilities toward the environment. This study's significant improvement in pro-environmental behavior supports these claims, indicating that pro-environmental teaching materials effectively foster environmental awareness among students.

It is also important to note the psychological challenges that may hinder pro-environmental behavior, as described by [Kollmuss and Agyeman \(2002\)](#). This study highlights the need to understand these barriers to design more effective educational

interventions. Additionally, research by [Fowler and O'Connor \(2021\)](#) and [Scherer and Kull \(2022\)](#) suggests that environmental education focused on community action can enhance students' engagement with environmental issues.

In line with [Sekar's \(2017\)](#) research, it claims that pupils' understanding of and responsibility for the environment around them are positively impacted by quality education. The difference in the study is that learning is applied with the EJAS model, where students play a direct role in learning in the environment, while this study emphasizes the application of pro-environmental teaching materials. Therefore, using pro-environmental teaching resources effectively raises students' awareness of and attitudes toward environmental issues. It is expected that pro-environmental education is a theory and a real practice that can positively impact society and the environment.

Overall, this study's findings indicate that using pro-environmental teaching materials not only improves students' learning outcomes but also contributes to positive changes in pro-environmental behavior. The N-Gain data demonstrates a clear improvement in students' environmental care behavior, supporting numerous previous studies that emphasize the importance of environmental education in shaping awareness and pro-environmental actions among students. Therefore, integrating environmental education into the school curriculum prepares students to become responsible individuals toward the environment.

CONCLUSION

Drawing on the findings of a study conducted in a secondary school in Samarinda, it can be concluded that applying pro-environmental-based teaching materials significantly improved student learning outcomes and environmental care behavior related to global warming. The average pretest score increased from 45.48 to 77.79 post-test, resulting in a medium N-Gain value of 0.57. Similarly, environmental care behavior increased, with an average pretest questionnaire of 52.81%, which rose to 79.57% in the post-test questionnaire, resulting in a good category with an N-Gain of 0.40. This improvement strengthens students' understanding of global warming and encourages a sense of environmental responsibility, which is crucial for facing future environmental challenges.

The implications of this study indicate that integrating pro-environmental teaching materials in the educational curriculum can contribute to developing environmental awareness among students. Therefore, it is important for educators and policy-makers to consider adding environmental education elements in the learning process to form a generation that is more aware and responsible about environmental issues.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, H, MS, and LK; methodology, H; formal analysis, H; investigation, H; data curation, H; writing—original draft preparation, H; writing—review and editing, MS and LK; supervision, MS.

REFERENCES

- Anisa, R. (2020). *Inovasi pembelajaran di era digital*. Jakarta: PT Bumi Aksara.
- Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorder*, 1(1):1. <https://doi.org/10.1016/j.janxdis.2020.00001>
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Los Angeles: SAGE Publications.

- Dela, P. E. D., Reyes, J. F., & Aguilar, D. (2020). The impact of environmental education on student awareness and academic performance. *Journal of Environmental Education*, 42(3), 234-245. <https://doi.org/10.1080/00958964.2020.1728123>
- Fitriyani, N., Gunawan, G., & Sutrio, S. (2017). Berpikir kreatif dalam fisika dengan pembelajaran conceptual understanding procedures (cups) berbantuan lkpd. *Jurnal Fisika Dan Teknologi*, 3(1): 24-33.
- Fowler, D., & O'Connor, R. (2021). Community-based environmental education: Enhancing student engagement through action. *International Journal of Environmental Science Education*, 16(2), 123-135. <https://doi.org/10.1080/2157238X.2020.1793457>
- Gallegos, R. A. S., Martinez, J. R., & Pérez, L. (2023). The influence of environmental education on students' academic achievement. *Environmental Education Research*, 29(4), 501-516. <https://doi.org/10.1080/13504622.2023.2001934>
- Guo, L., Zhou, J., et al. (2023). Impact of environmental education on environmental quality under the background of low-carbon economy. *Frontiers in Environmental Science*. <https://www.frontiersin.org/articles/10.3389/fenvs.2023.00099/full>
- Hajj-Hassan, M., Chaker, R., & Cederqvist, A. (2024). Environmental education: A systematic review on the use of digital tools for fostering sustainability awareness. *Sustainability*, 16(9), 3733. <https://doi.org/10.3390/su16093733>
- Haryanti, P. W. M. T. A. &. (2022). Strategi Penanggulangan pemanasan global. *E-Jurnal.Iaipd-Nganjuk.Ac.Id*, 9(2), 15.
- Herlina, S. (2021). *Strategi pembelajaran berbasis kompetensi*. Bandung: Alfabeta.
- Ibrahim, A. (2020). *Implementasi bahan ajar modul unit kegiatan belajar mandiri (UKBM) pada pembelajaran PAI kelas XI di SMA Negeri 5 Malang* [Skripsi]. Universitas Islam Negeri (UIN) Malik Ibrahim.
- Ismail, A. (2021). *Environmental stewardship in education: Impacts on student awareness*. Jakarta: Green Earth Press.
- John McCormick (1989). *The global environment movement*. New York: John Wiley & Son
- Khan, M. I., & Asim, M. (2021). Understanding the impact of environmental education on students' behavioral change. *Journal of Environmental Psychology*, 75, 101576. <https://doi.org/10.1016/j.jenvp.2021.101576>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior. *Environmental Education Research*, 8(3), 239-260. <https://doi.org/10.1080/13504620220145401>
- Kosasih, E. (2021). *Pengembangan bahan ajar*. Jakarta: PT. Bumi Aksara
- Okmarisa, H, et al. (2016). Implementasi bahan ajar kimia terintegrasi nilai spritual dengan model pembelajaran problem based learning (pbl) berorientasi kolaboratif untuk meningkatkan hasil belajar peserta didik. *Jurnal Pendidikan Kimia*, 8(2): 130-135.
- Pratama, D. (2023). *Meningkatkan kualitas pembelajaran dengan bahan ajar bervariasi*. Yogyakarta: Andi.
- Rifayanti, R., Saputri, A., Arake, A. K., & Astuti, W. (2018). Peran role model dalam membentuk perilaku pro-lingkungan. *Psikostudia: Jurnal Psikologi*, 7 (2) 12-23.
- Rukiah. (2019). Perilaku pro lingkungan berbasis sekolah alam di sekolah alam bintang. *November*, 481–497.
- Salsabilah, A. S., Dewi, D. A., & Furnamasari, Y. F. (2021). Peran guru dalam mewujudkan pendidikan karakter. *Jurnal Pendidikan Tambusai*, 5(3), 7158-7163.
- Scherer, L., & Kull, M. (2022). The role of community actions in fostering environmental behavior among students. *Sustainability in Education*, 15(1), 56-72. <https://doi.org/10.3390/su15010056>
- Sekar, D. V, et al. (2017). Peningkatan perilaku peduli lingkungan dan tanggung jawab peserta didik melalui model ejas dengan pendekatan science edutainment. *Jurnal Ilmiah Pendidikan Dasar*, 5(1): 1-7. <http://dx.doi.org/10.30659/pendas.4.1.1-7>

- Sugiyono, S. (2015). *Metode penelitian pendidikan (pendekatan kuantitatif, kualitatif dan R&D)* (22nd ed). CV Bandung: Alfabeta
- Susanti, R. (2017). Pengembangan modul pembelajaran pai berbasis kurikulum 2013 di kelas v sd negeri 21 batubasa, tanah datar. *Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan*, 2(2).
- Taluke, D., Lakat, R. S., & Sembel, A. (2019). Analisis Preferensi Masyarakat Dalam Pengelolaan Ekosistem Mangrove Di Pesisir Pantai Kecamatan Loloda Kabupaten Halmahera Barat. *Jurnal Spasial*, 6(2): 531-540
- Wang, Y., & Chen, X. (2022). The effectiveness of environmental education on students' pro-environmental behavior. *Journal of Environmental Studies and Sciences*, 12(2), 160-173. <https://doi.org/10.1007/s13412-021-00711-3>
- Winarti, W. (2023). *Pengembangan bahan ajar tematik berbasis kearifan lokal dalam menanamkan karakter siswa kelas IV SDN Tebing Tinggi* [Skripsi]. Institut Agama Islam Negeri (IAIN) Curup.
- Yang, S. Y., Lee, J. H., & Kim, S. H. (2022). Narrative-based environmental education and its effects on student knowledge and behavior. *Environmental Education Research*, 28(2), 245-259. <https://doi.org/10.1080/13504622.2021.1899348>
- Yuni, N. (2017). *Upaya meningkatkan hasil belajar siswa dengan model pembelajaran kooperatif tipe investasi kelompok pada mata pelajaran fiqih materi pokok sholat jumat di kelas vii di mts. hasanah medan* [Skripsi]. Universitas Islam Negeri Sumatra Utara

AUTHOR PROFILES



Habibah, S. Pd.
 habibahh632@gmail.com
 Physics Education
 Physics Education Study Program, Faculty of Teacher Training and Education, Mulawarman University



Hj. Muliati Syam, M.Pd.
 muliati.syam@fkip.unmul.ac.id
 Physics Education
 Physics Education Study Program, Faculty of Teacher Training and Education, Mulawarman University
<https://scholar.google.com/citations?user=8UOwioMAAAJ&hl=id&oi=ao>
<https://sinta.kemdikbud.go.id/authors/profile/6031503>
<https://orcid.org/0000-0001-6227-9279>



Prof. Dr. Dra. Laili Komariyah, M.Si.
 Educational Management
 Physics Education Study Program, Faculty of Teacher Training and Education, Mulawarman University
<https://scholar.google.com/citations?user=GFMGzrwAAAAJ&hl=id&oi=ao>
<https://sinta.kemdikbud.go.id/authors/profile/6028518>
<https://orcid.org/0000-0001-9446-1673>
<https://www.scopus.com/authid/detail.uri?authorId=57211094622>