InJAST
Volume 6, Number 1, April 2025
Pages: 34-40

P - ISSN: 2722 - 0133
E - ISSN: 2722 - 0141
DOI: https://doi.org/10.33751/injast.v6i`1.26

Design and development of a problem-based learning (PBL) e-module in environmental education for enhancing pro-environmental behaviour

NUR HUMAIROH UMI[1,2,*], RITA RETNOWATI[1], YOSSA ISTIADI[1]

[1]Magister Program of Environmental Management, Pakuan University, Jalan Pakuan,Tegallega, Bogor 16129, Indonesia
[2]Sekolah Alam Cendekia, Jalan Cilubang Nagrak, Bogor Barat, Bogor 16115, Indonesia

*Corresponding author: *Nurhumairohumi@gmail.com*

Submitted 9 December 2024; Accepted 10 August 2025; Published 12 August 2025

ABSTRACT

This study aimed to develop an environmental education e-module based on the Problem-Based Learning (PBL) approach to foster pro-environmental behaviour among elementary school students. The research employed the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model, encompassing five sequential stages. The findings indicate that the PBL-based e-module on environmental change effectively enhanced pro-environmental behaviour in Grade V students. Pre-test and post-test analysis yielded an average N-gain score of 0.69 (medium category) and a percentage gain of 68.98% (quite effective category). Furthermore, assessment of pro-environmental behaviour indicators showed high achievement criteria. These results suggest that the developed e-module is both suitable for classroom use and effective in promoting pro-environmental behaviour.

Keywords: *ADDIE, e-module, Problem Based Learning (PBL), pro-environmental behaviour*

INTRODUCTION

Indonesia faces numerous environmental problems, ranging from global warming (Priatna et al., 2025) and inadequate waste management systems to the degradation of marine ecosystems, forest fires, deforestation, and other forms of environmental damage. The environment serves as a space where living organisms interact, creating reciprocal relationships among them (Uar et al., 2016). As a fundamental element supporting human life, the environment plays a crucial role in fulfilling human needs. Its quality, however, is strongly influenced by the attitudes and behaviours of the people who inhabit it (Hamzah, 2013). Projections of Indonesia's population growth indicate a significant future challenge for environmental management if appropriate measures are not implemented. As the population increases, so does the demand for natural resources to meet daily needs. Unfortunately, this high rate of consumption is often not accompanied by adequate environmental management (Marfai, 2016).

Humans must have responsibility and care for their environment for future generations (Darmawan. 2017). Environmental damage occurs on land, sea, and air, which is influenced by natural and human factors. However, damage caused by human activities has long-term and more chronic impacts. More and more developments are occurring in Indonesia from various sectors ranging from technology, agriculture, industry, and others but sometimes they are not followed by environmentally friendly activities (Kuswati et al., 2021). Lack of action to reduce negative environmental impacts so that environmental protection and restoration is the main challenge facing society today, therefore it is necessary to know and understand pro-environmental behaviour and the factors that influence it (Bronfman et al. 2015). One way that can be done to reduce natural damage is through efforts to embed human awareness, concern and understanding of the environment, namely through environmental education (Wiharjo et al., 2017). Pro-environmental behaviour is an action carried out intentionally to reduce negative impacts on the environment and is applied as daily behaviour related to environmental preservation (Kollmuss & Agyeman, 2002). The formation of pro-environmental behaviour can be done through education with environmentally-oriented learning (Susanto, 2012; Priatna & Khan, 2024).

The curriculum currently being implemented is an independent curriculum whose implementation emphasizes the selection of learning models. Based on the skills that a person must have in facing current developments in science and technology, researchers determine what learning models can be applied. One of the learning models that is chosen in the independent curriculum system formulated by the Ministry of Education and Culture is the Problem Based Learning (PBL) model (Kemendikbud, 2022). In fact, in Indonesia it is still a goal to continue to improve the quality of education by providing a choice of learning models to be used. The realization of the learning model must be adapted to the characteristics of the students. The successful implementation of the learning model must be supported by the use of relevant learning materials.

The need for innovative teaching materials is always growing in line with the ever-growing needs of science (Downey et al., 2021). The teaching method of educators still uses the lecture method from beginning to end, which causes students to get bored in the learning process. The available teaching materials are mostly in the form of print media in schools. Based on researchers' observations, there is no use of learning modules, especially e-modules (Rismayanti et al., 2022). According to Nurmayanti (2015), e-modules are independent teaching materials containing specific learning objectives, then systematically arranged into smaller learning activities. Based on the background that has been explained, to help students and teachers achieve learning goals and add interactive learning media references to adapt to current developments in technology and science, researchers are trying to develop an environmental education e-module with a problem based learning model (PBL) for elementary school students in fostering pro-environmental behaviour.

METHOD

ADDIE (Analysis Design Development Implementation Evaluation)

This research method uses research and development or R&D (Research and Development) methods with a development model, namely ADDIE. This model is used to develop an instructional model product so that it is right on target, effective and dynamic to help develop learning products for teachers. The product to be developed is an application of the e-module.

Location

The research location for conducting field trials consists of two places of elementary schools. For conducting small scale trials we used Sekolah Alam Cendekia (located at Jalan Cilubang Nagrak RT 01 RW, Situ Gede, Bogor Barat, Bogor City), while for conducting large scale trials we used SDN Balungbang Jaya 1 (located at Jalan Swadaya II RT 1/6, Babakan, Kelurahan Balumbang Jaya, Bogor Barat, Bogor City).

RESULTS

Analysis

A needs analysis is conducted by gathering information related to the learning process and the types of teaching media required to support the achievement of learning objectives. This information is obtained through curriculum reviews, teacher interviews, and student questionnaires to determine material suitability, difficulty level, and media usage preferences. The results of this analysis serve as the basis for designing relevant and effective learning offerings, ensuring that the developed media can help students understand the material more optimally, increase learning motivation, and support the achievement of expected competencies.

Design

Preparing Design in Media

The next stage after analyzing the needs in developing this e-module is to start by designing the learning content that will be used. Design of learning media that will be created using the Canva Pro application or software.

Preparation of Material Presentation

Based on the description of science and science learning outcomes in the independent curriculum, it has been reduced to several learning objectives that refer to higher order thinking skills or what are called Higher Order Thinking Skills (HOTS). One of the ways teachers can improve the quality of students is by focusing on improving the quality of learning in the classroom which is oriented towards high-level thinking skills.

Instrument Design

The instrument is a form of assessment that contains statements to be submitted to experts and users of the e-module being developed to determine the percentage of feasibility and attractiveness of the media created. Apart from that. instruments have been prepared to measure understanding of the material that has been designed in the e-module being developed. Then create a response instrument regarding the acceptance of the e-module on a small scale and a large scale.

Development

This e-module was created using the canva.com application which was published in pdf form. The application used by canva.com is premium because it is more applicable with tools that can be used once you have made a payment, so the support for the e-module design is more varied. After completing the input of learning objectives, the material will be explained to students via the canva.com application until the final stage and can be tested with several experts to provide assessments along with suggestions or comments from each expert who has been determined.

Validation

Validation aims to check the media being developed by experts. The experts will fill out an instrument sheet related to their expertise, firstly a multimedia expert, a language expert, a learning materials expert, curriculum expert, and learning methods expert. The following are the validation results from experts on the e-module developed (Table 1).

Table 1. Expert validation calculation results.

Aspect	Value obtained	Expected value	P (%)	Criteria
Multimedia	4.71	5	94.29	Very Worth It
Language	4.33	5	86.67	Very Worth It
Learning materials	4.83	5	96.60	Very Worth It
Curriculum	4.83	5	96.67	Very Worth It
Expenditure Method	4.67	5	93.33	Very Worth It

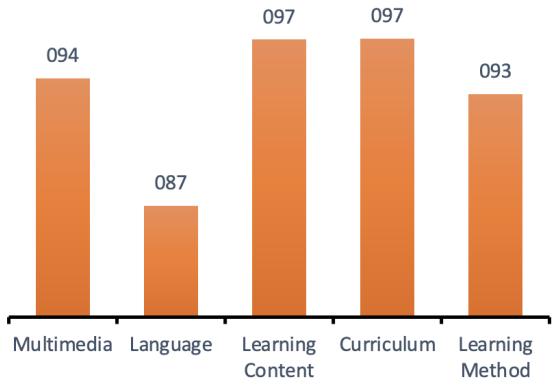

Figure 1. Result of expert validation.

Based on the results above, the development of this e-module has gone through validation stages from experts in multimedia, language, learning materials, curriculum, and learning methods expert. The results of validation and input from experts have been carried out by researchers and improvements have been made. Starting from the initial model, there are still many shortcomings in appearance and there are several materials that still need improvement. The multimedia validation results were 94.29%, 86.67% for language experts, 96.60% for material experts, 96.67% for curriculum experts, and 93.33% for learning methods experts (Figure 1). Based on these results, "No Revision is Required" so the e-module developed is suitable for use (Table 2).

Table 2. Eligibility level qualification.

Achievement Level	Qualification	Information
80-100%	Valid	No Revision Required
60-79%	Fairly Valid	No Revision Required
40-59%	Less Valid	Revision
0-38%	Invalid	Revision

Source: Arikunto et al., 2010

According to the Science Education Resource Center (SERC), there are advantages in using learning media from the student side, consisting of 1) the media used can help attract students' attention and interest during the learning process, 2) students can hone their analytical skills using the theories and concepts they have learned, learn with the help of these learning media, 3) students can see new theories and examples when listening to explanations with friends, and 4) students learn about developments in the wider world, especially if the environment being explained is different from that in everyday life.

Implementation

The implementation process is a process of field testing the learning media that is being developed. At this stage the product is declared valid and suitable for testing, then the product can be tested on a small scale and a large scale.

Small Scale Field Trials

The first field trial was carried out on a small scale at an elementary school educational institution, namely Sekolah Alam Cendekia, in Bogor City. A small-scale trial of the environmental change e-module was carried out on 20 grade V elementary school students at the this school. Before explaining the material according to the Problem Based Learning (PBL) learning steps, students carry out a pre-test first.

After carrying out a pre-test (Table 3) on material related to environmental change, testing is then carried out based on the activities that have been designed in the e-module. The pre-test is carried out before explaining the e-module to students and the post-test is carried out after the e-module is applied to students.

The data obtained was then analyzed using the T test to find out whether the use of e-modules with the Problem Based Learning (PBL) model had an impact on understanding environmental change, with the following hypothesis:

H_0 = there is no difference in the average score before and after

H_1 = there is a difference in the average score before and after

Table 3. The results of pre and post-test in small scale field trial.

	Pre-test	Post-test
Average	60.00	84.50
Deviation	19.19	16.44
Variance	388.89	270.18
dk (Degree of Freedom)	ni+n2-2	38

Table 4. Summary of T-test results of small scale field trial.

Averages range	24.50
Var 1/n1	19.44
Var 2/n2	13.51
KOEF correlation	0.74
2 Koef. Correlation	1.47
Deviation / Square root n1	4.29
Deviation / Square root n2	3.68

Based on the data processing above, the t count is -7.86588 and the t table is -1.7247. The calculated t criterion is not between the t tables, then H0 is rejected and H1 can be accepted. Based on these data, it shows that the use of the environmental change e-module has an effect on environmental knowledge in fostering pro-environmental behaviour because there is a difference in scores before and after, with an average score difference of 24.50 (Table 4).

Table 5. Small scale N-Gain score results.

Field Trials	N-Gain Score	N-Gain Score %
Small Scale	0.65 Currently	64.83 Quite Effective

Based on the pre-test and post-test scores (Table 3), the average N-Gain score was 0.65 (Table 5). Based on the criteria presented by Meltzer (2002), if the average N-Gain score is between 0.3 and 0.7, it is included in the medium criteria. According to Hake (2002), the criteria for the N-Gain percentage are between 56-75, so it is included in the "quite effective" criteria. The calculation results in the table above show an average N-Gain value of 0.65, which means the feasibility level of the e-module being developed is included in the "Medium" criteria and the N-Gain percentage score shows 64.83, meaning the e-module changes the environment, developed to meet the criteria of "Fairly Effective" for use and has an effect on increasing environmental understanding in V grade elementary school students.

Large-Scale Field Trials

Next, a large-scale trial will be carried out on the feasibility of environmental change e-modules in fostering pro-environmental behaviour, and field trials will be carried out again on a large scale. Large-scale trials have the same stages as trials that have been carried out on a small scale. The difference is that the environmental change e-module was carried out on grade V elementary school students in different schools, namely 42 students at SDN Balungbang Jaya 1 in Bogor City. The data obtained (Table 6) was then analyzed using the T test to find out whether the use of e-modules with the Problem Based Learning (PBL) model had an impact on understanding environmental change, with the following hypothesis:

H_0 = there is no difference in the average score before and after

H_1 = there is a difference in the average score before and after

From these data, the t count is -15.4169 and the t table is -1.6636. The calculated t criterion is not between the t tables, then Ho is rejected and H1 can be accepted.

Table 6. The results of pre and post-test in large scale field trial.

	Pre-test	Post-test
Average	56.90	85.48
Deviation	17.46	9.93
Variance	304.82	98.55
dk (Degree of Freedom)	ni+n2-2	82

Table 7. Summary of T-test results of large scale field trial.

Averages range	28.57
Var 1/n1	7.26
Var 2/n2	2.35
KOEF correlation	0.75
2 Koef. Correlation	1.50
Deviation / Square root n1	2.69
Deviation / Square root n2	1.53

Based on these data, it shows that the use of the environmental change e-module has an effect on environmental knowledge in fostering pro-environmental behaviour because there is a difference in scores before and after, with an average difference in score of 28.57 (Table 7).

Table 8. Large scale N-Gain score results.

Field Trials	N-Gain Score	N-Gain Score %
Large Scale	0.69 Currently	68.89 Quite Effective

Based on the pre-test and post-test scores (Table 6), the average N-Gain score was 0.69 (Table 8). Based on the criteria presented by Meltzer, if the average N-Gain score is between 0.3 and 0.7, it is included in the medium criteria. According to Hake (2002), the N-Gain percentage criteria that have been carried out are if you get an N-Gain score percentage between 56-75 then it is included in the "quite effective" criteria. Based on the calculation results from the table above, the average N-Gain value is 0.69, which means that the e-module being developed is within the "Medium" criteria and the N-Gain percentage score shows 68.98, meaning the environmental change e-module meets the criteria, which is "Quite Effective" for use and has an effect on increasing the environmental understanding of class V students at large-scale elementary schools at SDN Balungbang Jaya 1.

Response from the Science Class Teacher

During the e-module testing process, both small scale and large scale, each class teacher from the school concerned also carried out an assessment of the e-module that the researcher developed. The validation results from small and large scale class teachers are in the following table (Table 9).

Table 9. Classroom teacher validation results.

Validator	Value Obtained	Expected Value	P (%)	Criteria
Small-scale Test Class Teacher	4.57	5	91.43	Very Worth It
Large-scale Test Class Teacher	4.86	5	97.14	Very Worth It

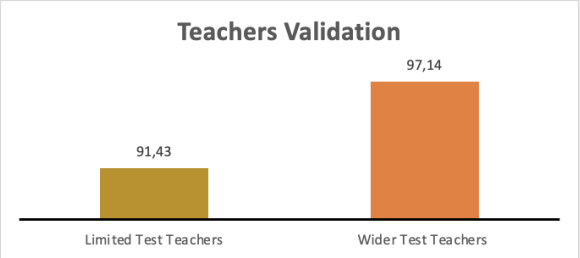

Figure 2. The graph of class teacher validation results.

Based on the responses submitted by class teachers, the percentage was 91.43% for the small scale and 97.14% for the large scale (Figure 2). So that the percentage results that get the criteria are very feasible and do not need to be revised. The response from each class teacher who carried out the learning process was very good and the e-module developed was friendly for elementary school students to use because it was interesting, complete with visual pictures and learning videos that could be accessed independently to increase understanding of environmental changes.

Response from Students

Based on the statement prepared by the researcher, students will respond to the statement with Yes or No. Information for statements that receive a response of "Yes" is worth "1" while for "No" is worth "0". The following are the results of the small-scale student responses (Table 10). Formula used to calculate Content Validity Ratio:

CVR (Content Validity Ratio)

Formula = (Ne-N/2)/(N/2)

Then the CVI (Content Validity Index)

formula = Ne/N

Table 10. CVR & CVI results of student responses from small and large scale field trial.

Small Scale		Large Scale	
CVR	**CVI**	**CVR**	**CVI**
0.7000	0.8500	1.000	1.000
0.8000	0.9000	1.000	1.000
0.9000	0.9500	1.000	1.000
0.7000	0.8500	1.000	1.000
1.0000	1.0000	1.000	1.000
0.7000	0.8500	1.000	1.000
0.6000	0.8000	1.000	1.000

The range of CVR and CVI values is -1 < 0 < 1.

These figures are categorized as follows:

-1 < x < 0 = not good

0 = good

0 < x < 1 = very good

Based on the calculation results in the Table 10, it shows that the accumulated responses from small and large scale field test students are "Very Good" so it can be concluded that the e-module developed is suitable for use.

Pro-Environmental Behaviour Analysis

Researchers tested several indicators that reflect pro-environmental behaviour by selecting three indicators that will serve as references in developing this e-module. These indicators are saving energy, recycling and avoiding waste, the reason is because these three indicators are quite familiar to elementary school students who are the objects of implementing e-module development. The following are the results of the pro-environment instrument analysis (Table 11).

Table 11. Instrument calibration of the pro-environment.

	Validity	**Reliability**
Pro Environmental Indicator	0.3527	0.8591

According to (Azwar, 2013), items can be accepted if they meet the item correlation coefficient requirements, namely ≥ 0.30. The terms of the item correlation coefficient in this study that can be accepted are 0.30. The results of the variable validity evaluation reveal that all variables involved in this research have been proven to be valid if the numbers exceed 0.3. Then the environmental indicators in this research will be analyzed for reliability using the Cronbach's alpha method. The standard used is a value that exceeds 0.6. If the Cronbach's alpha value exceeds the limit of 0.6, it can be considered that the data has an adequate level of reliability. The results of the analysis show that the results of the analysis of the pro-environmental indicators used have an adequate level of reliability, because the Cronbach's alpha value exceeds the threshold of >0.6. which means that the Cronbach's alpha value has met the requirements so that the entire construct can be said to be reliable (Sugiyono, 2018).

Then the percentage of each pro-environment indicator is calculated when implementing small-scale and large-scale e-modules. Following are the results of the presentation (Table 12).

Table 12. Response results for small scale pro-environmental indicators.

	Energy saving (X)	Recycling (Y)	Avoiding Waste (Z)
Amount	350	181	421
Max	21	12	25
Min	12	8	17
Mean	17.5	9.05	21.05
SD	2.3731	1.1910	2.2589
%	83.33	75.42	78.00
K	High	Medium	Medium

Table 13. Response results of large scale pro-environmental indicators.

	Energy saving (X)	Recycling (Y)	Avoiding Waste (Z)
Total	342	188	406
Max	21	11	26
Min	11	5	15
Mean	17.10	9.4	20.30
SD	2.6931	1.2732	2.8855
%	81.43	78.33	75.19
K	High	Medium	Medium

The results above are an accumulation of small-scale and large-scale student responses regarding pro-environmental behaviour (Table 12 & 13). There are three indicators used as measurement scales in fostering pro-environmental behaviour. Energy saving indicators total 7 statements, recycling indicators total 4 statements, and waste avoidance indicators total 9 statements. The statements provided by the researchers were selected by respondents according to the conditions felt during the field trials, resulting in a pro-environment indicator that received the largest percentage, namely energy saving, while recycling and avoiding waste were in the medium criteria.

Based on the results of this research, it further strengthens that using learning media by utilizing digital media can make it easier to understand learning material (Afrila & Yarmayani, 2018). Abdelraheem & Al-Rabane (2005) research states that utilizing learning media can improve the quality of learning, so it is very important for teachers to use learning media. The e-module developed uses a problem based learning model by making students become "Student Centers" who focus on problem solving to improve critical thinking, which is one of the goals of the independent learning curriculum. Through interactive learning, students not only learn about theory, but are also invited to develop critical, collaborative and creative thinking skills in finding solutions in solving these problems. The e-module development carried out by researchers also has an influence in fostering pro-environmental behaviour. Based on the effectiveness of e-module development which is effective enough for small and large scale use, the pro-environmental behaviour results are quite good with a high percentage of energy saving indicators.

According to Wawan (2011) behaviour is an action that can be observed and has a specific frequency, duration and purpose and has interacting factors. Environmental protection behaviour has a strong influence when you have understanding and knowledge in the environmental field and show it to others. so that the expected goals can be achieved (Robertson. 2016). Based on the results of the understanding test explained above, the criteria that are quite effective when carrying out small and large scale field trials have an influence in fostering pro-environmental behaviour with fairly high criteria results for energy saving indicators. This also shows that insight into the environment and environmental issues in the everyday environment is more experienced by respondents who are elementary school age students so that fostering pro-environmental behaviour can still be carried out because the process is still long.

CONCLUSION

The development of the Problem-Based Learning (PBL)-based environmental change e-module followed a systematic process, beginning with a needs analysis to identify required innovations in teaching materials, followed by design, collaborative development, and expert validation. Validation by five experts, along with small-scale and large-scale field tests, demonstrated that the e-module is suitable for fostering pro-environmental behavior among elementary school students. Future development can be adapted to align with specific school needs and current curriculum standards, ensuring that innovations in learning media continue to enhance students' understanding, both in teacher-guided and independent learning contexts.

REFERENCES

Afrila, D., & Yaymayani, A. (2018). Development of Interactive Learning Media Module with Adobe Flash Software in Mathematics Economics Course at Batanghari University Jambi. *Scientific Journal of Batanghari University Jambi, 18(3), 539-551.*

Abdelraheem A. Y., & Al-Rabane, A. H (2005). Utilisation and Benefits of Instructional Media in Teaching Social Studies Courses asPerceived by Omani Students. *Malaysian Online Journal of Instructional Technology, 2(1), 1-8.*

Arikunto., Suharsimi., & Safruddin, A. J. C. (2010). *Evaluasi Program Pendidikan*. Jakarta: Bumi Aksara.

Azwar, S. (2013). *Reliability and Validity*. Yogyakarta: Pustaka Pelajar.

Bronfman, N. C., Cisternas, P. C., López-vázquez, E., Maza. C. De., & Oyanedel, J. C. (2015). Understanding Attitudes and Pro-Environmental Behaviors in a Chilean Community. *Sustainability, 7(10), 14133-14152*. https://doi.org/10.3390/su71014133

Darmawan, D. (2017). The Influence of Packaging and Price on Purchasing Decisions for Hydroponic Vegetable Products. *Agrimas Journal. 1(1). 1-10*.

Downey, H., Amano, T., Cadotte, M., Cook, C. N., Cooke, S. J., ..., Plotnik, J. M., Priatna, D., Ramos, A. G., et al. (2021). Training future generations to deliver evidence-based conservation and ecosystem management. *Ecological Solutions and Evidence, 2(1), e12032*.

Hake, R. (2002). Lessons from The Physics Education Reform Effort. *Conservation Ecology, 5(2), 28*. [online] URL: http://www.consecol.org/vol5/iss2/art28/

Hamzah, S. (2013). *Environmental Education: An Introductory Insight*. Bandung: Refika Aditama.

Kemendikbud. (2022). *Learning Achievements in Early Childhood Education. Primary Education Level and Secondary Education Level in the Independent Curriculum*. Jakarta: Kemendikbud RI.

Kuswati, R. (2021). Instruments Validation of Pro Environmental Behaviour Model. *Validasi Instrumen Model Perilaku Pro Lingkungan*. http://repository.urecol.org/index.php/proceeding/article/view/1717

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why Do People Behave Environmentally and What are the Barriers to Pro-Environmental Behaviour. *Environmental Education Research, 8(3), 239-260*. https://doi.org/10.1080//1350462022014540

Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gain in physics: A possible "hidden variable" in diagnostic pre-test scores. *American Association of Physics Teachers, 70(12), 1259-1268*.

Nurmayanti, F. (2015). Development of an Electronic Physics Module with the PDEODE Strategy on the Subject of Kinetic Theory of Gases for Class XI SMA Students. Proceedings of the National Symposium on Science Innovation and Learning. Bandung: ITB.

Marfai, M. A. (2016). *Introduction to Environmental Ethics and Local Wisdom*. Yogyakarta: Gadjah Mada University Press

Priatna, D., & Khan, S. M. (2024). The importance of education and role of educational institutions in climate change mitigation and achieving UN SDG 13 "Climate Action" *Indonesian Journal of Applied Environmental Studies, 5(1), 1-5*.

Priatna, D., Monk, K. A., & Khan, S. M. (2025). Empowering the Planet: The 2025 Earth Day Resolution. *Indonesian Journal of Applied Environmental Studies, 6(1), 1-6*.

Rismayanti, T. A., Anriani. N., & Sukirwan, S. (2022). Development of Modular-Assisted E-Modules on Smartphones to Improve Junior High School Students' Mathematical Critical Thinking Abilities. *Journal of Mathematics Education, 6(1), 859–873*. https://doi.org/10.31004/cendekia.v6i1.1286

Robertson, J. L. (2016). Greening Organizations Through Leader's Influence on Employees Pro- Environmental Behaviors. *Journal of Organizational Behavior, 34(2), 176–194*.

Sugiyono. (2018). *Quantitative, Qualitative and R&D Research Methods*. Bandung: Alfabeta.

Susanto. D. (2012). Implementation of character education through nature-based learning at SD Alam Ar-Ridho Semarang. [Thesis]. Universitas Negeri Yogyakarta, Yogyakarta.

Uar, N. D., Murti, S. H., & Hadisusanto, S. (2016). Kerusakan Lingkungan Akibat Aktivitas Manusia pada Ekosistem Terumbu Karang. *MGI Journal, 30(1). 88-95*.

Wawan, A., & Dewi, M. (2011). *Theory and Measurement of Knowledge, Attitudes, and Human Behavior*. Yogyakarta: Nuha Medika.

Wiharjo, D. S., Sofia, H., Yuliani, N., & Sujarwanta, A. (2017). The effects of green schooling knowledge level and intensity of parental guidance on the environmental awareness of the early age student. *Academic Journals, 12(5), 251-257*. doi: 10.5897/ERR2015.2608