**BUKTI KORESPONDENSI**

**ARTIKEL JURNAL INTERNASIONAL TERINDEKS DATA BASE BEREPUTASI**

Judul Artikel        : Factors affecting pro-environmental behaviour of Indonesian

                     university students

Jurnal               : Journal of Turkish Science Education
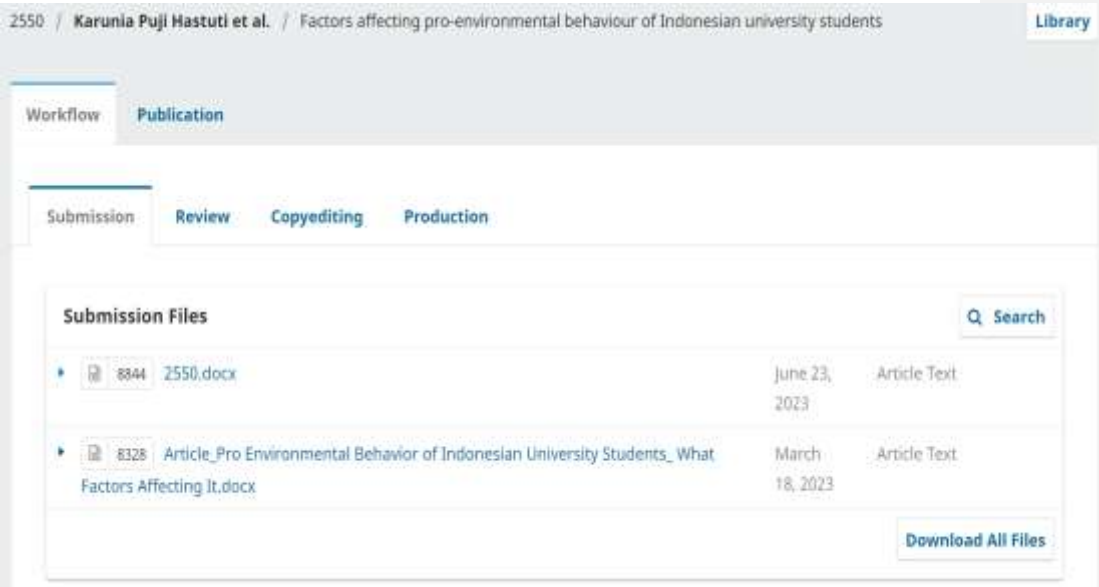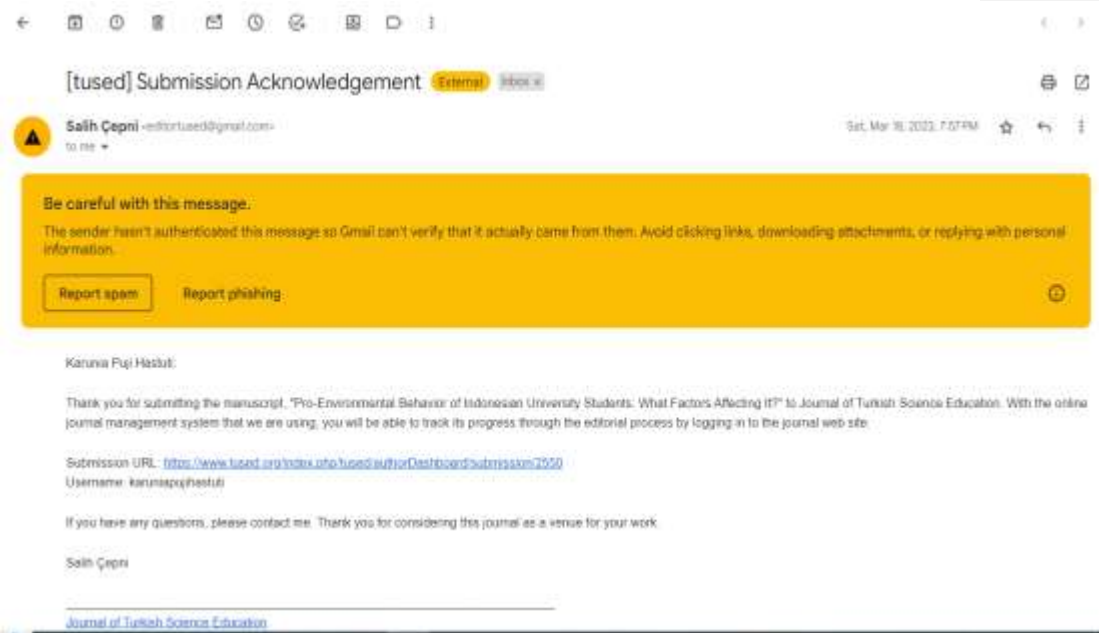
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Penulis             : Karunia Puji Hastuti, Deasy Arisanty, Muhammad Muhaimin, Parida

                     Angriani, Eva Alviawati, Nevy Farista Aristin, Akhmad Munaya
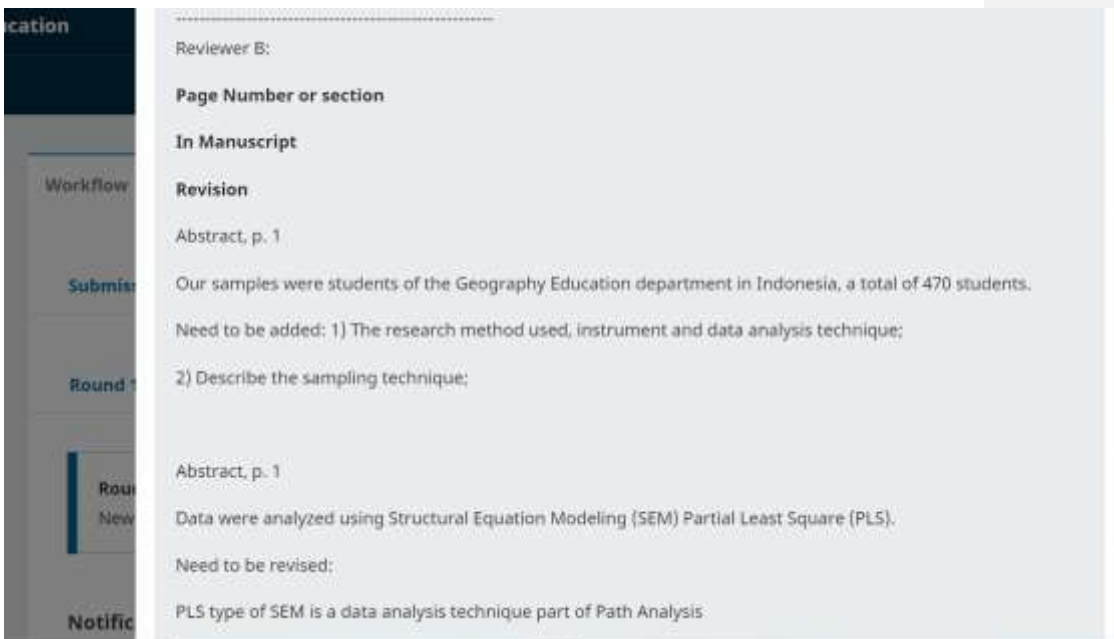
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| 1 | Bukti konfirmasi submit artikel dan artikel yang disubmit | 18 Maret 2023 |
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**(1) Bukti konfirmasi submit artikel dan artikel yang disubmit**



Karunia Puji Hastuti:

Thank you for submitting the manuscript, "Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?" to Journal of Turkish Science Education. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site.

Submission URL: https://www.tused.org/index.php/tused/authorDashboard/submission/2550
Username: karuniapujihastuti

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Salih Çepni

Journal of Turkish Science Education

**(2) Bukti review pertama dari reviewer B dan C**

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Reviewer B:

**Page Number or section**

**In Manuscript**

**Revision**

Abstract, p. 1

Our samples were students of the Geography Education department in Indonesia, a total of 470 students.

Need to be added: 1) The research method used, instrument and data analysis technique;

2) Describe the sampling technique;

Abstract, p. 1

Data were analyzed using Structural Equation Modeling (SEM) Partial Least Square (PLS).

Need to be revised:

PLS type of SEM is a data analysis technique part of Path Analysis

1. Introduction, p. 2-3

The present study aims to analyze factors affecting pro-environmental behavior among university students in Indonesia.

1) At the end of the introductory section, the objectives do not match the objectives in the abstract;

2) Notice: Writing consistent goals makes it easier to write conclusions

2. Literature review, p. 3

(Bechtel & Bechtel, 1997; Saegert & Winkel, 1990); (Schultz et al., 1995; Stern et al., 1999)

1) References published before 2000 must be replaced with more recent sources;

2) References published between 2005 – 2010, it is recommended to be replaced with more recent sources;

3) The review above applies to citations on other pages.

Workflow

Submiss

Round 1

Rou
New

Notific

Literature review, p. 3;          3rd paragraph

To sum up, pro-environmental behavior is one's effort to reduce the negative impact of his or her activities on the environment to prevent environmental damage and preserve the environment.

An idea is only one sentence, show it is joined to the upper or lower paragraph, taking into account the relation of ideas between the two paragraphs

Literature review, final paragraph, p. 4

There is also a difference in pro-environmental behavior between the younger and older generations (Alzubaidi et al., 2021).

At the end of the paragraph, it is necessary:

Scientific reasons position certain variables preceded by other variables, for example X2 (causes or exogenous variables) precedes X3 (effect or endogenous variables), and so on; disclosed in the method

3. Material and Method, 2nd. paragraph, p. 5

This study employed a quantitative method with a cross-sectional approach

Among the literature (Gall et al., 2003; Borg et al., 2009) the principle of cross-sectional research is applied to

3. Material and Method, 2nd. paragraph, p. 5

This study employed a quantitative method with a cross-sectional approach

Among the literature (Gall et al., 2003; Borg et al., 2009) the principle of cross-sectional research is applied to subjects who have levels or ranks. This manuscript has not explained how to determine & what levels are for research subjects.

Material and Method, 2nd paragraph, p. 5

Twenty-one universities consisting of 7 publics and 14 privates, is there an explanation or coincidence?

Material and Method, 5th paragraph, p. 5

1. The proposed causal model should be given an explanation of the position between variables,

2. Provide a schematic or model figure proposed in this section (page 5) by determining the position of X1, X2, X3, X4, and Y, to lead to scientific truth for the pro-environmental model in Figure 1 (on page 9).

4. Results and discussion; 2nd paragraph, p.6

the results and discussion:

Before to paragraph 2, a table of data or data recapitulation for the five variables can be presented

Results and discussion;

Coefficient of Determinant (R-square), p.8

Review: SmartPLS3.0 software was used to analyze the data, the results are presented in Table 2.

But already written Table 1

Factors Affecting Pro-Environmental Behavior of University Students, 1st paragraph, p. 10

The path coefficient analysis presented in Table 3 for *testing the first hypothesis* shows that H0 is rejected and H1 is accepted.

The path analysis model has not been disclosed in the literature review and methods section, can to be added

5. conclusion, p. 14

It is extremely important for everyone, especially the young generation, to behave pro-environmentally to reduce environmental problems.

1.  Write down the essential items based on the results of data processing to answer the objectives related to the hypothesis;

2.  implications have not been stated

References

Writing references, following the journal template

References

Use references of 3 - 5 articles published in the last 2 -3 years, from the Journal of Turkish Science Education

Recommendation: Revisions Required

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Reviewer C:

The scope of the manuscript is not directly related to the scope of the journals. We usually published articles about science end technology education. The sample of the manuscript should be science teachers, or students taken science courses.

Recommendation: Decline Submission

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# Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?

**Abstract**

Environmental damage is proof of the negative effect of human activities. The young generation is the one taking the burden of environmental damage left by the previous generations. In addition, the young generation must also take a role as the agent of change in improving the environment. This study analyzes the pro-environmental behavior of Indonesian students, the factors affecting such behavior, and the efforts to improve the behavior. Our samples were students of the Geography Education department in Indonesia, a total of 470 students. The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y). Data were analyzed using Structural Equation Modeling (SEM) Partial Least Square (PLS). Findings confirmed high pro-environmental behavior, affected by environmental knowledge, environmental responsibility, value-belief-norm, and environmental education, having a convincing positive effect on forming environmental behavior. It is crucial that the young generation learns pro-environmental behavior through formal education since the behavior helps preserve the environment.

**Keyword**: environmental damage, pro-environmental behavior, human activities, young generation

> **Commented [A1]:** Need to be added: 1) The research method used, instrument and data analysis technique;
> 2) Describe the sampling technique;

> **Commented [A2]:** Need to be revised:
> PLS type of SEM, is a data analysis technique part of Path Analysis

## 1. Introduction

Environmental damage has been the topic of many discussions by the government, researchers, and local and international organizations. Their concern is not far from the issue of waste, pollution, deforestation, extreme climate change, global warming, ozone depletion, the greenhouse effect, and acid rain. Most environmental damage happens due to human activities; the damage will affect our ecosystem completely now and in the future. Human behavior greatly impacts the environment (Gifford & Nilsson, 2014; Steg & Vlek, 2009).

Awareness of environmental problems and efforts to preserve the environment is indispensable to prevent further damage to our only home; this can be done through pro-environmental behavior. Pro-environmental behavior refers to conscious efforts to minimize the negative impact of human activities on the environment (Kollmuss & Agyeman, 2002). Pro-environmental behavior can also be defined as real or perceptual actions contributing to environmental conservation (Kurisu, 2015). The United Nations Commission on Sustainable Development (UN CSD) International Work Programme defines pro-environmental behavior as the use of products and services to fulfill the primary needs and bring a better quality of life while minimizing the use of natural resources and reducing hazardous materials, waste, emission, and

pollutant through a lifecycle to not harm the life of the future generations (Jensen, 2002; Steg & Vlek, 2009).

Education is an important variable in explaining awareness of and environmental behavior (Zilahy & Huisingh, 2009; Zsóka et al., 2013). Previous studies suggest that people with higher education levels tend to care more about the quality of the environment and are motivated to be directly involved in environmental preservation due to awareness of damage potential (Lozano & Vallés, 2007; Ramos et al., 2015). Universities play a crucial role in directing students to develop environmental awareness in both the social and physical environment (Meyer, 2016).

University students are intellectuals who will become the nation's next generation—they must have pro-environmental behavior. The quality of our environment depends on our behavior. The young generation is the one taking the burden of environmental damage left by the previous generations; they are also an important factor in changing the environment towards a better state.

Universities in Indonesia have assisted students in improving their pro-environmental behavior through a course named *Pendidikan Lingkungan Hidup* (Environmental Education). The course is also provided to students majoring in Geography Education. The course teaches students the importance of the environment, environmental issues, and real actions to preserve the environment. The integration of this course into the curriculum is believed to be able to increase pro-environmental behavior. Even though the effect of knowledge has not been revealed scientifically, some studies show that knowledge plays a crucial role in increasing pro-environmental behavior; it also helps individuals to have alternative perspectives through the formation of arguments to support their beliefs and behavior (Larson et al., 2015).

Increased awareness and understanding of environmental issues and pro-environmental behavior can take place through environmental education (Jurdi-Hage et al., 2019). This aligns with the role of universities as effective agents of change. A study by (Jurdi-Hage et al., 2019; Meyer, 2016) mentions that certain policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation. The present study aims to analyze factors affecting pro-environmental behavior among university students in Indonesia.

## 2. Literature review

Pro-environmental behavior can be translated as actions that show concern for the environment in everyday life. The actions can be repetitive or just occasional, and the actions deal with preserving natural resources and the environment, such as preserving specific natural resources (water, soil, and air), reducing energy consumption (electricity, oil, and gas), recycling (recycling paper, plastic, and

> **Commented [A3]:** 1) At the end of the introductory section, the objectives do not match the objectives in the abstract;
> 2) Notice: Writing consistent goals makes it easier to write conclusions

others), and preserving life (animals and plants) (Bechtel & Bechtel, 1997; Saegert & Winkel, 1990). Pro-environmental behavior also refers to any actions to minimize environmental damage or to improve the environment (Scannell & Gifford, 2010). Pro-environmental behavior comes in dimensions, including recycling, which means reusing or remanufacturing what has been used.

Pro-environmental behavior is also seen as one's effort to prevent environmental damage, protect the environment, and solve environmental issues (Schultz et al., 1995; Stern et al., 1999). Pro-environmental behavior refers to conscious efforts to minimize the negative impact of one's action on nature (both natural and artificial ecosystems), such as minimizing natural resources and consumption, toxin, waste, and so forth (Kollmuss & Agyeman, 2002).

To sum up, pro-environmental behavior is one's effort to reduce the negative impact of his or her activities on the environment to prevent environmental damage and preserve the environment.

Several factors affecting pro-environmental behavior, environmental commitment and awareness, green lifestyle, and green self-efficacy positively affect the pro-environmental behavior of young people (Yusliza et al., 2020). Holistic and systemic perspectives on the environment are crucial in promoting pro-environmental behavior (P. Liu et al., 2020; X. Liu et al., 2018). Pro-environmental behavior also increases with sociodemographic factors, including knowledge, awareness, and understanding of environmental damage (Soares et al., 2021) Environmental knowledge affects pro-environmental behavior (Liobikienė & Poškus, 2019). Social norms and lifestyle contribute to pro-environmental behavior. The pro-environmental behavior of females is affected by social norms and lifestyle, while the lifestyle of males is affected by their views on certain policies (Wut et al., 2021). There is also a difference in pro-environmental behavior between the younger and older generations  (Alzubaidi et al., 2021).

Pro-environmental behavior of university students is also affected by formal education. Environmental knowledge delivered through formal education can improve pro-environmental behavior. Environmental systems, including political ecology, sustainable development, the environment and ecology, and environmental situations, affect pro-environmental behavior (Janmaimool & Khajohnmanee, 2019). Values, new environmental paradigms, and personal norms also affect pro-environmental behavior among students (S. Liu & Guo, 2018). Gender, ages, and positions of females (undergraduate and postgraduate students, post-doctoral students, professors, and scientists) have shown a positive and significant correlation with pro-environmental behavior (Hansmann et al., 2020).

Our research hypotheses are as follows:

*Hypothesis 1 (H1)*

*H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behavior*

*H1: Environmental Knowledge of students has a positive and significant correlation with Pro-Environmental Behavior*

*Hypothesis 2 (H2)*

*H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behavior*

*H1: Environmental Responsibility of students has a positive and significant correlation with Pro-Environmental Behavior*

*Hypothesis 3 (H3)*

*H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behavior*

*H1: Environmental Education of students has a positive and significant correlation with Pro-Environmental Behavior*

*Hypothesis 4 (H4)*

*H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behavior*

*H1: Value-belief-norm of students has a positive and significant correlation with Pro-Environmental Behavior*

## 3. Material and Methods

This study employed a quantitative method with a cross-sectional approach. A cross-sectional study examines causal relationships with some methods, such as observations and data collection within a single time (Wang & Cheng, 2020). In a cross-sectional study, dependent and independent variables are observed at the same time (Wang & Cheng, 2020; Zangirolami-Raimundo et al., 2018).

Our samples were students of the Geography Education department in Indonesia, a total of 470 students. The universities included Universitas Lambung Mangkurat, Universitas PGRI Kanjuruhan, Universitas Khairun Ternate, Universitas Samudra, Universitas Negeri Makasar, Universitas Negeri Malang, IKIP PGRI Pontianak, Universitas Al Muslim, Universitas Widya Dharma, Universitas Hamzanwadi, Universitas Negeri Padang, Universitas Muhammadiyah Mataram, STIKIP Kei Raga Ternate, Universitas Tadulako, USK, Universitas Halu Oleo, Universitas Siliwangi, IKIP PGRI Palangkaraya, Universitas Nusa Cendana Kupang, Amikom Yogyakarta, and

**Commented [A7]:** Among the literature (Gall et al., 2003; Borg et al., 2009) the principle of cross-sectional research is applied to subjects who have levels or ranks. This manuscript has not explained how to determine & what levels are for research subjects.

**Commented [A8]:** Twenty-one universities consisting of 7 publics and 14 privates, is there an explanation or coincidence?

Universitas Negeri Jember. Data were collected through observations, interviews, questionnaires, and documentation.

The Smart PLS 3.0 Program was used to check the validity of our instruments by looking at the loading factors of each construct indicator. The common requirement to test the validity of research instruments is that the loading factor must be bigger than 0.70 (Chan & Lay, 2018; Zürich et al., 2005). Reliability was tested by calculating the composite reliability—the range is 0.6 to 0.7 (Chan & Lay, 2018; Rasoolimanesh, 2022). The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y).

Data were analyzed using the Structural Equation Modeling (SEM) Partial Least Square (PLS). SEM-PLS is a causal model that explains the effect between variables on the construct variable (Chan & Lay, 2018).

Table 1. Research Variables

| Variable | Indicator |
|---|---|
| Environmental knowledge (X1) | 1. Knowing daily environmental problems<br>2. Knowing the causes of environmental problems<br>3. Knowing the solutions to solve environmental problems<br>4. Understanding the dependency of human beings on the environment<br>5. Knowing renewable energy |
| Environmental responsibility (X2) | 1. No littering<br>2. Keeping the environment clean<br>3. Using environmentally friendly energy and resources<br>4. Greening the surrounding areas |
| Value–belief–norm (X3) | 1. Believing that everything on earth is God's creation<br>2. Being thankful for what is available on earth<br>3. Sticking to the concept of cleanliness in doing religious rituals<br>4. Practicing religious advice to protect the environment |
| Environmental education (X4) | 1. Increasing understanding of environmental problems<br>2. Improving acceptance, assessment, organization, and personality characteristics in managing life in harmony with nature<br>3. Growing a love of the environment<br>4. Increasing interest in the environment |
| Pro-Environmental Behavior (Y) | 1. Participating in events/seminars/workshops on environmental issues<br>2. Reducing the use of plastic<br>3. Replacing disposable drinking bottles with tumblers |

**Commented [A9]:** 1. The proposed causal model should be given an explanation of the position between variables,
2. Provide a schematic or model figure proposed in this section (page 5) by determining the position of X1, X2, X3, X4, and Y, to lead to scientific truth for the pro-environmental model in Figure 1 (on page 9).

| | 4. Replacing food wrapping paper with lunch boxes |
| | 5. Buying items with a recyclable sign |
| | 6. Reusing items that are usable |
| | 7. Using rechargeable batteries |
| | 8. Sorting waste |
| | 9. Reusing items that are still suitable for use |
| | 10. Disposing of phone batteries or electronic device batteries properly |
| | 11. Turning off electronic devices that are not in use |
| | 12. Using electronic devices with energy-saving features |
| | 13. Turn off the lights during daytime |
| | 14. Using water wisely |
| | 15. Using a water storage tank |

## 4. Results and Discussion

**Outer Model**

The outer model was used to check the validity and reliability of the model. Before hypothesis testing to predict the relationship between latent variables in a structural model, we first evaluated the outer model to verify indicators and latent variables for further analysis. The validity test evaluates the ability of research instruments to measure what they are intended to measure (Hair et al., 2017; Hair Jr et al., 2020). The reliability test evaluates the consistency of a measurement instrument in measuring a concept or the consistency of research respondents in answering questionnaire items or research instruments. The result is presented in discriminant validity (outer loadings), Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

Measuring discriminant validity through outer loadings ensures that each concept of the latent model is different from other variables. Outer loadings or loading factors are the beginning of the validity checking of a model. An indicator is reliable if it has a correlation value of more than 0.70. An indicator is valid if its outer loading is between 0.50 – 0.60, so its presence is acceptable (Hair et al., 2020). The results of the outer model analysis are presented in Figure 1 and Table 1.

**Commented [A10]:** Before to paragraph 2, a table of data or data recapitulation for the five variables can be presented
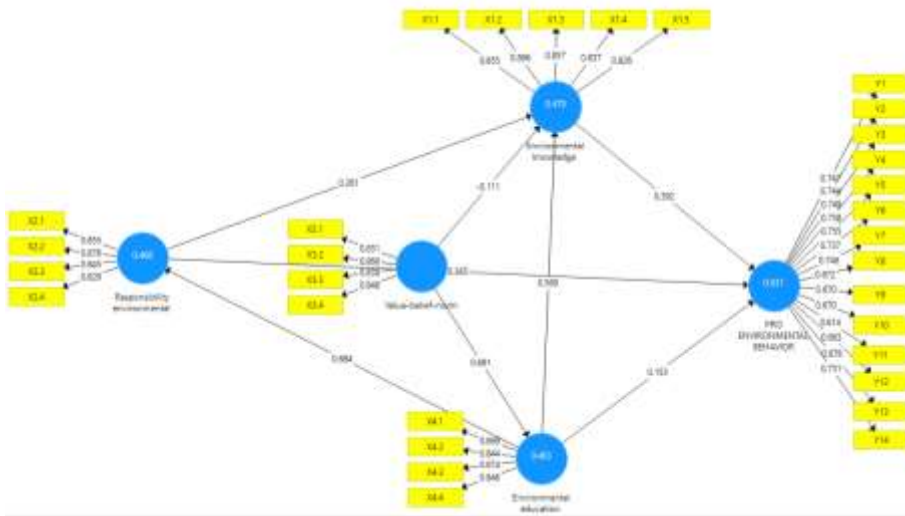
**Figure 1.** Model Pro-Environmental Behavior of University Students in Indonesia

Table 1. Structural Model

| Construct | Items | Loading Factors | Cronbach's alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|
| Environmental knowledge | X1.1 | 0.855 | 0.903 | 0.928 | 0.720 |
| | X1.2 | 0.866 | | | |
| | X1.3 | 0.857 | | | |
| | X1.5 | 0.837 | | | |
| | X1.5 | 0.826 | | | |
| Environmental responsibility | X2.1 | 0.855 | 0.874 | 0.914 | 0.726 |
| | X2.2 | 0.878 | | | |
| | X2.3 | 0.845 | | | |
| | X2.4 | 0.829 | | | |
| Value–belief–norm | X3.1 | 0.831 | 0.868 | 0.910 | 0.715 |
| | X3.2 | 0.866 | | | |
| | X3.3 | 0.838 | | | |
| | X3.4 | 0.848 | | | |
| Environmental education | X4.1 | 0.869 | 0.881 | 0.918 | 0.737 |
| | X4.2 | 0.844 | | | |
| | X4.3 | 0.874 | | | |
| | X4.4 | 0.846 | | | |
| Pro-Environmental Behavior | Y1 | 0.747 | 0.924 | 0.934 | 0.505 |
| | Y2 | 0.670 | | | |
| | Y3 | 0.614 | | | |
| | Y4 | 0.663 | | | |
| | Y5 | 0.678 | | | |
| | Y6 | 0.731 | | | |
| | Y7 | 0.744 | | | |

| | |
|---|---|
| Y8 | 0.749 |
| Y9 | 0.758 |
| Y10 | 0.755 |
| Y11 | 0.737 |
| Y12 | 0.746 |
| Y13 | 0.672 |
| Y14 | 0.670 |

Table 1 shows that all indicators of the latent variables are valid and reliable because their outer loading values are between 0.60 and 0.70. Thus, all latent variables could explain the variable of each indicator that measured them.

Discriminant validity can be determined using AVE for each construct or latent variable. The model has better discriminant validity if the AVE square root for each construct is greater than the correlation between the two constructs in the model.

Table 1 shows that the AVE value for all constructs is> 0.50. Therefore, there is no problem with convergent validity in the model being tested. The Cronbach Alpha and composite reliability values for all constructs are also > 0.60, which means that all constructs have very good reliability.

Table 1 shows that the AVE value for all constructs is > 0.50. Therefore, there is no problem with convergent validity in the model being tested. The Cronbach Alpha and composite reliability values for all constructs are > 0.60, which means that all constructs have very good reliability.

**Measuring the Structural Model (Inner Model)**

**Coefficient of Determinant (R-square)**

The R-square value is used to assess the extent of influence certain independent latent variables have on the dependent latent variable. Using SmartPLS 3.0 software, we obtained the following results.

Table 2. Coefficient of Determinant (R-square)

| | R-square | R-square Adjusted |
|---|---|---|
| Environmental education | 0.463 | 0.462 |
| Environmental knowledge | 0.479 | 0.476 |
| Pro-environmental behavior | 0.631 | 0.629 |
| Environmental responsibility | 0.468 | 0.466 |
| Value–belief–norm | 0.430 | 0.433 |

Commented [A12]: Revised table numbering

Table 2 shows the R-square value for environmental education is 0.463; this shows that environmental education has an influence of 46.3% on pro-environmental behavior. The R-square value for environmental knowledge is 0.479; this shows that environmental knowledge has a 47.6% influence on pro-environmental behavior. The R-square value for environmental responsibility is 0.468; this shows that environmental responsibility has a 46.8% influence on pro-environmental behavior. The R-square value for the value-belief-norm is 0.430; this shows that Value-belief-norm

has a 43.0% influence on pro-environmental behavior. The R-square value for pro-environmental behavior is 0.631, which indicates that environmental education, environmental knowledge, value-belief-norm, and environmental responsibility factors influence pro-environmental behavior by 63.1%.

**Hypothesis Testing**

To determine whether the hypothesis is accepted or rejected, the p-value is set at a significance level (α) of 5% or 0.05. If the p-value < 0.05, H0 is rejected, meaning an effect exists. Conversely, if the p-value > 0.05, H0 is accepted, meaning no effect exists. Table 1 presents the results of the evaluation of the structural model of the hypothesis test using the PLS method obtained from the SmartPLS 3.0 Bootstrapping Report.

Table 3. Path Coefficients

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|---|---|
| Environmental education-> Pro-environmental behavior | 0.153 | 0.154 | 0.059 | 2.611 | 0.009 |
| Environmental knowledge-> Pro-environmental Behavior | 0.392 | 0.395 | 0.046 | 8.618 | 0.000 |
| Environmental responsibility -> Pro-environmental behavior | 0.365 | 0.365 | 0.052 | 7.043 | 0.000 |
| Value–belief–norm-> Pro-environmental behavior | 0.430 | 0.433 | 0.033 | 13.234 | 0.000 |

Table 3 shows that environmental education has a positive relationship with pro-environmental behavior, with a p-value of 0.009 (p < 0.05). Environmental knowledge has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Environmental responsibility has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Value–Belief–Norm has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05).

**Factors Affecting Pro-Environmental Behavior of University Students**

The path coefficient analysis presented in Table 3 for *testing the first hypothesis* shows that H0 is rejected and H1 is accepted. This means that environmental knowledge has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Based on the analysis results, most students were already concerned

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Commented [A14]: The path analysis model has not been disclosed in the literature review and methods section, can to be added.

about the environment, such as environmental problems and the causes of such problems. Students also knew solutions to environmental problems and about renewable energy to overcome the problems. Renewable energy sources are environmentally friendly, do not pollute the environment, and do not contribute to climate change and global warming because the energy comes from sustainable natural sources, such as sunlight, wind, water, biofuels, and geothermal.

Knowledge is crucial to determining behavior. Students with environmental knowledge tend to change their behavior due to education; this aligns with the view that environmental knowledge affects pro-environmental behavior (Gifford & Nilsson, 2014). Knowledge is defined as a source of where environmental behavior is formed, and attitude is manifested (Kollmuss & Agyeman, 2002).

Developing students' environmental knowledge is important, especially on campus. A study in Canada reveals that more than 60% of the study respondents agree that one factor hindering pro-environmental behavior is a lack of knowledge (Kennedy et al., 2009; Kennedy & Kmec, 2018). Other studies also confirm that more profound and broader knowledge of environmental issues and solutions to such issues will increase the possibility of individuals taking action to protect the environment (Farrukh et al., 2022; Jensen, 2002; Kaiser, Ranney, et al., 1999; Kaiser, Wölfing, et al., 1999; Kollmuss & Agyeman, 2002; Latif et al., 2013). Individuals with sound knowledge of environmental issues tend to show pro-environmental behavior. Previous studies show that knowledge relates to actions and becomes a predictor of actions (Neolaka, 2020). To sum up, individuals with sound knowledge of environmental issues and solutions to such issues tend to show pro-environmental behavior to protect the environment.

(P. Liu et al., 2020) find a significant relationship between the level of knowledge and the pro-environmental behavior of students—the higher the level of environmental knowledge, the better the pro-environmental behavior of students and vice versa. (Fawehinmi et al., 2020) reveal a positive and quite significant relationship between environmental knowledge and attitudes towards environmental sustainability. If environmental knowledge increases, attitudes towards environmental sustainability will also increase, and vice versa.

(Ardoin et al., 2020) state that people with better environmental knowledge will be better aware of the environment and environmental issues. Thus, they will be motivated to act responsibly toward the environment. Developing environmental awareness through education has always been critical in building pro-environmental behavior. Knowledge people have will guide them to determine whether their actions will be good or bad for the environment. Environmental knowledge can be in the form of knowledge of environmental issues, causes, effects, solutions, and how to become an environmentally responsible agent of change related to the problems (Fawehinmi et al., 2020).

The path coefficient analysis presented in Table 3 for *testing the second hypothesis* shows that H0 is rejected and H1 is accepted. This means that environmental responsibility has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental responsibility is an action motivated by one's willingness to prevent environmental damage or preserve the environment. Our findings showed that the students had good environmental responsibility. They did not litter, cared for environmental cleanliness, used recyclable goods, and did greening of their surrounding areas.

Environmental responsibility is closely related to the ascription of responsibility. Initially, the ascription of responsibility is defined as a feeling of responsibility from the negative consequences of not behaving in a pro-social manner. This theory is widely applied in green behavior because most people behave green based on their altruistic feelings, such as recycling, energy policies, and other green behaviors in general.

Increased awareness and understanding of changing environmental issues and increased skills for environmentally responsible actions can be developed through environmental education (Jurdi-Hage et al., 2019). This is consistent with the university's role as an effective agent of change.

Building awareness to be environmentally responsible aims to preserve the environment, so human beings not only take benefit of the environment for their lives but also take care of and be accountable for preserving the environment. Individuals with high environmental awareness can improve pro-environmental behaviour (Zareie & Navimipour, 2016). In addition, students with higher environmental awareness show more pro-environmental behavior (S. Liu & Guo, 2018; S.-C. Liu & Lin, 2015). As previously indicated, specific environmental awareness can lead to better predictability of environmentally responsible behavior if certain pro-environmental behaviors are assessed.

As formal education institutions, universities must implement pro-environmental behavior (Usaini et al., 2015). People are not born with pro-environmental behavior—the behavior is taught and shaped along with their developmental stages. Increased environmental responsibility will finally lead to positive changes toward pro-environmental behavior.

The path coefficient analysis presented in Table 3 *for testing the third hypothesis* shows that H0 is rejected and H1 is accepted. This means that environmental education has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Our findings confirmed that the students received environmental education, proven by increased environmental knowledge and understanding that they refused to damage the environment at any cost.

Education is crucial in forming pro-environmental behavior (Iswari & Kusuma, 2022). Human behavior greatly impacts the environment. Environmental knowledge gained through education is positively and significantly important to preserve the environment (Azhar et al., 2015). Environmental education teaches students the importance of preserving the environment—it increases students' awareness, directs students, and shapes their attitudes toward preserving the environment (Mulyana, 2009). Environmental education aims to increase people's understanding and concern and is oriented toward preventing environmental damage and finding solutions to environmental issues.

The findings align with (Meyer, 2016), stating that certain policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation.

*The fourth hypothesis testing* shows that H0 is rejected and H1 is accepted. This means the value-belief-norm has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). Our findings showed that students had good value-belief-norm for pro-environmental behaviour, as seen from the willingness of students to protect the environment and support policies to preserve the environment. This aligns with (Whitley et al., 2018), revealing that biosphere and altruistic values make students more willing to be involved in pro-environmental activities, such as supporting policies to protect the environment.

The value-belief-norm theory is proposed by (Stern et al., 1999), stating that value orientation can, directly and indirectly, affect pro-environmental behavior. The theory assumes three value orientations related to environmental concerns relevant to understanding pro-environmental attitudes, preferences, and behavior: altruistic, egoistic, and biosphere value orientations (Oreg & Katz-Gerro, 2006; Stern et al., 1999). Our findings strengthen the theory since the findings show a direct contribution of value orientation toward pro-environmental behavior.

Norms show a person about acceptable and unacceptable behavior. Norms are the rules of society regarding good and bad attitudes and actions that are permissible and not permissible. There are three types of norms: habits, prohibitions, and conventions (Kaiser et al., 2005, 2006). Personal norms are moral ethics and obligations towards something related to orientation in treating something. An ethical approach to dealing with environmental problems is needed. This approach is intended to determine attitudes, actions, and ethical perspectives and appropriately manage environmental care and its ecosystem (Liobikienė & Poškus, 2019).

The principle of respect for nature deals with a moral responsibility towards nature. Every part and object in this universe was created by God with certain purposes, regardless of whether it is for the benefit of humans or not. Therefore, as part of the universe, humans are also responsible for

protecting nature. This responsibility is individual and collective (Stern et al., 1999). Moral responsibility requires humans to take concrete initiatives, efforts, policies, and actions to protect the universe and everything in it. This means the preservation and destruction of nature is a shared responsibility of all humankind. This responsibility is also manifested in the form of warning, prohibiting, and punishing those who damage and endanger nature (Kurisu, 2015; Stern et al., 1999).

Building students' positive environmental values in educational institutions are important as it should help solve environmental problems and improve environmental quality (Chen, 2015). This will help to create a knowledgeable society about environmental issues that will play a major role in preserving the environment.

**Efforts to Improve Pro-Environmental Behavior**

Improving pro-environmental behavior, especially among the younger generation, can be done through education. Building a character of caring for the environment through education is an effort the government of Indonesia takes to preserve the environment. Such character is manifested in attitudes and actions of preventing environmental damage and taking steps to repair the already-happen environmental damage. Some actions to form pro-environmental behavior are: (1) caring for the environment, (2) reducing plastic use, (3) sorting waste, (4) reducing carbon emission, and (5) saving energy. Actions to repair environmental damage include (1) planting trees, (2) reusing goods, and (3) using environmentally friendly technology. The character of caring for the environment must be built from an early age through fun learning.

Other efforts to increase public awareness of the importance of protecting the environment can be carried out through informational and structural strategies. Informational strategies refer to interventions through campaigns or socialization to increase knowledge to minimize environmentally damaging behavior. For example, the reduce, reuse, and recycle (3R) campaign and creating eco-points for residential communities to collect metal, paper, glass, and organic waste for recycling. In addition to reducing waste, the 3R program can also be a means of earning income in which people can deposit their waste to waste banks or recycling facilities.

Efforts to increase public awareness through structural strategies can be made through behavioral changes that affect behavioral decisions. This strategy focuses on external environmental planning that can support pro-environmental behavior—for example, providing easily-accessible bins to avoid littering.

Governments, companies, or other organizations can also improve people's pro-environmental behavior through appropriate environmental policies primarily aimed at increasing self-motivation from the community to behave pro-environmentally. This can be done through activities including providing infrastructure that makes it easier for people to adopt pro-

environmental behavior, such as providing environmentally friendly objects at lower prices, providing pro-environmental education to students as early as possible, developing an in-depth understanding of waste recycling efforts through various media, and supervising the public in subsidy programs for people with pro-environmental behavior and fines for violators of environmental policies.

## 5. Conclusion

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## References

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2)Use references from 3 - 5 articles published in the last 2 -3 years, from the Journal of Turkish Science Education

Alzubaidi, H., Slade, E. L., & Dwivedi, Y. K. (2021). Examining antecedents of consumers' pro-environmental behaviours: TPB extended with materialism and innovativeness. *Journal of Business Research*, *122*, 685–699.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224.

Azhar, A., Basyir, M. D., & Alfitri, A. (2015). Hubungan pengetahuan dan etika lingkungan dengan sikap dan perilaku menjaga kelestarian lingkungan. *Jurnal Ilmu Lingkungan*, *13*(1), 36–41.

Bechtel, R. B., & Bechtel, R. B. (1997). *Environment and behavior: An introduction*. Sage.

Chan, S. H., & Lay, Y. F. (2018). Examining the reliability and validity of research instruments using partial least squares structural equation modeling (PLS-SEM). *Journal of Baltic Science Education*, *17*(2), 239.

Chen, M. (2015). An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in T aiwan. *Asian Journal of Social Psychology*, *18*(2), 145–151.

Farrukh, M., Raza, A., Mansoor, A., Khan, M. S., & Lee, J. W. C. (2022). Trends and patterns in pro-environmental behaviour research: a bibliometric review and research agenda. *Benchmarking: An International Journal*.

Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behaviour of academics: The role of green human resource management and environmental knowledge. *International Journal of Manpower*, *41*(7), 879–900.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141–157.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hansmann, R., Laurenti, R., Mehdi, T., & Binder, C. R. (2020). Determinants of pro-environmental behavior: A comparison of university students and staff from diverse faculties at a Swiss University. *Journal of Cleaner Production*, *268*, 121864.

Iswari, N., & Kusuma, A. B. (2022). Analysis of the factors that influence the environmental quality index in Bekasi Regency. *Jurnal Pengelolaan Sumber Daya Alam Dan Lingkungan*, *12*(4), 720–728.

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of environmental system knowledge in promoting university students' environmental attitudes and pro-environmental behaviors. *Sustainability*, *11*(16), 4270.

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, *8*(3), 325–334.

Jurdi-Hage, R., Hage, H. S., & Chow, H. P. H. (2019). Cognitive and behavioural environmental concern among university students in a Canadian city: Implications for institutional interventions. *Australian Journal of Environmental Education*, *35*(1), 28–61.

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior 1. *Journal of Applied Social Psychology*, *35*(10), 2150–2170.

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (1999). Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment - European Psychologist - Volume 4, Number 2 / 1999 - Hogrefe Publishing. *European Psychologist*, *4*(2).

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (2006). Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment. *Http://Dx.Doi.Org/10.1027//1016-9040.4.2.59*, *4*(2), 59–74. https://doi.org/10.1027//1016-9040.4.2.59

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). ENVIRONMENTAL ATTITUDE AND ECOLOGICAL BEHAVIOUR. *Journal of Environmental Psychology*, *19*(1), 1–19. https://doi.org/10.1006/JEVP.1998.0107

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Why we don't" walk the talk": Understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, 151–160.

Kennedy, E. H., & Kmec, J. (2018). Reinterpreting the gender gap in household pro-environmental behaviour. *Environmental Sociology*, *4*(3), 299–310.

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.

Kurisu, K. (2015). *Pro-environmental behaviors*. Springer.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, *43*, 112–124.

Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia-Social and Behavioral Sciences*, *105*, 866–874.

Liobikienė, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behavior: modifying the value-belief-norm theory. *Sustainability*, *11*(12), 3324.

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment*, *728*, 138126.

Liu, S., & Guo, L. (2018). Based on environmental education to study the correlation between environmental knowledge and environmental value. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3311–3319.

Liu, S.-C., & Lin, H. (2015). Exploring undergraduate students' mental models of the environment: Are they related to environmental affect and behavior? *The Journal of Environmental Education*, *46*(1), 23–40.

Liu, X., Zou, Y., & Wu, J. (2018). Factors influencing public-sphere pro-environmental behavior among Mongolian college students: A test of value–belief–norm theory. *Sustainability*, *10*(5), 1384.

Lozano, M., & Vallés, J. (2007). An analysis of the implementation of an environmental management system in a local public administration. *Journal of Environmental Management*, *82*(4), 495–511.

Meyer, A. (2016). Heterogeneity in the preferences and pro-environmental behavior of college students: The effects of years on campus, demographics, and external factors. *Journal of Cleaner Production*, *112*, 3451–3463.

Mulyana, R. (2009). Penanaman etika lingkungan melalui sekolah perduli dan berbudaya lingkungan. *Jurnal Tabularasa*, *6*(2), 175–180.

Neolaka, A. (2020). Pengaruh pengetahuan pro environmental terhadap perilaku ramah lingkungan. *Prosiding Seminar Nasional Pascasarjana*, *1*(01), 14–21.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: Values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, *38*(4), 462–483.

Ramos, T. B., Caeiro, S., van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, *106*, 3–10.

Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: A comprehensive composite-based approach. *Data Analysis Perspectives Journal*, *3*(2), 1–8.

Saegert, S., & Winkel, G. H. (1990). Environmental psychology. *Annual Review of Psychology*, *41*(1), 441–477.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology*, *30*(3), 289–297.

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, *15*(2), 105–121.

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: Knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials*, *412*, 125227.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97.

Usaini, M. I., Abubakar, N. B., & Bichi, A. A. (2015). Influence of school environment on academic performance of secondary school students in Kuala Terengganu, Malaysia. *The American Journal of Innovative Research and Applied Sciences*, *1*(6), 203–209.

Wang, X., & Cheng, Z. (2020). Cross-sectional studies: strengths, weaknesses, and recommendations. *Chest*, *158*(1), S65–S71.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2018). Sustainability behaviors among college students: An application of the VBN theory. *Environmental Education Research*, *24*(2), 245–262.

Wut, T. M., Ng, P., Kan Mike, H.-K., & Fong Samuel, C. (2021). Does gender matter? Attitude towards waste charging policy and pro-environmental behaviours. *Social Responsibility Journal*, *17*(8), 1100–1115.

Yusliza, M. Y., Amirudin, A., Rahadi, R. A., Nik Sarah Athirah, N. A., Ramayah, T., Muhammad, Z., Dal Mas, F., Massaro, M., Saputra, J., & Mokhlis, S. (2020). An investigation of pro-environmental behaviour and sustainable development in Malaysia. *Sustainability*, *12*(17), 7083.

Zangirolami-Raimundo, J., Echeimberg, J. de O., & Leone, C. (2018). Research methodology topics: Cross-sectional studies. *Journal of Human Growth and Development*, *28*(3), 356–360.

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*, 1–8.

Zilahy, G., & Huisingh, D. (2009). The roles of academia in regional sustainability initiatives. *Journal of Cleaner Production*, *17*(12), 1057–1066.

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138.

Zürich, F., Zingg, Æ. A., Biber, Æ. P., Zimmerman, D. L., Zimble, D. a., Evans, D. L., Carlson, G. C., Parker, R. C., Grado, S. C., Gerard, P. D., Zianis, D., Muukkonen, P., Mäkipää, R., Zhao, Y., Krzic, M., Bulmer, C. E., Schmidt, M. G., Simard, S. W., Zhao, D., … Leuven, K. U. (2005). A Structural Equation Model Analysis of Postfire Plant Diversity. *Forest Ecology and Management*, *10*(1).

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**Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?**

**Abstract**

Environmental damage is proof of the negative effect of human activities. The young generation is the one taking the burden of environmental damage left by the previous generations. In addition, the young generation must also take a role as the agent of change in improving the environment. This study analyzes the pro-environmental behavior of Indonesian students, the factors affecting such behavior, and the efforts to improve the behavior. The research design is based on a cross-sectional survey. Our samples were students of the Geography Education department in Indonesia, a total of 470 students. The research sample used random sampling techniques from several public and private universities in Indonesia. The research instrument used was a questionnaire with reference to the Likert scale. The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y). Data were analyzed using path analysis through partial least squares structural equation modeling (PLS-SEM) software version 3. Findings confirmed high pro-environmental behavior, affected by environmental knowledge, environmental responsibility, value-belief-norm, and environmental education, having a convincing positive effect on forming environmental behavior. It

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is crucial that the young generation learns pro-environmental behavior through formal education since the behavior helps preserve the environment.

## 4. Introduction

Environmental damage has been the topic of many discussions by the government, researchers, and local and international organizations. Their concern is not far from the issue of waste, pollution, deforestation, extreme climate change, global warming, ozone depletion, the greenhouse effect, and acid rain. Most environmental damage happens due to human activities; the damage will affect our ecosystem completely now and in the future. Human behavior greatly impacts the environment (Gifford & Nilsson, 2014; Steg & Vlek, 2009).

Awareness of environmental problems and efforts to preserve the environment is indispensable to prevent further damage to our only home; this can be done through pro-environmental behavior. Pro-environmental behavior refers to conscious efforts to minimize the negative impact of human activities on the environment (Kollmuss & Agyeman, 2002). Pro-environmental behavior can also be defined as real or perceptual actions contributing to environmental conservation (Kurisu, 2015). The United Nations Commission on Sustainable Development (UN CSD) International Work Programme defines pro-environmental behavior as the use of products and services to fulfill the primary needs and bring a better quality of life while minimizing the use of natural resources and reducing hazardous materials, waste, emission, and pollutant through a lifecycle to not harm the life of the future generations (Jensen, 2002; Steg & Vlek, 2009).

Education is an important variable in explaining awareness of and environmental behavior (Zilahy & Huisingh, 2009; Zsóka et al., 2013). Previous studies suggest that people with higher education levels tend to care more about the quality of the environment and are motivated to be directly involved in environmental preservation due to awareness of damage potential (Lozano & Vallés, 2007; Ramos et al., 2015). Universities play a crucial role in directing students to develop environmental awareness in both the social and physical environment (Meyer, 2016).

University students are intellectuals who will become the nation's next generation—they must have pro-environmental behavior. The quality of our environment depends on our behavior. The young generation is the one taking the burden of environmental damage left by the previous generations; they are also an important factor in changing the environment towards a better state.

Universities in Indonesia have assisted students in improving their pro-environmental behavior through a course named *Pendidikan Lingkungan Hidup* (Environmental Education). The

course is also provided to students majoring in Geography Education. The course teaches students the importance of the environment, environmental issues, and real actions to preserve the environment. The integration of this course into the curriculum is believed to be able to increase pro-environmental behavior. Even though the effect of knowledge has not been revealed scientifically, some studies show that knowledge plays a crucial role in increasing pro-environmental behavior; it also helps individuals to have alternative perspectives through the formation of arguments to support their beliefs and behavior (Larson et al., 2015).

Increased awareness and understanding of environmental issues and pro-environmental behavior can take place through environmental education (Jurdi-Hage et al., 2019). This aligns with the role of universities as effective agents of change. A study by (Jurdi-Hage et al., 2019; Meyer, 2016) mentions that certain policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation. The present study aims to analyze the pro-environmental behavior of Indonesian students, the factors affecting such behavior, and the efforts to improve the behaviour.

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## 5. Literature review

Pro-environmental behavior can be translated as actions that show concern for the environment in everyday life. The actions can be repetitive or just occasional, and the actions deal with preserving natural resources and the environment, such as preserving specific natural resources (water, soil, and air), reducing energy consumption (electricity, oil, and gas), recycling (recycling paper, plastic, and others), and preserving life (animals and plants) (Erdogan & Ozsoy, 2007). Pro-environmental behavior also refers to any actions to minimize environmental damage or to improve the environment (Scannell & Gifford, 2010). Pro-environmental behavior comes in dimensions, including recycling, which means reusing or remanufacturing what has been used.

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Pro-environmental behavior is also seen as one's effort to prevent environmental damage, protect the environment, and solve environmental issues (Schultz et al., 1995; Stern et al., 1999). Pro-environmental behavior refers to conscious efforts to minimize the negative impact of one's action on nature (both natural and artificial ecosystems), such as minimizing natural resources and consumption, toxin, waste, and so forth (Kollmuss & Agyeman, 2002). However, pro-environmental behavior is one's effort to reduce the negative impact of his or her activities on the environment to prevent environmental damage and preserve the environment.

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Several factors affecting pro-environmental behavior, environmental commitment and awareness, green lifestyle, and green self-efficacy positively affect the pro-environmental behavior of young people (Yusliza et al., 2020). Holistic and systemic perspectives on the environment are

crucial in promoting pro-environmental behavior (P. Liu et al., 2020; X. Liu et al., 2018). Pro-environmental behavior also increases with sociodemographic factors, including knowledge, awareness, and understanding of environmental damage (Soares et al., 2021)  Environmental knowledge affects pro-environmental behavior (Liobikienė & Poškus, 2019). Social norms and lifestyle contribute to pro-environmental behavior. The pro-environmental behavior of females is affected by social norms and lifestyle, while the lifestyle of males is affected by their views on certain policies (Wut et al., 2021). There is also a difference in pro-environmental behavior between the younger and older generations  (Alzubaidi et al., 2021).

Pro-environmental behavior of university students is also affected by formal education. Environmental knowledge delivered through formal education can improve pro-environmental behavior. Environmental systems, including political ecology, sustainable development, the environment and ecology, and environmental situations, affect pro-environmental behavior (Janmaimool & Khajohnmanee, 2019). Values, new environmental paradigms, and personal norms also affect pro-environmental behavior among students (S. Liu & Guo, 2018).
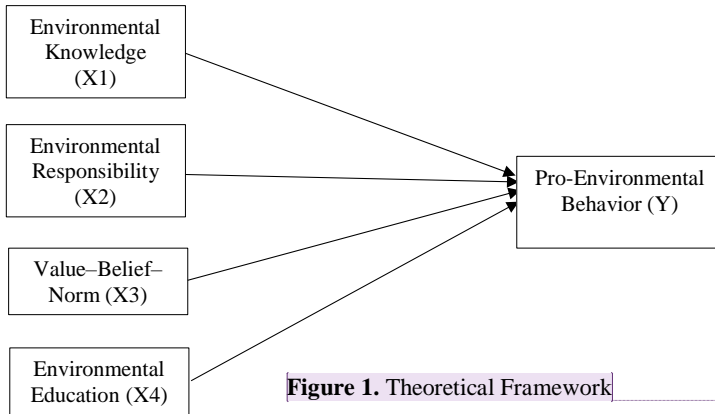
## 6. Material and Methods

This study employed a quantitative method with a cross-sectional approach.  The cross-sectional approach is carried out for regular undergraduate students in geography or geographical science education who have taken environmental education courses. A total of 470 students were involved in this study from various public and private universities in Indonesia who were randomly selected. A cross-sectional study examines causal relationships with some methods, such as observations and data collection within a single time (Wang & Cheng, 2020). In a cross-sectional study, dependent and independent variables are observed at the same time (Wang & Cheng, 2020; Zangirolami-Raimundo et al., 2018). Pemilihan subjek penelitian pada metode cross-sectional

The universities included Universitas Lambung Mangkurat, Universitas PGRI Kanjuruhan, Universitas Khairun Ternate, Universitas Samudra, Universitas Negeri Makasar, Universitas Negeri Malang, IKIP PGRI Pontianak, Universitas Al Muslim, Universitas Widya Dharma, Universitas Hamzanwadi, Universitas Negeri Padang, Universitas Muhammadiyah Mataram, STIKIP Kei Raga Ternate, Universitas Tadulako, USK, Universitas Halu Oleo, Universitas Siliwangi, IKIP PGRI Palangkaraya, Universitas Nusa Cendana Kupang, Amikom Yogyakarta, and Universitas Negeri Jember. Data were collected through observations, interviews, questionnaires, and documentation.

The Smart PLS 3.0 Program was used to check the validity of our instruments by looking at the loading factors of each construct indicator. The common requirement to test the validity of research instruments is that the loading factor must be bigger than 0.70 (Chan & Lay, 2018; Zürich et al., 2005). Reliability was tested by calculating the composite reliability—the range is 0.6 to 0.7

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(Chan & Lay, 2018; Rasoolimanesh, 2022). The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y).



**Figure 1.** Theoretical Framework

Data were analyzed using the Structural Equation Modeling (SEM) Partial Least Square (PLS). SEM-PLS is a causal model that explains the effect between variables on the construct variable (Chan & Lay, 2018).

Table 1. Research Variables

| Variable | Indicator |
|---|---|
| Environmental knowledge (X1) | 6. Knowing daily environmental problems<br>7. Knowing the causes of environmental problems<br>8. Knowing the solutions to solve environmental problems<br>9. Understanding the dependency of human beings on the environment<br>10. Knowing renewable energy |
| Environmental responsibility (X2) | 5. No littering<br>6. Keeping the environment clean<br>7. Using environmentally friendly energy and resources<br>8. Greening the surrounding areas |
| Value–belief–norm (X3) | 5. Believing that everything on earth is God's creation<br>6. Being thankful for what is available on earth<br>7. Sticking to the concept of cleanliness in doing religious rituals<br>8. Practicing religious advice to protect the environment |
| Environmental education (X4) | 5. Increasing understanding of environmental problems<br>6. Improving acceptance, assessment, organization, and personality characteristics in managing life in harmony with nature<br>7. Growing a love of the environment |

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| | 8.  Increasing interest in the environment |
|---|---|
| Pro-Environmental Behavior (Y) | 16. Participating in events/seminars/workshops on environmental issues<br>17. Reducing the use of plastic<br>18. Replacing disposable drinking bottles with tumblers<br>19. Replacing food wrapping paper with lunch boxes<br>20. Buying items with a recyclable sign<br>21. Reusing items that are usable<br>22. Using rechargeable batteries<br>23. Sorting waste<br>24. Reusing items that are still suitable for use<br>25. Disposing of phone batteries or electronic device batteries properly<br>26. Turning off electronic devices that are not in use<br>27. Using electronic devices with energy-saving features<br>28. Turn off the lights during daytime<br>29. Using water wisely<br>30. Using a water storage tank |

Our research hypotheses are as follows:

Hypothesis 1 (H1)

H0: Environmental Knowledge of students does not have a positive and significant correlation  with Pro-Environmental Behavior

H1: Environmental Knowledge of students has a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 2 (H2)

H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behavior

H1: Environmental Responsibility of students has a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 3 (H3)

H0: Environmental Education of students  does not have a positive and significant correlation with Pro-Environmental Behavior

H1: Environmental Education of students has a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 4 (H4)

H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behavior

H1: Value-belief-norm of students has a positive and significant correlation with Pro-Environmental Behavior

## 6. Results and Discussion

**Outer Model**

   The outer model was used to check the validity and reliability of the model. Before hypothesis testing to predict the relationship between latent variables in a structural model, we first evaluated the outer model to verify indicators and latent variables for further analysis. The validity test evaluates the ability of research instruments to measure what they are intended to measure (Hair et al., 2017; Hair Jr et al., 2020). The reliability test evaluates the consistency of a measurement instrument in measuring a concept or the consistency of research respondents in answering questionnaire items or research instruments. The result is presented in discriminant validity (outer loadings), Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

Table 2. Structural Model

| Construct | Items | Loading Factors | Cronbach's alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|
| Environmental knowledge | X1.1 | 0.855 | 0.903 | 0.928 | 0.720 |
| | X1.2 | 0.866 | | | |
| | X1.3 | 0.857 | | | |
| | X1.5 | 0.837 | | | |
| | X1.5 | 0.826 | | | |
| Environmental responsibility | X2.1 | 0.855 | 0.874 | 0.914 | 0.726 |
| | X2.2 | 0.878 | | | |
| | X2.3 | 0.845 | | | |
| | X2.4 | 0.829 | | | |
| Value–belief–norm | X3.1 | 0.831 | 0.868 | 0.910 | 0.715 |
| | X3.2 | 0.866 | | | |
| | X3.3 | 0.838 | | | |
| | X3.4 | 0.848 | | | |
| Environmental education | X4.1 | 0.869 | 0.881 | 0.918 | 0.737 |
| | X4.2 | 0.844 | | | |
| | X4.3 | 0.874 | | | |
| | X4.4 | 0.846 | | | |
| Pro-Environmental Behavior | Y1 | 0.747 | 0.924 | 0.934 | 0.505 |
| | Y2 | 0.670 | | | |
| | Y3 | 0.614 | | | |
| | Y4 | 0.663 | | | |
| | Y5 | 0.678 | | | |
| | Y6 | 0.731 | | | |
| | Y7 | 0.744 | | | |
| | Y8 | 0.749 | | | |
| | Y9 | 0.758 | | | |
| | Y10 | 0.755 | | | |
| | Y11 | 0.737 | | | |
| | Y12 | 0.746 | | | |
| | Y13 | 0.672 | | | |

Commented [A24]: We have revised according to the suggestions

| Y14 | 0.670 |
|---|---|

Table 2 showed that measuring discriminant validity through outer loadings ensures that each concept of the latent model is different from other variables. Outer loadings or loading factors are the beginning of the validity checking of a model. An indicator is reliable if it has a correlation value of more than 0.70. An indicator is valid if its outer loading is between 0.50 – 0.60, so its presence is acceptable (Hair et al., 2020).

Table 2 shows that all indicators of the latent variables are valid and reliable because their outer loading values are between 0.60 and 0.70. Thus, all latent variables could explain the variable of each indicator that measured them. Discriminant validity can be determined using AVE for each construct or latent variable. The model has better discriminant validity if the AVE square root for each construct is greater than the correlation between the two constructs in the model.

Table 2 shows that the AVE value for all constructs is > 0.50. Therefore, there is no problem with convergent validity in the model being tested. The Cronbach Alpha and composite reliability values for all constructs are also > 0.60, which means that all constructs have very good reliability. The results of the outer model analysis are presented in Figure 1.
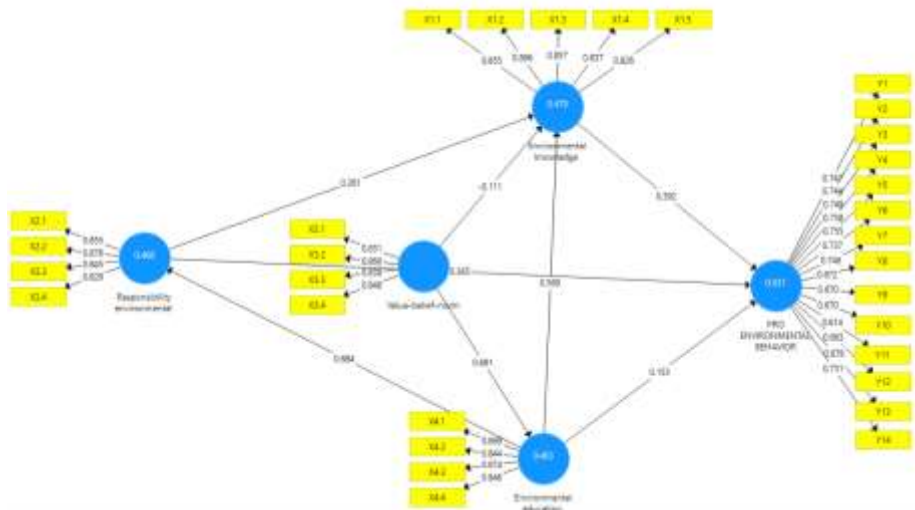


**Figure 2.** Model Pro-Environmental Behavior of University Students in Indonesia

**Measuring the Structural Model (Inner Model)**

**Coefficient of Determinant (R-square)**

The R-square value is used to assess the extent of influence certain independent latent variables have on the dependent latent variable. Using SmartPLS 3.0 software, we obtained the following results.

Table 3. Coefficient of Determinant (R-square)

| | R-square | R-square Adjusted |
|---|---|---|
| Environmental education | 0.463 | 0.462 |
| Environmental knowledge | 0.479 | 0.476 |
| Pro-environmental behavior | 0.631 | 0.629 |
| Environmental responsibility | 0.468 | 0.466 |
| Value–belief–norm | 0.430 | 0.433 |

Table 3 shows the R-square value for environmental education is 0.463; this shows that environmental education has an influence of 46.3% on pro-environmental behavior. The R-square value for environmental knowledge is 0.479; this shows that environmental knowledge has a 47.6% influence on pro-environmental behavior. The R-square value for environmental responsibility is 0.468; this shows that environmental responsibility has a 46.8% influence on pro-environmental behavior. The R-square value for the value-belief-norm is 0.430; this shows that Value-belief-norm has a 43.0% influence on pro-environmental behavior. The R-square value for pro-environmental behavior is 0.631, which indicates that environmental education, environmental knowledge, value-belief-norm, and environmental responsibility factors influence pro-environmental behavior by 63.1%.

**Hypothesis Testing**

To determine whether the hypothesis is accepted or rejected, the p-value is set at a significance level (α) of 5% or 0.05. If the p-value < 0.05, H0 is rejected, meaning an effect exists. Conversely, if the p-value > 0.05, H0 is accepted, meaning no effect exists. Table 4 presents the results of the evaluation of the structural model of the hypothesis test using the PLS method obtained from the SmartPLS 3.0 Bootstrapping Report.

Table 4. Path Coefficients

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|---|---|
| Environmental education-> Pro-environmental behavior | 0.153 | 0.154 | 0.059 | 2.611 | 0.009 |
| Environmental knowledge-> Pro-environmental Behavior | 0.392 | 0.395 | 0.046 | 8.618 | 0.000 |
| Environmental responsibility -> Pro-environmental behavior | 0.365 | 0.365 | 0.052 | 7.043 | 0.000 |
| Value–belief–norm-> Pro-environmental behavior | 0.430 | 0.433 | 0.033 | 13.234 | 0.000 |

Table 4 shows that environmental education has a positive relationship with pro-environmental behavior, with a p-value of 0.009 (p < 0.05). Environmental knowledge has a positive

relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Environmental responsibility has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Value–Belief–Norm has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05).

**Factors Affecting Pro-Environmental Behavior of University Students**

The path coefficient analysis presented in Table 4 for testing the first hypothesis shows that H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected and H1: Environmental Knowledge of students has a positive and significant correlation with Pro-Environmental Behavior is accepted. This means that environmental knowledge has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Based on the analysis results, most students were already concerned about the environment, such as environmental problems and the causes of such problems. Students also knew solutions to environmental problems and about renewable energy to overcome the problems. Renewable energy sources are environmentally friendly, do not pollute the environment, and do not contribute to climate change and global warming because the energy comes from sustainable natural sources, such as sunlight, wind, water, biofuels, and geothermal.

Knowledge is crucial to determining behavior. Students with environmental knowledge tend to change their behavior due to education; this aligns with the view that environmental knowledge affects pro-environmental behavior (Gifford & Nilsson, 2014). Knowledge is defined as a source of where environmental behavior is formed, and attitude is manifested (Kollmuss & Agyeman, 2002).

Developing students' environmental knowledge is important, especially on campus. A study in Canada reveals that more than 60% of the study respondents agree that one factor hindering pro-environmental behavior is a lack of knowledge (Kennedy et al., 2009; Kennedy & Kmec, 2018). Other studies also confirm that more profound and broader knowledge of environmental issues and solutions to such issues will increase the possibility of individuals taking action to protect the environment (Farrukh et al., 2022; Jensen, 2002; Kaiser, Ranney, et al., 1999; Kaiser, Wölfing, et al., 1999; Kollmuss & Agyeman, 2002; Latif et al., 2013). Individuals with sound knowledge of environmental issues tend to show pro-environmental behavior. Previous studies show that knowledge relates to actions and becomes a predictor of actions (Neolaka, 2020). To sum up, individuals with sound knowledge of environmental issues and solutions to such issues tend to show pro-environmental behavior to protect the environment.

(P. Liu et al., 2020) find a significant relationship between the level of knowledge and the pro-environmental behavior of students—the higher the level of environmental knowledge, the better

the pro-environmental behavior of students and vice versa. (Fawehinmi et al., 2020) reveal a positive and quite significant relationship between environmental knowledge and attitudes towards environmental sustainability. If environmental knowledge increases, attitudes towards environmental sustainability will also increase, and vice versa.

(Ardoin et al., 2020) state that people with better environmental knowledge will be better aware of the environment and environmental issues. Thus, they will be motivated to act responsibly toward the environment. Developing environmental awareness through education has always been critical in building pro-environmental behavior. Knowledge people have will guide them to determine whether their actions will be good or bad for the environment. Environmental knowledge can be in the form of knowledge of environmental issues, causes, effects, solutions, and how to become an environmentally responsible agent of change related to the problems (Fawehinmi et al., 2020).

The path coefficient analysis presented in Table 3 for testing the second hypothesis shows that H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected and H1: Environmental Responsibility of students has a positive and significant correlation with Pro-Environmental Behavior is accepted. This means that environmental responsibility has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental responsibility is an action motivated by one's willingness to prevent environmental damage or preserve the environment. Our findings showed that the students had good environmental responsibility. They did not litter, cared for environmental cleanliness, used recyclable goods, and did greening of their surrounding areas.

Environmental responsibility is closely related to the ascription of responsibility. Initially, the ascription of responsibility is defined as a feeling of responsibility from the negative consequences of not behaving in a pro-social manner. This theory is widely applied in green behavior because most people behave green based on their altruistic feelings, such as recycling, energy policies, and other green behaviors in general.

Increased awareness and understanding of changing environmental issues and increased skills for environmentally responsible actions can be developed through environmental education (Jurdi-Hage et al., 2019). This is consistent with the university's role as an effective agent of change.

Building awareness to be environmentally responsible aims to preserve the environment, so human beings not only take benefit of the environment for their lives but also take care of and be accountable for preserving the environment. Individuals with high environmental awareness can improve pro-environmental behaviour (Zareie & Navimipour, 2016). In addition, students with higher environmental awareness show more pro-environmental behavior (S.-C. Liu & Lin, 2015; S.

Liu & Guo, 2018). As previously indicated, specific environmental awareness can lead to better predictability of environmentally responsible behavior if certain pro-environmental behaviors are assessed.

As formal education institutions, universities must implement pro-environmental behavior (Usaini et al., 2015). People are not born with pro-environmental behavior—the behavior is taught and shaped along with their developmental stages. Increased environmental responsibility will finally lead to positive changes toward pro-environmental behavior.

The path coefficient analysis presented in Table 4 for testing the third hypothesis shows that H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected and H1: Environmental Education of students has a positive and significant correlation with Pro-Environmental Behavior is accepted. This means that environmental education has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Our findings confirmed that the students received environmental education, proven by increased environmental knowledge and understanding that they refused to damage the environment at any cost.

Education is crucial in forming pro-environmental behavior (Iswari & Kusuma, 2022). Human behavior greatly impacts the environment. Environmental knowledge gained through education is positively and significantly important to preserve the environment (Azhar et al., 2015; Erdogan & Ozsoy, 2007; Sontay et al., 2015). Environmental education teaches students the importance of preserving the environment—it increases students' awareness, directs students, and shapes their attitudes toward preserving the environment (Hassan & Pudin, 2011; Mulyana, 2009; Özalemdar, 2021). Environmental education aims to increase people's understanding and concern and is oriented toward preventing environmental damage and finding solutions to environmental issues.

The findings align with (Meyer, 2016), stating that certain policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation.

The fourth hypothesis testing shows that H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected and H1: Value-belief-norm of students has a positive and significant correlation with Pro-Environmental Behavior is accepted. This means the value-belief-norm has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 (p < 0.05). Our findings showed that students had good value-belief-norm for pro-environmental behaviour, as seen from the willingness of students to protect the environment and support policies to preserve the

environment. This aligns with (Mahat et al., 2020; Whitley et al., 2018), revealing that biosphere and altruistic values make students more willing to be involved in pro-environmental activities, such as supporting policies to protect the environment.

The value-belief-norm theory is proposed by (Stern et al., 1999), stating that value orientation can, directly and indirectly, affect pro-environmental behavior. The theory assumes three value orientations related to environmental concerns relevant to understanding pro-environmental attitudes, preferences, and behavior: altruistic, egoistic, and biosphere value orientations (Oreg & Katz-Gerro, 2006; Stern et al., 1999). Our findings strengthen the theory since the findings show a direct contribution of value orientation toward pro-environmental behavior.

Norms show a person about acceptable and unacceptable behavior. Norms are the rules of society regarding good and bad attitudes and actions that are permissible and not permissible. There are three types of norms: habits, prohibitions, and conventions (Kaiser et al., 2005, 2006). Personal norms are moral ethics and obligations towards something related to orientation in treating something. An ethical approach to dealing with environmental problems is needed. This approach is intended to determine attitudes, actions, and ethical perspectives and appropriately manage environmental care and its ecosystem (Hassan & Pudin, 2011; Liobikienė & Poškus, 2019).

The principle of respect for nature deals with a moral responsibility towards nature. Every part and object in this universe were created by God with certain purposes, regardless of whether it is for the benefit of humans or not. Therefore, as part of the universe, humans are also responsible for protecting nature. This responsibility is individual and collective (Stern et al., 1999). Moral responsibility requires humans to take concrete initiatives, efforts, policies, and actions to protect the universe and everything in it. This means the preservation and destruction of nature is a shared responsibility of all humankind. This responsibility is also manifested in the form of warning, prohibiting, and punishing those who damage and endanger nature (Kurisu, 2015; Stern et al., 1999).

Building students' positive environmental values in educational institutions are important as it should help solve environmental problems and improve environmental quality (Chen, 2015). This will help to create a knowledgeable society about environmental issues that will play a major role in preserving the environment.

**Efforts to Improve Pro-Environmental Behavior**

Improving pro-environmental behavior, especially among the younger generation, can be done through education. Building a character of caring for the environment through education is an effort the government of Indonesia takes to preserve the environment. Such character is manifested in attitudes and actions of preventing environmental damage and taking steps to repair the already-happen environmental damage. Some actions to form pro-environmental behavior are: (1) caring for

the environment, (2) reducing plastic use, (3) sorting waste, (4) reducing carbon emission, and (5) saving energy. Actions to repair environmental damage include (1) planting trees, (2) reusing goods, and (3) using environmentally friendly technology. The character of caring for the environment must be built from an early age through fun learning. This is in line with the results of research (Yüzüak & Erten, 2022) which suggest that environmental education be included in various disciplines and raise environmental awareness among individuals should become one of national education's primary objectives.

Other efforts to increase public awareness of the importance of protecting the environment can be carried out through informational and structural strategies. Informational strategies refer to interventions through campaigns or socialization to increase knowledge to minimize environmentally damaging behavior. For example, the reduce, reuse, and recycle (3R) campaign and creating eco-points for residential communities to collect metal, paper, glass, and organic waste for recycling. In addition to reducing waste, the 3R program can also be a means of earning income in which people can deposit their waste to waste banks or recycling facilities.

Efforts to increase public awareness through structural strategies can be made through behavioral changes that affect behavioral decisions. This strategy focuses on external environmental planning that can support pro-environmental behavior—for example, providing easily-accessible bins to avoid littering.

Governments, companies, or other organizations can also improve people's pro-environmental behavior through appropriate environmental policies primarily aimed at increasing self-motivation from the community to behave pro-environmentally. This can be done through activities including providing infrastructure that makes it easier for people to adopt pro-environmental behavior, such as providing environmentally friendly objects at lower prices, providing pro-environmental education to students as early as possible, developing an in-depth understanding of waste recycling efforts through various media, and supervising the public in subsidy programs for people with pro-environmental behavior and fines for violators of environmental policies.

## 7. Conclusion

It is extremely important for everyone, especially the young generation, to behave pro-environmentally to reduce environmental problems. Our findings confirm that environmental knowledge has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Environmental responsibility has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value

of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental education has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). The value-belief-norm has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). That means, students in university have very good pro-environmental behavior, where this behavior is influenced by factors of environmental knowledge, environmental responsibility, environmental education, and values. This research implies that pro-environmental behavior has a very important role in efforts to minimize environmental damage. Pro environmental behavior is crucial to building the character of loving the environment since early childhood through formal education to ensure environmental preservation and sustainability.

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**References**

Alzubaidi, H., Slade, E. L., & Dwivedi, Y. K. (2021). Examining antecedents of consumers' pro-environmental behaviours: TPB extended with materialism and innovativeness. *Journal of Business Research*, *122*, 685–699.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224.

Azhar, A., Basyir, M. D., & Alfitri, A. (2015). Hubungan pengetahuan dan etika lingkungan dengan sikap dan perilaku menjaga kelestarian lingkungan. *Jurnal Ilmu Lingkungan*, *13*(1), 36–41.

Chan, S. H., & Lay, Y. F. (2018). Examining the reliability and validity of research instruments using partial least squares structural equation modeling (PLS-SEM). *Journal of Baltic Science Education*, *17*(2), 239.

Chen, M. (2015). An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in T aiwan. *Asian Journal of Social Psychology*, *18*(2), 145–151.

Erdogan, M., & Ozsoy, A. (2007). Graduate Students' Perspectives On The Human-Environment Relationship. *Journal of Turkish Science Education*, *4*(2), 21–30.

Farrukh, M., Raza, A., Mansoor, A., Khan, M. S., & Lee, J. W. C. (2022). Trends and patterns in pro-environmental behaviour research: a bibliometric review and research agenda. *Benchmarking: An International Journal*.

Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behaviour of academics: The role of green human resource management and environmental knowledge. *International Journal of Manpower*, *41*(7), 879–900.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141–157.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hassan, A., & Pudin, S. (2011). The Informal Environmental Education Value Practices Among Adults in Sabah, Malaysia. *Journal of Turkish Science Education*, *8*(1), 19–28.

Iswari, N., & Kusuma, A. B. (2022). Analysis of the factors that influence the environmental quality index in Bekasi Regency. *Jurnal Pengelolaan Sumber Daya Alam Dan Lingkungan*, *12*(4), 720–728.

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of environmental system knowledge in promoting university students' environmental attitudes and pro-environmental behaviors. *Sustainability*, *11*(16), 4270.

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, *8*(3), 325–334.

Jurdi-Hage, R., Hage, H. S., & Chow, H. P. H. (2019). Cognitive and behavioural environmental concern among university students in a Canadian city: Implications for institutional interventions. *Australian Journal of Environmental Education*, *35*(1), 28–61.

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior 1. *Journal of Applied Social Psychology*, *35*(10), 2150–2170.

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (1999). Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment - European Psychologist - Volume 4, Number 2 / 1999 - Hogrefe Publishing. *European Psychologist*, *4*(2).

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (2006). Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment. *Http://Dx.Doi.Org/10.1027//1016-9040.4.2.59*, *4*(2), 59–74. https://doi.org/10.1027//1016-9040.4.2.59

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). ENVIRONMENTAL ATTITUDE AND ECOLOGICAL BEHAVIOUR. *Journal of Environmental Psychology*, *19*(1), 1–19. https://doi.org/10.1006/JEVP.1998.0107

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Why we don't" walk the talk": Understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, 151–160.

Kennedy, E. H., & Kmec, J. (2018). Reinterpreting the gender gap in household pro-environmental behaviour. *Environmental Sociology*, *4*(3), 299–310.

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.

Kurisu, K. (2015). *Pro-environmental behaviors*. Springer.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, *43*, 112–124.

Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia-Social and Behavioral Sciences*, *105*, 866–874.

Liobikienė, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behavior: modifying the value-belief-norm theory. *Sustainability*, *11*(12), 3324.

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment*, *728*, 138126.

Liu, S.-C., & Lin, H. (2015). Exploring undergraduate students' mental models of the environment: Are they related to environmental affect and behavior? *The Journal of Environmental Education*, *46*(1), 23–40.

Liu, S., & Guo, L. (2018). Based on environmental education to study the correlation between environmental knowledge and environmental value. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3311–3319.

Liu, X., Zou, Y., & Wu, J. (2018). Factors influencing public-sphere pro-environmental behavior among Mongolian college students: A test of value–belief–norm theory. *Sustainability*, *10*(5), 1384.

Lozano, M., & Vallés, J. (2007). An analysis of the implementation of an environmental management system in a local public administration. *Journal of Environmental Management*, *82*(4), 495–511.

Mahat, H., Hashim, M., Saleh, Y., Nayan, N., & Norkhaidi, S. B. (2020). Transformation of Education for Sustainable Development through Low Carbon Schools Community Program. *Journal of Turkish Science Education*, *17*(3), 429–442.

Meyer, A. (2016). Heterogeneity in the preferences and pro-environmental behavior of college students: The effects of years on campus, demographics, and external factors. *Journal of Cleaner Production*, *112*, 3451–3463.

Mulyana, R. (2009). Penanaman etika lingkungan melalui sekolah perduli dan berbudaya lingkungan. *Jurnal Tabularasa*, *6*(2), 175–180.

Neolaka, A. (2020). PENGARUH PENGETAHUAN PRO ENVIRONMENTAL TERHADAP PERILAKU RAMAH LINGKUNGAN. *Prosiding Seminar Nasional Pascasarjana*, *1*(01), 14–21.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: Values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, *38*(4), 462–483.

Özalemdar, L. (2021). The Effect on Environmental Attitude of the Active Learning Method Applied in Teaching the Biology Topic "Current Environmental Issues and Human" for 10th Grade Students. *Journal of Turkish Science Education*, *18*(2), 276–289. https://doi.org/10.36681/tused.2021.65

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, *106*, 3–10.

Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: A comprehensive composite-based approach. *Data Analysis Perspectives Journal*, *3*(2), 1–8.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology*, *30*(3), 289–297.

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, *15*(2), 105–121.

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: Knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials*, *412*, 125227.

Sontay, G., Gokdere, M., & Usta, E. (2015). A Comparative Investigation of Sub-Components of the Environmental Literacy at the Secondary School Level. *Journal of Turkish Science Education*, *12*(1), 19–28.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97.

Usaini, M. I., Abubakar, N. B., & Bichi, A. A. (2015). Influence of school environment on academic performance of secondary school students in Kuala Terengganu, Malaysia. *The American Journal of Innovative Research and Applied Sciences*, *1*(6), 203–209.

Wang, X., & Cheng, Z. (2020). Cross-sectional studies: strengths, weaknesses, and recommendations. *Chest*, *158*(1), S65–S71.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2018). Sustainability behaviors among college students: An application of the VBN theory. *Environmental Education Research*, *24*(2), 245–262.

Wut, T. M., Ng, P., Kan Mike, H.-K., & Fong Samuel, C. (2021). Does gender matter? Attitude towards waste charging policy and pro-environmental behaviours. *Social Responsibility Journal*, *17*(8), 1100–1115.

Yusliza, M. Y., Amirudin, A., Rahadi, R. A., Nik Sarah Athirah, N. A., Ramayah, T., Muhammad, Z., Dal Mas, F., Massaro, M., Saputra, J., & Mokhlis, S. (2020). An investigation of pro-environmental behaviour and sustainable development in Malaysia. *Sustainability*, *12*(17), 7083.

Yüzüak, A. V., & Erten, S. (2022). Teachers' Views About Turkey's Zero Waste Project (TZWP). *Journal of Turkish Science Education*, *19*(1), 71–81. https://doi.org/10.36681/tused.2022.110

Zangirolami-Raimundo, J., Echeimberg, J. de O., & Leone, C. (2018). Research methodology topics: Cross-sectional studies. *Journal of Human Growth and Development*, *28*(3), 356–360.

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*, 1–8.

Zilahy, G., & Huisingh, D. (2009). The roles of academia in regional sustainability initiatives. *Journal of Cleaner Production*, *17*(12), 1057–1066.

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138.

Zürich, F., Zingg, Æ. A., Biber, Æ. P., Zimmerman, D. L., Zimble, D. a., Evans, D. L., Carlson, G. C., Parker, R. C., Grado, S. C., Gerard, P. D., Zianis, D., Muukkonen, P., Mäkipää, R., Zhao, Y., Krzic, M., Bulmer, C. E., Schmidt, M. G., Simard, S. W., Zhao, D., … Leuven, K. U. (2005). A Structural Equation Model Analysis of Postfire Plant Diversity. *Forest Ecology and Management*, *10*(1).

**(4) Bukti review dari reviewer A**

## [tused] Editor Decision

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Karunia Puji Hastuti, Deasy Arisanty, Muhammad Muhaimin, Parida Angriani, Eva Alviawati, Nevy Farista Aristin, Akhmad Munaya Rahman:

We have reached a decision regarding your submission to Journal of Turkish Science Education, "Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?".

Our decision is: Revisions Required

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Reviewer A:

Still, there is a problem after the revision of the manuscript; after the literature review some results from the literature should be reached then, what will be new for this research should be well documented. This point is ignored. Also, the literature review section is insufficient. There should be much more current literature and their synthesis.

In method section; "Pemilihan subjek penelitian pada metode cross-sectional" shodul be translated.
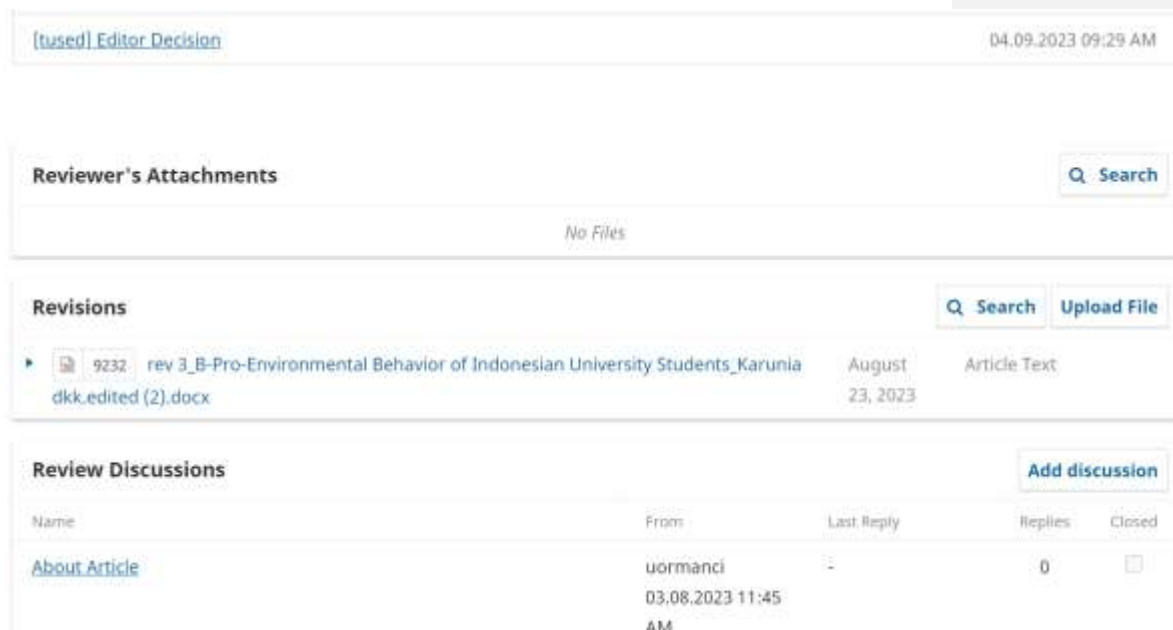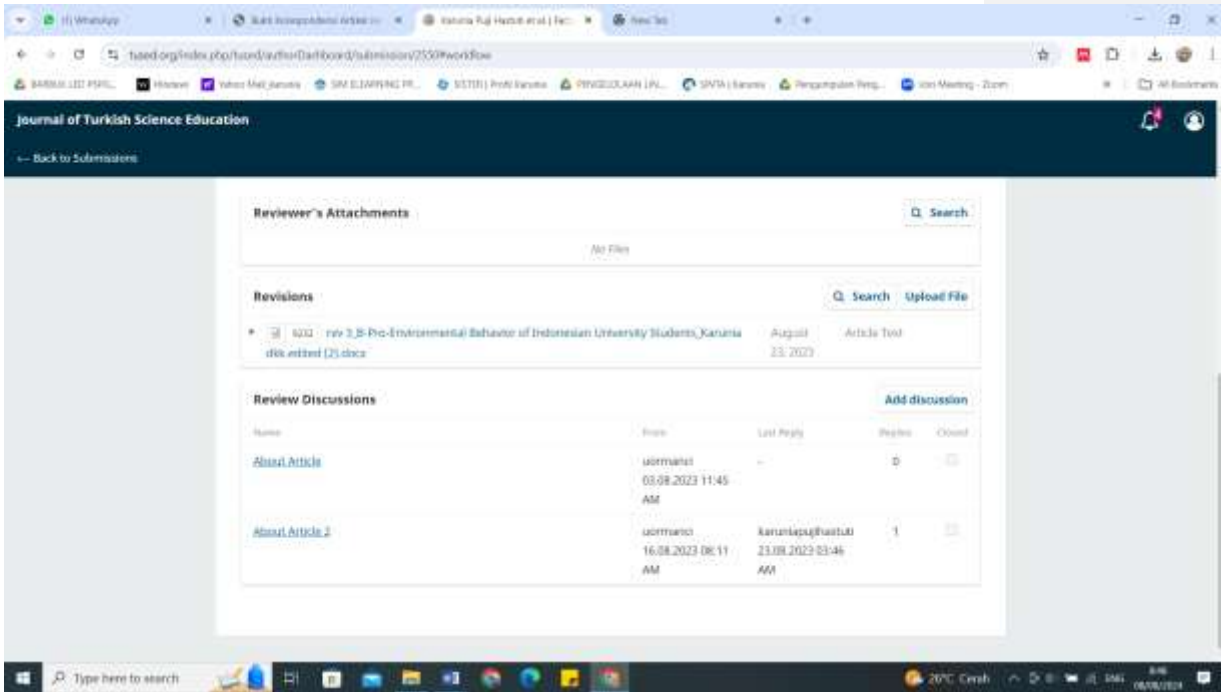
There should be much more detailed information and their implementation of "the environmental education course" that the sample has taken.

You should write one of the hypotheses Ho or H1. You can delete all the H1 hypotheses.

In the method section, you should give much more detailed information about "a cross-sectional survey" that you did. Why the method is cross-sectional? In the method section how many students were in the first and second years, and how many of the sample were in the third year etc? These variables have not been given. Therefore, it is not understandable why you use cross-sectional methods. This section should be written in much more detail. there are not any comparisons among groups in the findings sections also.

Recommendation: Revisions Required

**(5) Bukti perbaikan dari reviewer A**



[tused] Editor Decision                                                04.09.2023 09:29 AM

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**Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?**

**Abstract**

Environmental damage is proof of the negative effect of human activities. The young generation is taking the burden of environmental damage left by the previous generations. In addition, the young generation must also take a role as the agent of change in improving the environment. This study analyzes the pro-environmental behavior of Indonesian students, the factors affecting such behavior, and the efforts to improve the behavior. This research uses a quantitative approach with survey methods. Four hundred seventy (470) students department of geography and department of geography education from various public and private universities in Indonesia have participated as research respondents. The research sample used random sampling techniques from several public and private universities in Indonesia. The research instrument used was a questionnaire regarding the Likert scale. The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y). Data were analyzed using path analysis through partial least squares structural equation modeling (PLS-SEM) software version 3. Findings confirmed high pro-environmental behavior, affected by environmental knowledge, environmental responsibility, value-belief-norm, and environmental education, having a convincing positive effect on forming environmental behavior. The young generation must learn pro-environmental behavior through formal education since the behavior helps preserve the environment.

**Keyword**s: environmental damage, pro-environmental behavior, human activities, a young generation

7. **Introduction**

Environmental damage has been the topic of many discussions by the government, researchers, and local and international organizations. Their concern is close to waste, pollution, deforestation, extreme climate change, global warming, ozone depletion, the greenhouse effect, and acid rain. Most environmental damage happens due to human activities; the damage will affect our ecosystem completely now and in the future. Human behavior dramatically impacts the environment (Gifford & Nilsson, 2014; Steg & Vlek, 2009).

Awareness of environmental problems and efforts to preserve the environment is indispensable to prevent further damage to our only home; this can be done through pro-environmental behavior. Pro-environmental behavior refers to conscious efforts to minimize the negative impact of human activities on the environment (Kollmuss & Agyeman, 2002). Pro-environmental behavior can also be defined as actual or perceptual actions contributing to environmental conservation (Kurisu, 2015). The United Nations Commission on Sustainable Development (UN CSD) International Work Programme defines pro-environmental behavior as the use of products and services to fulfill the primary needs and bring a better quality of life while

minimizing the use of natural resources and reducing hazardous materials, waste, emission, and pollutant through a lifecycle not to harm the life of the future generations (Jensen, 2002; Steg & Vlek, 2009).

Education is essential in explaining awareness of environmental behavior (Zilahy & Huisingh, 2009; Zsóka et al., 2013). Previous studies suggest that people with higher education levels tend to care more about the quality of the environment and are motivated to be directly involved in environmental preservation due to awareness of damage potential (Lozano & Vallés, 2007; Ramos et al., 2015). Universities play a crucial role in directing students to develop environmental awareness in both the social and physical environment (Meyer, 2016).

University students are intellectuals who will become the nation's next generation—they must have pro-environmental behavior. The quality of our environment depends on our behavior. The young generation takes the burden of environmental damage left by the previous generations; they are also an important factor in changing the environment towards a better state.

Universities in Indonesia have assisted students in improving their pro-environmental behavior through a course named *Pendidikan Lingkungan Hidup* (Environmental Education). The course is also provided to students majoring in Geography Education. The course teaches students the importance of the environment, environmental issues, and tangible actions to preserve the environment. Integrating this course into the curriculum will likely increase pro-environmental behavior. Even though the effect of knowledge has not been revealed scientifically, some studies show that learning plays a crucial role in increasing pro-environmental behavior; it also helps individuals to have alternative perspectives through the formation of arguments to support their beliefs and behavior (Larson et al., 2015).

Increased awareness and understanding of environmental issues and pro-environmental behavior can take place through environmental education (Jurdi-Hage et al., 2019). This aligns with the role of universities as effective agents of change. A study by (Jurdi-Hage et al., 2019; Meyer, 2016) mentions that specific policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation. The present study aims to analyze the pro-environmental behavior of Indonesian students, the factors affecting such behavior, and the efforts to improve the behavior.

## 8. Literature review

Pro-environmental behavior can be translated as actions that show concern for the environment in everyday life. The activities can be repetitive or just occasional. The measures deal with preserving natural resources and the environment, such as preserving specific natural resources (water, soil, and

air), reducing energy consumption (electricity, oil, and gas), recycling (recycling paper, plastic, and others), and preserving life (animals and plants) (Erdogan & Ozsoy, 2007). Pro-environmental behavior also refers to any actions to minimize environmental damage or to improve the environment (Scannell & Gifford, 2010). Pro-environmental behavior comes in dimensions, including recycling, which means reusing or remanufacturing what has been used.

**Environmental Knowledge**

Environmental knowledge means knowledge and awareness of environmental problems and their solutions. The most crucial thing in any individual's environmental awareness is environmental knowledge, values, willingness to act, and actual behavior that is influenced by several factors, including elements of intention and situation (Jensen, 2002; Latif et al., 2013).

Environmental knowledge is a process of knowing values and concepts in developing skills. It is a necessary medium to understand and appreciate the interaction between humans and culture and the physical environment (Latif et al., 2013; Zareie & Navimipour, 2016). Awareness of the environment is needed to recognize environmental problems and issues. Environmental knowledge can be held formally, informally, and informally by families, communities, governments, and schools (P. Liu et al., 2020).

Knowledge can influence students' attitudes and behavior toward the environment. Students with high environmental knowledge will be aware of preserving their environment. According to (Otto & Pensini P, 2017) students' awareness of the environment will shape responsible environmental attitudes and behaviors. Based on the results of research by (Janmaimool & Khajohnmanee, 2019) there is a positive correlation between students' awareness and attitudes toward the environment, so if students have a lot of knowledge about environmental issues, then they will become more aware of environmental issues that are happening and this awareness encourages them to act responsibly towards the environment. According to (Jensen, 2002), behavior based on knowledge will last longer than behavior that is not based on knowledge. Research conducted by (Latif et al., 2013) found that facts in the field in the form of knowledge are a variable that correlates with pro-environmental knowledge.

**Environmental Responsibility**

(Fettahlıoğlu & Aydoğdu, 2020) revealed that environmentally responsible behavior seeks to preserve the environment and look for environmental problems. The environmentally responsible behavior is an individual or group action aimed at doing the right thing to protect the environment in everyday life, such as recycling, energy conservation, reducing littering, and not caring for the environment. According to (Kaiser, Ranney, et al., 1999), environmentally responsible behavior contains several dimensions: recycling, avoiding purchases to minimize environmental impact as a

form of green consumerism, being politically active in communities to influence decisions that impact the environment, and educating oneself about environmental awareness.

(Singh & Gupta, 2013) argues that environmentally responsible behavior measures a person's readiness to protect the environment actively. That's mean environmentally responsible behavior is an environmental protection mechanism to reduce and prevent damage to environmental resources.

**Value-Belief-Norm**

Pro-environmental behavior is a behavior that various groups of society can carry out, but the group that is currently highlighted is young people. Young people are the key to facing environmental issues today because young people are the most instrumental in influencing policies, increasing public awareness, conducting educational programs, and so on (Stern et al., 1999).

One conceptual framework that can explain the relationship between environmental beliefs and pro-environmental behavior is the Value Belief Norm (VBN) Theory. (Stern et al., 1999) explained, variables such as value orientation, NEP, awareness of consequences, beliefs to be able to act, and individual norms are variables that can influence pro-environmental behavior. VBN theory combines value, NEP, and norm-activation theories as causal chains that lead to pro-environmental behavior. The closer the variable's position is to the part of pro-environmental behavior, the stronger the variable relates to pro-environmental behavior. Several previous studies conducted by (Liobikienė & Poškus, 2019; Oreg & Katz-Gerro, 2006) have shown a positive relationship between VBN and pro-environmental behavior.

**Environmental Education**

Environmental education is an educational program to nurture children or students to have rational and responsible understanding, awareness, attitudes, and behaviors about the mutual influence between residents and the environment in various aspects of human life (Kollmuss & Agyeman, 2002; Zsóka et al., 2013). Environmental education seeks to change the behavior and attitudes carried out by multiple parties or elements of society, which aims to increase people's knowledge, skills, and awareness of environmental values and environmental issues, which in turn can move the community to play an active role in environmental conservation and safety efforts for the benefit of current and future generations. From various opinions about environmental education, it can conclude that environmental education is education about the environment in the context of internalization, directly or indirectly, in forming independent personalities and mindsets of students.

Pro-environmental behavior is also seen as one's effort to prevent environmental damage, protect the environment, and solve environmental issues (Schultz et al., 1995; Stern et al., 1999). Pro-environmental behavior refers to conscious efforts to minimize the negative impact of one's action on nature (both natural and artificial ecosystems), such as reducing natural resources and

consumption, toxin, waste, and so forth (Kollmuss & Agyeman, 2002). However, pro-environmental behavior is one's effort to reduce the negative impact of their activities on the environment to prevent environmental damage and preserve the environment.

Several factors affecting pro-environmental behavior, environmental commitment and awareness, green lifestyle, and green self-efficacy positively affect the pro-environmental behavior of young people (Yusliza et al., 2020). Holistic and systemic perspectives on the environment are crucial in promoting pro-environmental behavior (P. Liu et al., 2020; X. Liu et al., 2018). Pro-environmental behavior also increases with sociodemographic factors, including knowledge, awareness, and understanding of environmental damage (Soares et al., 2021). Environmental knowledge affects pro-environmental behavior (Liobikienė & Poškus, 2019). Social norms and lifestyle contribute to pro-environmental behavior. The pro-environmental behavior of females is affected by social norms and lifestyle, while the lifestyle of males is affected by their views on specific policies (Wut et al., 2021). There is also a difference in pro-environmental behavior between the younger and older generations (Alzubaidi et al., 2021).

Pro-environmental behavior of university students is also affected by formal education. Environmental knowledge delivered through formal education can improve pro-environmental behavior. Environmental systems, including political ecology, sustainable development, the environment and ecology, and environmental situations, affect pro-environmental behavior (Janmaimool & Khajohnmanee, 2019). Values, new environmental paradigms, and personal norms also affect pro-environmental behavior among students (S. Liu & Guo, 2018).

The novelty of this study compared to several previous studies lies in determining the factors that influence pro-environmental behavior in students. Where these factors include: environmental knowledge, environmental responsibility, value-belief-norm, and environmental education.
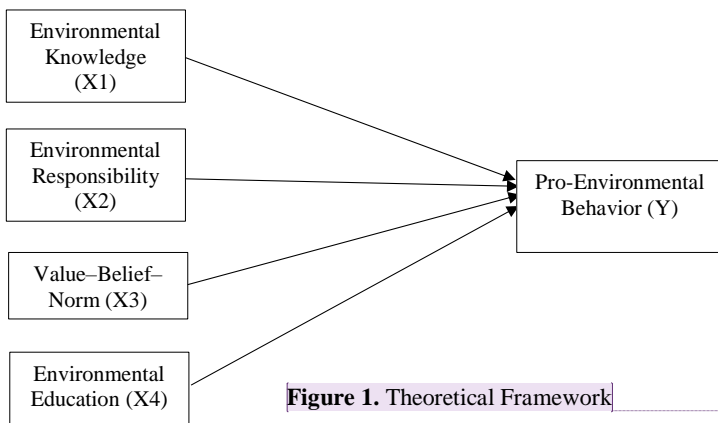
## 9. Material and Methods

This research uses a quantitative approach with survey methods. The survey method is a research method that takes samples from a population using questionnaires as a data collection tool (Creswell & Creswell, 2017; Hoy & Adams, 2015). The survey aims to get a general picture of the characteristics of the population that can be seen from attitudes, values, beliefs, opinions, habits, behaviors, and others. In this study, the picture/information researchers want to get from respondents is pro-environmental behavior seen from environmental knowledge, environmental responsibility, value–belief–norm, and environmental education.

The respondents in this study were students of geography study programs and geography education from various public and private universities in Indonesia who were randomly selected. The reason for choosing students of the geography study program and geography education is because of

the environmental education courses in this study program. Environmental education aims to change human attitudes and behavior to have rational thinking, maintain the environment, and be responsible for the current and future quality of life. Four hundred seventy (470) students of geography study programs and geography education from various public and private universities in Indonesia have participated as research respondents. The universities included Universitas Lambung Mangkurat, Universitas PGRI Kanjuruhan, Universitas Khairun Ternate, Universitas Samudra, Universitas Negeri Makasar, Universitas Negeri Malang, IKIP PGRI Pontianak, Universitas Al Muslim, Universitas Widya Dharma, Universitas Hamzanwadi, Universitas Negeri Padang, Universitas Muhammadiyah Mataram, STIKIP Kei Raga Ternate, Universitas Tadulako, USK, Universitas Halu Oleo, Universitas Siliwangi, IKIP PGRI Palangkaraya, Universitas Nusa Cendana Kupang, Amikom Yogyakarta, and Universitas Negeri Jember. Data collection in this study used questionnaires filled out online through Google form and shared via WhatsApp group. The research instrument used was a questionnaire regarding the Likert scale.

The Smart PLS 3.0 Program was used to check our instruments' validity by looking at each construct indicator's loading factors. The standard requirement to test the validity of research instruments is that the loading factor must be more significant than 0.70 (Chan & Lay, 2018; Zürich et al., 2005). Reliability was tested by calculating the composite reliability—the range is 0.6 to 0.7 (Chan & Lay, 2018; Rasoolimanesh, 2022). The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behavior (Y).



**Figure 1.** Theoretical Framework

Data were analyzed using the Structural Equation Modeling (SEM) Partial Least Square (PLS). SEM-PLS is a causal model explaining the effect of variables on the constructed variable (Chan & Lay, 2018).

Table 1. Research Variables

| Variable | Indicator |
|---|---|
| Environmental knowledge (X1) | 11. Knowing daily environmental problems<br>12. Knowing the causes of environmental problems<br>13. Learning the solutions to solve environmental problems<br>14. Understanding the dependency of human beings on the environment<br>15. Knowing renewable energy |
| Environmental responsibility (X2) | 9. No littering<br>10. Keeping the environment clean<br>11. Using environmentally friendly energy and resources<br>12. Greening the surrounding areas |
| Value–belief–norm (X3) | 9. Believing that everything on earth is God's creation<br>10. Being thankful for what is available on earth<br>11. Sticking to the concept of cleanliness in doing religious rituals<br>12. Practicing religious advice to protect the environment |
| Environmental education (X4) | 9. Increasing understanding of environmental problems<br>10. Improving acceptance, assessment, organization, and personality characteristics in managing life in harmony with nature<br>11. Growing a love of the environment<br>12. Increasing interest in the environment |
| Pro-Environmental Behavior (Y) | 31. Participating in events/seminars/workshops on environmental issues<br>32. Reducing the use of plastic<br>33. Replacing disposable drinking bottles with tumblers<br>34. Replacing food wrapping paper with lunch boxes<br>35. Buying items with a recyclable sign<br>36. Reusing usable things<br>37. Using rechargeable batteries<br>38. Sorting waste<br>39. Reusing things that are still suitable for use<br>40. Disposing of phone batteries or electronic device batteries properly<br>41. Turning off electronic devices that are not in use<br>42. Using electronic devices with energy-saving features<br>43. Turn off the lights during daytime<br>44. Using water wisely |

| | 45. Using a water storage tank |
|---|---|

Our research hypotheses are as follows:

Commented [A37]: We have revised according to the suggestions

Hypothesis 1

H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 2

H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 3

H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behavior

Hypothesis 4

H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behavior

## 8. Results and Discussion

**Outer Model**

The outer model was used to check the validity and reliability of the model. Before hypothesis testing to predict the relationship between latent variables in a structural model, we first evaluated the outer model to verify indicators and latent variables for further analysis. The validity test evaluates the ability of research instruments to measure what they are intended to measure (Hair et al., 2017; Hair Jr et al., 2020). The reliability test evaluates the consistency of a measurement instrument in measuring a concept or the character of research respondents in answering questionnaire items or research instruments. The result is presented in discriminant validity (outer loadings), Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

Table 2. Structural Model

Commented [A38]: We have revised according to the suggestions

| Construct | Items | Loading Factors | Cronbach's alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|
| Environmental knowledge | X1.1 | 0.855 | 0.903 | 0.928 | 0.720 |
| | X1.2 | 0.866 | | | |
| | X1.3 | 0.857 | | | |
| | X1.5 | 0.837 | | | |
| | X1.5 | 0.826 | | | |
| Environmental responsibility | X2.1 | 0.855 | 0.874 | 0.914 | 0.726 |
| | X2.2 | 0.878 | | | |
| | X2.3 | 0.845 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | X2.4 | 0.829 | | | |
| Value–belief–norm | X3.1 | 0.831 | 0.868 | 0.910 | 0.715 |
| | X3.2 | 0.866 | | | |
| | X3.3 | 0.838 | | | |
| | X3.4 | 0.848 | | | |
| Environmental education | X4.1 | 0.869 | 0.881 | 0.918 | 0.737 |
| | X4.2 | 0.844 | | | |
| | X4.3 | 0.874 | | | |
| | X4.4 | 0.846 | | | |
| Pro-Environmental Behavior | Y1 | 0.747 | 0.924 | 0.934 | 0.505 |
| | Y2 | 0.670 | | | |
| | Y3 | 0.614 | | | |
| | Y4 | 0.663 | | | |
| | Y5 | 0.678 | | | |
| | Y6 | 0.731 | | | |
| | Y7 | 0.744 | | | |
| | Y8 | 0.749 | | | |
| | Y9 | 0.758 | | | |
| | Y10 | 0.755 | | | |
| | Y11 | 0.737 | | | |
| | Y12 | 0.746 | | | |
| | Y13 | 0.672 | | | |
| | Y14 | 0.670 | | | |

Table 2 shows that measuring discriminant validity through outer loadings ensures that each concept of the latent model is different from other variables. Outer loadings or loading factors begin the validity checking of a model. An indicator is reliable if it has a correlation value of more than 0.70. An indicator is valid if its outer loading is between 0.50 – 0.60, so its presence is acceptable (Hair et al., 2020).

Table 2 shows that all indicators of the latent variables are valid and reliable because their outer loading values are between 0.60 and 0.70. Thus, all latent variables could explain the variable of each indicator that measured them. Discriminant validity can be determined using AVE for each construct or latent variable. The model has better discriminant validity if the AVE square root for each construct is greater than the correlation between the two constructs in the model.

Table 2 shows that the AVE value for all constructs is > 0.50. Therefore, convergent validity in the model being tested is acceptable. The Cronbach Alpha and composite reliability values for all constructs are also > 0.60, which means that all constructs have very good reliability. The results of the outer model analysis are presented in Figure 1.
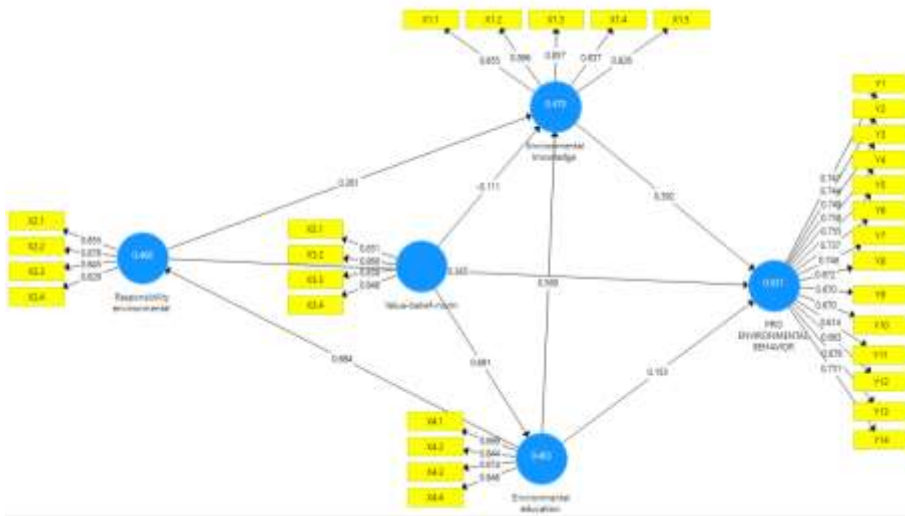
**Figure 2.** Model Pro-Environmental Behavior of University Students in Indonesia

**Measuring the Structural Model (Inner Model)**

**Coefficient of Determinant (R-square)**

   The R-square value is used to assess the extent of influence certain independent latent variables have on the dependent latent variable. Using SmartPLS 3.0 software, we obtained the following results.

Table 3. Coefficient of Determinant (R-square)

| | R-square | R-square Adjusted |
|---|---|---|
| Environmental education | 0.463 | 0.462 |
| Environmental knowledge | 0.479 | 0.476 |
| Pro-environmental behavior | 0.631 | 0.629 |
| Environmental responsibility | 0.468 | 0.466 |
| Value–belief–norm | 0.430 | 0.433 |

   Table 3 shows the R-square value for environmental education is 0.463; this shows that environmental education has an influence of 46.3% on pro-environmental behavior. The R-square value for environmental knowledge is 0.479; this indicates that environmental knowledge has a 47.6% influence on pro-environmental behavior. The R-square value for environmental responsibility is 0.468; this shows that environmental responsibility has a 46.8% influence on pro-environmental behavior. The R-square value for the value-belief-norm is 0.430; this indicates that Value-belief-norm has a 43.0% influence on pro-environmental behavior. The R-square value for pro-environmental behavior is 0.631, which indicates that environmental education, environmental

knowledge, value-belief-norm, and environmental responsibility factors influence pro-environmental behavior by 63.1%.

**Hypothesis Testing**

The p-value is set at a significance level (α) of 5% or 0.05 to determine whether the hypothesis is accepted or rejected. If the p-value < 0.05, H0 is rejected, meaning an effect exists. Conversely, if the p-value > 0.05, H0 is accepted, indicating no effect exists. Table 4 presents the results of evaluating the structural model of the hypothesis test using the PLS method obtained from the SmartPLS 3.0 Bootstrapping Report.

Table 4. Path Coefficients

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|---|---|
| Environmental education-> Pro-environmental behavior | 0.153 | 0.154 | 0.059 | 2.611 | 0.009 |
| Environmental knowledge-> Pro-environmental Behavior | 0.392 | 0.395 | 0.046 | 8.618 | 0.000 |
| Environmental responsibility -> Pro-environmental behavior | 0.365 | 0.365 | 0.052 | 7.043 | 0.000 |
| Value–belief–norm-> Pro-environmental behavior | 0.430 | 0.433 | 0.033 | 13.234 | 0.000 |

Table 4 shows that environmental education has a positive relationship with pro-environmental behavior, with a p-value of 0.009 (p < 0.05). Environmental knowledge has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Environmental responsibility has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05). Value–Belief–Norm has a positive relationship with pro-environmental behavior, with a p-value of 0.000 (p < 0.05).

**Factors Affecting Pro-Environmental Behavior of University Students**

The path coefficient analysis presented in Table 4 for testing the first hypothesis shows that H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected. This means that environmental knowledge has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Based on the analysis results, most students were already concerned about the environment, such as environmental problems and the causes of such problems. Students

also knew solutions to environmental problems and about renewable energy to overcome the problems. Renewable energy sources are environmentally friendly, do not pollute the environment, and do not contribute to climate change and global warming because the energy comes from sustainable natural sources, such as sunlight, wind, water, biofuels, and geothermal.

Knowledge is crucial to determining behavior. Students with environmental knowledge tend to change their behavior due to education; this aligns with the view that environmental knowledge affects pro-environmental behavior (Gifford & Nilsson, 2014). Knowledge is defined as a source of where environmental behavior is formed and attitude is manifested (Kollmuss & Agyeman, 2002).

Developing students' environmental knowledge is important, especially on campus. A study in Canada reveals that more than 60% of the study respondents agree that one factor hindering pro-environmental behavior is a lack of knowledge (Kennedy et al., 2009; Kennedy & Kmec, 2018). Other studies also confirm that more profound and broader knowledge of environmental issues and solutions to such issues will increase the possibility of individuals taking action to protect the environment (Farrukh et al., 2022; Jensen, 2002; Kaiser, Ranney, et al., 1999; Kaiser, Wölfing, et al., 1999; Kollmuss & Agyeman, 2002; Latif et al., 2013). Individuals with sound knowledge of environmental issues tend to show pro-environmental behavior. Previous studies show that knowledge relates to actions and becomes a predictor of actions (Neolaka, 2020). To sum up, individuals with sound knowledge of environmental issues and solutions to such issues tend to show pro-environmental behavior to protect the environment.

(P. Liu et al., 2020) find a significant relationship between the level of knowledge and the pro-environmental behavior of students—the higher the level of environmental knowledge, the better the pro-environmental behavior of students and vice versa. (Fawehinmi et al., 2020) Reveal a positive and significant relationship between environmental knowledge and attitudes towards environmental sustainability. If environmental knowledge increases, attitudes towards environmental sustainability will also increase, and vice versa.

(Ardoin et al., 2020) People with better environmental knowledge will be better aware of the environment and environmental issues. Thus, they will be motivated to act responsibly toward the environment. Developing environmental awareness through education has always been critical in building pro-environmental behavior. Knowledge of people will guide them to determine whether their actions will be good or bad for the environment. Environmental knowledge can be in the form of knowledge of environmental issues, causes, effects, solutions, and how to become an environmentally responsible agent of change related to the problems (Fawehinmi et al., 2020).

The path coefficient analysis presented in Table 3 for testing the second hypothesis shows that H0: Environmental Responsibility of students has no positive and significant correlation with

Pro-Environmental Behavior is rejected. This means that environmental responsibility has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 (p < 0.05). Environmental responsibility is an action motivated by one's willingness to prevent environmental damage or preserve the environment. Our findings showed that the students had good environmental responsibility. They did not litter, cared for environmental cleanliness, used recyclable goods, and did greening of their surrounding areas.

Environmental responsibility is closely related to the ascription of responsibility. Initially, the ascription of responsibility is defined as a feeling of responsibility from the negative consequences of not behaving in a pro-social manner. This theory is widely applied in green behavior because most people behave green based on their altruistic feelings, such as recycling, energy policies, and other green behaviors in general.

Increased awareness and understanding of changing environmental issues and improved skills for environmentally responsible actions can be developed through environmental education (Jurdi-Hage et al., 2019). This is consistent with the university's role as an effective agent of change.

Building awareness to be environmentally responsible aims to preserve the environment, so human beings not only take benefit of the environment for their lives but also take care of and be accountable for preserving the environment. Individuals with high environmental awareness can improve pro-environmental behavior (Zareie & Navimipour, 2016). In addition, students with higher environmental awareness show more pro-environmental behavior (S.-C. Liu & Lin, 2015; S. Liu & Guo, 2018). As previously indicated, specific environmental awareness can lead to better predictability of environmentally responsible behavior if certain pro-environmental behaviors are assessed.

As formal education institutions, universities must implement pro-environmental behavior (Usaini et al., 2015). People are not born with pro-environmental behavior—the behavior is taught and shaped along with their developmental stages. Increased environmental responsibility will finally lead to positive changes toward pro-environmental behavior.

The path coefficient analysis presented in Table 4 for testing the third hypothesis shows that H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected. This means that environmental education has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Our findings confirmed that the students received environmental education, proven by increased environmental knowledge and understanding that they refused to damage the environment at any cost.

Education is crucial in forming pro-environmental behavior (Iswari & Kusuma, 2022). Human behavior greatly impacts the environment. Environmental knowledge gained through education is positively and significantly important to preserve the environment (Azhar et al., 2015; Erdogan & Ozsoy, 2007; Sontay et al., 2015). Environmental education teaches students the importance of preserving the environment—it increases students' awareness, directs students, and shapes their attitudes toward preserving the environment (Hassan & Pudin, 2011; Mulyana, 2009; Özalemdar, 2021). Environmental education aims to increase people's understanding and concern and is oriented toward preventing environmental damage and finding solutions to environmental issues.

The findings align with (Meyer, 2016), stating that specific policies, programs, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation.

The fourth hypothesis testing shows that H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behavior is rejected. This means the value-belief-norm has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). Our findings showed that students had good value-belief-norm for pro-environmental behavior, as seen from the willingness of students to protect the environment and support policies to preserve the environment. This aligns with (Mahat et al., 2020; Whitley et al., 2018), revealing that biosphere and altruistic values make students more willing to be involved in pro-environmental activities, such as supporting policies to protect the environment.

The value-belief-norm theory is proposed by (Stern et al., 1999), stating that value orientation can, directly and indirectly, affect pro-environmental behavior. The theory assumes three value orientations related to environmental concerns relevant to understanding pro-environmental attitudes, preferences, and behavior: altruistic, egoistic, and biosphere value orientations (Oreg & Katz-Gerro, 2006; Stern et al., 1999). Our findings strengthen the theory since the results show a direct contribution of value orientation toward pro-environmental behavior.

Norms show a person about acceptable and unacceptable behavior. Norms are the rules of society regarding good and bad attitudes and actions that are permissible and not permissible. There are three types of norms: habits, prohibitions, and conventions (Kaiser et al., 2005, 2006). Personal norms are moral ethics and obligations towards something related to orientation in creating something. An ethical approach to dealing with environmental problems is needed. This approach is intended to determine attitudes, actions, and ethical perspectives and appropriately manage environmental care and its ecosystem (Hassan & Pudin, 2011; Liobikienė & Poškus, 2019).

The principle of respect for nature deals with a moral responsibility towards nature. Every part and object in this universe was created by God with specific purposes, regardless of whether it is for the benefit of humans or not. Therefore, humans are also responsible for protecting nature as part of the universe. This responsibility is individual and collective (Stern et al., 1999). Moral responsibility requires humans to take concrete initiatives, efforts, policies, and actions to protect the universe and everything in it. This means the preservation and destruction of nature is a shared responsibility of all humankind. This responsibility also manifests in warning, prohibiting, and punishing those who damage and endanger nature (Kurisu, 2015; Stern et al., 1999).

Building students' positive environmental values in educational institutions are essential as it should help solve environmental problems and improve environmental quality (Chen, 2015). This will help to create a knowledgeable society about environmental issues that will play a significant role in preserving the environment.

**Efforts to Improve Pro-Environmental Behavior**

Improving pro-environmental behavior, especially among the younger generation, can be done through education. Building a character of caring for the environment through education is an effort the government of Indonesia takes to preserve the environment. Such character is manifested in attitudes and actions of preventing environmental damage and taking steps to repair the already-happen environmental damage. Some activities to form pro-environmental behavior are: (1) caring for the environment, (2) reducing plastic use, (3) sorting waste, (4) reducing carbon emission, and (5) saving energy. Actions to repair environmental damage include (1) planting trees, (2) reusing goods, and (3) using environmentally friendly technology. The character of caring for the environment must be built from an early age through fun learning. This is in line with the research results (Yüzüak & Erten, 2022), which suggest that environmental education be included in various disciplines and raise environmental awareness among individuals should become one of national education's primary objectives.

Other efforts to increase public awareness of the importance of protecting the environment can be carried out through informational and structural strategies. Informative strategies refer to interventions through campaigns or socialization to increase knowledge to minimize environmentally damaging behavior. For example, the reduce, reuse, and recycle (3R) campaign and creating eco-points for residential communities to collect metal, paper, glass, and organic waste for recycling. In addition to reducing waste, the 3R program can also be a means of earning income in which people can deposit their waste to waste banks or recycling facilities.

Efforts to increase public awareness through structural strategies can be made through behavioral changes that affect behavioral decisions. This strategy focuses on external environmental

planning that can support pro-environmental behavior—for example, providing easily-accessible bins to avoid littering.

Governments, companies, or other organizations can also improve people's pro-environmental behavior through appropriate environmental policies primarily aimed at increasing self-motivation from the community to behave pro-environmentally. This can be done through activities including providing infrastructure that makes it easier for people to adopt pro-environmental behavior, such as providing environmentally friendly objects at lower prices, providing pro-environmental education to students as early as possible, developing an in-depth understanding of waste recycling efforts through various media, and supervising the public in subsidy programs for people with pro-environmental behavior and fines for violators of environmental policies.

## 9. Conclusion

It is significant for everyone, especially the young generation, to behave pro-environmentally to reduce environmental problems. Our findings confirm that environmental knowledge has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Environmental responsibility has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental education has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). The value-belief-norm has a significant and positive relationship with pro-environmental behavior, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). That means students in university have excellent pro-environmental behavior, where factors of environmental knowledge, environmental responsibility, environmental education, and values influence this behavior. This research implies that pro-environmental behavior is crucial in minimizing environmental damage. Pro-environmental behavior is essential to building the character of loving the environment since early childhood through formal education to ensure environmental preservation and sustainability.

**Conflicts of Interest:** The authors declare no conflicts of interest.

**References**

Alzubaidi, H., Slade, E. L., & Dwivedi, Y. K. (2021). Examining antecedents of consumers' pro-environmental behaviours: TPB extended with materialism and innovativeness. *Journal of Business Research*, *122*, 685–699.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224.

Azhar, A., Basyir, M. D., & Alfitri, A. (2015). Hubungan pengetahuan dan etika lingkungan dengan sikap dan perilaku menjaga kelestarian lingkungan. *Jurnal Ilmu Lingkungan*, *13*(1), 36–41.

Chan, S. H., & Lay, Y. F. (2018). Examining the reliability and validity of research instruments using partial least squares structural equation modeling (PLS-SEM). *Journal of Baltic Science Education*, *17*(2), 239.

Chen, M. (2015). An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in T aiwan. *Asian Journal of Social Psychology*, *18*(2), 145–151.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Erdogan, M., & Ozsoy, A. (2007). Graduate students' perspectives on the human-environment relationship. *Journal of Turkish Science Education*, *4*(2), 21–30.

Farrukh, M., Raza, A., Mansoor, A., Khan, M. S., & Lee, J. W. C. (2022). Trends and patterns in pro-environmental behaviour research: a bibliometric review and research agenda. *Benchmarking: An International Journal*.

Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behaviour of academics: The role of green human resource management and environmental knowledge. *International Journal of Manpower*, *41*(7), 879–900.

Fettahlıoğlu, P., & Aydoğdu, M. (2020). Developing environmentally responsible behaviours through the implementation of argumentation-and problem-based learning models. *Research in Science Education*. https://link.springer.com/article/10.1007/s11165-018-9720-0

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141–157.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hassan, A., & Pudin, S. (2011). The informal environmental education value practices among adults in Sabah, Malaysia. *Journal of Turkish Science Education*, *8*(1), 19–28.

Hoy, W. K., & Adams, C. M. (2015). *Quantitative research in education: A primer* (Second Edi). Sage Publications.

Iswari, N., & Kusuma, A. B. (2022). Analysis of the factors that influence the environmental quality index in Bekasi Regency. *Jurnal Pengelolaan Sumber Daya Alam Dan Lingkungan*, *12*(4), 720–728.

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of environmental system knowledge in promoting university students' environmental attitudes and pro-environmental behaviors. *Sustainability*, *11*(16), 4270.

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, *8*(3), 325–334.

Jurdi-Hage, R., Hage, H. S., & Chow, H. P. H. (2019). Cognitive and behavioural environmental concern among university students in a Canadian city: Implications for institutional interventions. *Australian Journal of Environmental Education*, *35*(1), 28–61.

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior 1. *Journal of Applied Social Psychology*, *35*(10), 2150–2170.

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (2006). Ecological behavior, environmental attitude, and feelings of responsibility for the environment. *European Psychologist*, *4*(2), 59–74. https://doi.org/10.1027//1016-9040.4.2.59

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*, *19*(1), 1–19. https://doi.org/10.1006/JEVP.1998.0107

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Why we don't" walk the talk": Understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, 151–160.

Kennedy, E. H., & Kmec, J. (2018). Reinterpreting the gender gap in household pro-environmental behaviour. *Environmental Sociology*, *4*(3), 299–310.

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.

Kurisu, K. (2015). *Pro-environmental behaviors*. Springer.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, *43*, 112–124.

Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia-Social and Behavioral Sciences*, *105*, 866–874.

Liobikienė, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behavior: modifying the value-belief-norm theory. *Sustainability*, *11*(12), 3324.

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment*, *728*, 138126.

Liu, S.-C., & Lin, H. (2015). Exploring undergraduate students' mental models of the environment: Are they related to environmental affect and behavior? *The Journal of Environmental Education*, *46*(1), 23–40.

Liu, S., & Guo, L. (2018). Based on environmental education to study the correlation between environmental knowledge and environmental value. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3311–3319.

Liu, X., Zou, Y., & Wu, J. (2018). Factors influencing public-sphere pro-environmental behavior among Mongolian college students: A test of value–belief–norm theory. *Sustainability*, *10*(5), 1384.

Lozano, M., & Vallés, J. (2007). An analysis of the implementation of an environmental management system in a local public administration. *Journal of Environmental Management*, *82*(4), 495–511.

Mahat, H., Hashim, M., Saleh, Y., Nayan, N., & Norkhaidi, S. B. (2020). Transformation of Education for Sustainable Development through Low Carbon Schools Community Program. *Journal of Turkish Science Education*, *17*(3), 429–442.

Meyer, A. (2016). Heterogeneity in the preferences and pro-environmental behavior of college students: The effects of years on campus, demographics, and external factors. *Journal of Cleaner Production*, *112*, 3451–3463.

Mulyana, R. (2009). Penanaman etika lingkungan melalui sekolah perduli dan berbudaya lingkungan. *Jurnal Tabularasa*, *6*(2), 175–180.

Neolaka, A. (2020). Pengaruh Pengetahuan Pro Environmental Terhadap Perilaku Ramah Lingkungan. *Prosiding Seminar Nasional Pascasarjana*, *1*(01), 14–21.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: Values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, *38*(4), 462–483.

Otto & Pensini P, S. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, *47*, 88–94.

Özalemdar, L. (2021). The effect on environmental attitude of the active learning method applied in teaching the biology topic "Current Environmental Issues and Human" for 10th Grade Students. *Journal of Turkish Science Education*, *18*(2), 276–289. https://doi.org/10.36681/tused.2021.65

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, *106*, 3–10.

Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: A comprehensive composite-based approach. *Data Analysis Perspectives Journal*, *3*(2), 1–8.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology*, *30*(3), 289–297.

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, *15*(2), 105–121.

Singh, N., & Gupta, K. (2013). Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*, *9*(1), 4–18. https://doi.org/10.1108/17471111311307787/FULL/XML

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: Knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials*, *412*, 125227.

Sontay, G., Gokdere, M., & Usta, E. (2015). A comparative investigation of sub-components of the environmental literacy at the secondary school level. *Journal of Turkish Science Education*, *12*(1), 19–28.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97.

Usaini, M. I., Abubakar, N. B., & Bichi, A. A. (2015). Influence of school environment on academic performance of secondary school students in Kuala Terengganu, Malaysia. *The American Journal of Innovative Research and Applied Sciences*, *1*(6), 203–209.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2018). Sustainability behaviors among college students: An application of the VBN theory. *Environmental Education Research*, *24*(2), 245–262.

Wut, T. M., Ng, P., Kan Mike, H.-K., & Fong Samuel, C. (2021). Does gender matter? Attitude towards waste charging policy and pro-environmental behaviours. *Social Responsibility Journal*, *17*(8), 1100–1115.

Yusliza, M. Y., Amirudin, A., Rahadi, R. A., Nik Sarah Athirah, N. A., Ramayah, T., Muhammad, Z., Dal Mas, F., Massaro, M., Saputra, J., & Mokhlis, S. (2020). An investigation of pro-environmental behaviour and sustainable development in Malaysia. *Sustainability*, *12*(17), 7083.

Yüzüak, A. V., & Erten, S. (2022). Teachers' Views About Turkey's Zero Waste Project (TZWP). *Journal of Turkish Science Education*, *19*(1), 71–81. https://doi.org/10.36681/tused.2022.110

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*, 1–8.

Zilahy, G., & Huisingh, D. (2009). The roles of academia in regional sustainability initiatives. *Journal of Cleaner Production*, *17*(12), 1057–1066.

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138.

Zürich, F., Zingg, Æ. A., Biber, Æ. P., Zimmerman, D. L., Zimble, D. a., Evans, D. L., Carlson, G. C., Parker, R. C., Grado, S. C., Gerard, P. D., Zianis, D., Muukkonen, P., Mäkipää, R., Zhao, Y., Krzic, M., Bulmer, C. E., Schmidt, M. G., Simard, S. W., Zhao, D., … Leuven, K. U. (2005). A structural equation model analysis of postfire plant diversity. *Forest Ecology and Management*, *10*(1).
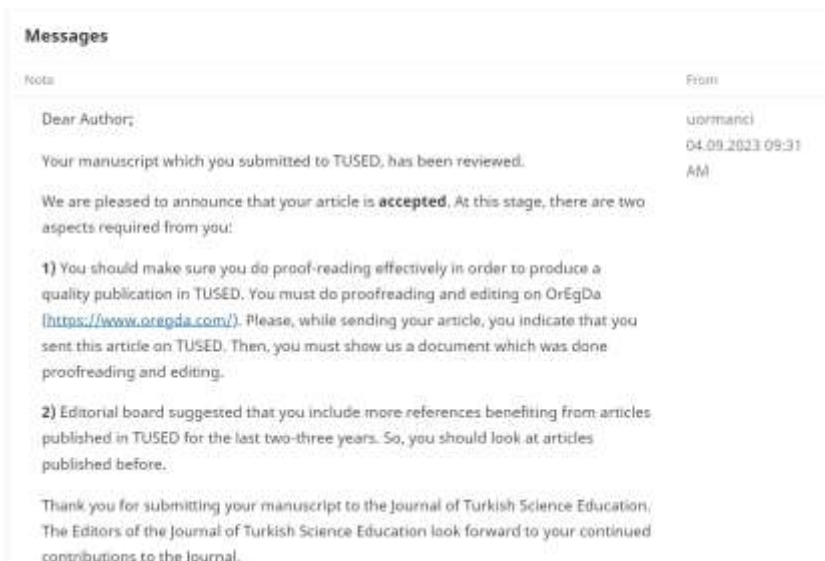
**(6) Bukti Accept submission**



**Notifications** ✕

## [tused] Editor Decision

04.09.2023 09:29 AM

Karunia Puji Hastuti, Deasy Arisanty, Muhammad Muhaimin, Parida Angriani, Eva Alviawati, Nevy Farista Aristin, Akhmad Munaya Rahman:

We have reached a decision regarding your submission to Journal of Turkish Science Education, "Pro-Environmental Behavior of Indonesian University Students: What Factors Affecting It?".

Our decision is to: Accept Submission

Reviewer A:

The researchers have met all the requirements made by the referees. It can be accepted for publication.

Recommendation: Accept Submission

**(7) Permintaan proof reading dari pihak editorial jurnal**

Participants

Ümmühan Ormancı (uormanci)

Karunia Puji Hastuti (karuniapujihastuti)

### Messages

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|---|---|
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**(8) Hasil proof reading dari pihak editorial jurnal**



Insertion/replacement

Suggested deletion

Query/comment

Questionable wording or placement

# Factors Affecting Pro-Environmental Behaviour of Indonesian University Students: What Factors Affecting It?

Karunia Puji Hastuti[1], Deasy Arisanty[2], Muhammad Muhaimin[3], Parida Angriani[4], Eva Alviawati[5], Nevy Farista Aristin[6], Akhmad Munaya Rahman[7]

[1] *Universitas Lambung Mangkurat, Indonesia, karuniapuji@ulm.ac.id, ORCID ID: 0000-0002-0813-7699*
[2] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0001-5937-2309*
[3] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-4957-6225*
[4] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0001-6847-8834*
[5] *Universitas Lambung Mangkurat, Indonesia*
[6] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-1551-6654*
[7] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-1748-9717*

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Research Article

**ABSTRACT**

Environmental damage is a negative effect of human activities. The young generation is saddled with the burden of environmental damage left by the previous generations and must also take on a role as an agent of change in improving the environment. This study analyses the pro-environmental behaviour of Indonesian students, the factors affecting such behaviour, and efforts to improve those behaviours. This research uses a quantitative approach with survey methods. Four hundred seventy (470) students in the department of geography and department of geography education from various public and private universities in Indonesia have participated as research respondents. The research sample used random sampling techniques from several public and private universities in Indonesia. The research instrument used was a questionnaire employing the Likert scale. The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behaviour (Y). Data were analysed using path analysis through partial least squares structural equation modelling (PLS-SEM) software version 3. Findings revealed high levels of pro-environmental behaviour, affected by environmental knowledge, environmental responsibility, value-belief-norm, and environmental education having a convincing positive effects on forming environmental behaviour. The young generation must learn pro-environmental behaviour through formal education since the behaviour helps preserve the environment.

## Introduction

Environmental damage has been the topic of many discussions by the governments, researchers, and local and international organisations. Their concerns have mostly been waste, pollution, deforestation, extreme climate change, global warming, ozone depletion, the greenhouse effect, and acid rain. (sentences switched) Human behaviour dramatically impacts the environment (Gifford & Nilsson, 2014; Steg & Vlek, 2009).Most environmental damage happens due to human activities; the damage will affect our ecosystem completely now and in the future.

Awareness of environmental problems and efforts to preserve the environment are indispensable to prevent further damage to our only planetary home; this can be done through inculcating pro-environmental behaviour. Pro-environmental behaviour refers to conscious efforts to minimise the negative impact of human activities on the environment (Kollmuss & Agyeman, 2002). Pro-environmental behaviour can also be defined as actual or perceptual actions contributing to environmental conservation (Kurisu, 2015). The United Nations Commission on Sustainable Development (UN CSD) International Work Programme defines pro-environmental behaviour as the use of products and services to fulfil the primary needs and bring about a better quality of life while minimising the use of natural resources and reducing hazardous materials, waste, emission, and other pollutants through a lifecycle not to harm the life of the future generations (Jensen, 2002; Steg & Vlek, 2009).

Education is essential in raising awareness of environmental behaviour (Zilahy & Huisingh, 2009; Zsóka et al., 2013). Previous studies suggest that people with higher educational levels tend to care more about the quality of the environment and are motivated to be directly involved in environmental preservation due to their greater awareness of damage potential (Lozano & Vallés, 2007; Ramos et al., 2015). Universities play a crucial role in directing students to develop environmental awareness in both the social and physical environments (Meyer, 2016).

University students are intelligent young people who will become the nation's next intelligentsia—they must accordingly exhibit pro-environmental behaviour. The quality of our environment depends on our behaviour. The young generation takes the burden of environmental damage left by the previous generations; they are also an important factor in changing the environment towards a better state. Universities in Indonesia assist students in improving their pro-environmental behaviour through a course named *Pendidikan Lingkungan Hidup* (Environmental Education) is this the same for all universities? Is it a mandatory course?.

The course is also provided to students majoring in Geography Education. The course teaches students the importance of the environment, environmental issues, and tangible actions to preserve the environment. Integrating this course into the curriculum will likely increase pro-environmental behaviour. Even though the effect of knowledge has not been ascertained precisely, some studies show that learning plays a crucial role in increasing pro-environmental behaviour; it also helps individuals to have alternative perspectives through the formation of arguments to support their beliefs and behaviour (Larson et al., 2015).

Increased awareness and understanding of environmental issues and pro-environmental behaviour can take place through environmental education (Jurdi-Hage et al., 2019). This aligns with the role of universities as effective agents of change. A study by (Jurdi-Hage et al., 2019; Meyer, 2016) mentions that specific policies, programmes, and courses on the environment can affect the preferred construction of students conceptions related to the environment because the students have more knowledge and skills for environmental preservation. The present study aims to analyse the pro-environmental behaviour of Indonesian students, the factors affecting such behaviour, and the efforts to improve those behaviours. I would prefer to see a separate section on Objectives/Aims, Rationale, Research Questions

**Literature Review**

Pro-environmental behaviour NB can use 'behaviour(s) as a singular or a plural can be construed as actions that show concern for the environment in everyday life. The activities can be repetitive or just occasional. The measures deal with preserving natural resources and the environment, such as preserving specific natural resources (water, soil and air), reducing energy consumption (electricity, oil and gas), recycling (recycling paper, plastics, and others), and preserving life (animals and plants) (Erdogan & Ozsoy, 2007). Pro-environmental behaviour also refers to any actions to minimise environmental damage or to improve the environment (Scannell & Gifford, 2010). Pro-environmental behaviour includes recycling, which means reusing or remanufacturing what has been used.

**Environmental Knowledge** you need to distinguish between headings and subheadings through the font

Environmental knowledge means knowledge and awareness of environmental problems and their solutions. The most crucial thing in any individual's environmental awareness is environmental knowledge, values, willingness to act, and actual behaviour that is influenced by several factors, including elements of intention and situation (Jensen, 2002; Latif et al., 2013).

Environmental knowledge is a process of acquiring values and concepts and developing skills. It is a necessary medium to understand and appreciate the interaction between humans and their culture and the physical environment (Latif et al., 2013; Zareie & Navimipour, 2016). Awareness of the environment is needed to recognise environmental problems and issues. Environmental knowledge can be held formally or informally, and informally by families, communities, governments, and schools (P. Liu et al., 2020).

Knowledge can influence students' attitudes and behaviour toward the environment. Students with high environmental knowledge will be aware of the need to preserve their environment. According to (Otto & Pensini P, 2017) students' awareness of the environment will shape responsible environmental attitudes and behaviours combine the last two sentences. Based on the results of research by (Janmaimool & Khajohnmanee, 2019) there is a positive correlation between students' awareness of and attitudes toward the environment, so if students have a lot of knowledge about environmental issues, then they will become more aware of environmental issues that are happening and this awareness encourages them to act responsibly towards the environment. According to (Jensen, 2002), behaviour based on knowledge will last longer than behaviour that is not based on knowledge. Research conducted by (Latif et al., 2013) found that factual knowledge in the form of knowledge is a variable that correlates with pro-environmental knowledge.

**Environmental Responsibility**

(Fettahlıoğlu & Aydoğdu, 2020) revealed that environmentally responsible behaviour seeks to preserve the environment and look for environmental problems. environmentally responsible citizenry refers to individual or group action aimed at doing the right thing to protect the environment in everyday life, such

as recycling, energy conservation and reducing littering, and not caring for the environment ??. According to (Kaiser, Ranney, et al., 1999), environmentally responsible behaviour contains several dimensions: recycling, avoiding purchases to minimise environmental impact as a form of green consumerism, being politically active in communities to influence decisions that impact the environment, and educating oneself about environmental awareness.

(Singh & Gupta, 2013) argues that environmentally responsible behaviour measures a person's readiness to protect the environment actively. That's mean environmentally responsible behaviour is an environmental protection mechanism to reduce and prevent damage to environmental resources.

**Value-Belief_Norm**

Pro-environmental behaviour is a behaviour that various groups of society can carry out, but the group that is currently highlighted is young people. Young people are the key to facing environmental issues today because young people are the most instrumental in influencing policies, increasing public awareness, conducting educational programmes, highly contestable! In many cultures, young people are hardly listened to at all and so on (Stern et al., 1999).

A conceptual framework that can explain the relationship between environmental beliefs and pro-environmental behaviour is the Value Belief Norm (VBN) Theory. (Stern et al., 1999) explained, variables such as value orientation, NEP spell out, awareness of consequences, beliefs to be able to act, and individual norms are variables that can influence pro-environmental behaviour. VBN theory combines value, NEP, and norm-activation theories as causal chains that lead to pro-environmental behaviour. The closer the variable's position is to the part of pro-environmental behaviour, the stronger the variable relates to pro-environmental behaviour This needs a bit of explaining – comes across as a tautology Several previous studies conducted by (Liobikienė & Poškus, 2019; Oreg & Katz-Gerro, 2006) have shown a positive relationship between VBN and pro-environmental behaviour.

**Environmental education**

Environmental education is an educational programme to encourage children as learners to exhibit rational and responsible understanding, awareness, attitudes, and behaviours about the mutual influence between residents and the environment in various aspects of human life (Kollmuss & Agyeman, 2002; Zsóka et al., 2013). Environmental education seeks to change the behaviour and attitudes carried out by multiple parties or elements of society aiming to increase people's knowledge, skills, and awareness of environmental values and environmental issues, which in turn can move the community to play an active role in environmental conservation and safety efforts for the benefit of current and future generations. From various opinions about environmental education, it can conclude that environmental education is about internalisation, directly or indirectly, in forming independent personalities and mindsets of students.

Pro-environmental behaviour is also seen as one's effort to prevent environmental damage, protect the environment, and solve environmental issues (Schultz et al., 1995; Stern et al., 1999). Pro-environmental behaviour refers to conscious efforts to minimise the negative impact of one's action on nature (both natural and artificial ecosystems), such as reducing natural resources and consumption, toxin, waste, and so forth (Kollmuss & Agyeman, 2002). However, pro-environmental behaviour is one's effort to reduce the negative impact of their activities on the environment to prevent environmental damage and preserve the environment. This material is repetitive

Several factors affecting pro-environmental behaviour, environmental commitment and awareness, green lifestyle, and green self-efficacy positively affect the pro-environmental behaviour of young people (Yusliza et al., 2020). Holistic and systemic perspectives on the environment are crucial in promoting pro-environmental behaviour (P. Liu et al., 2020; X. Liu et al., 2018). Pro-environmental behaviour also increases with sociodemographic that's things like social class and family size, not what follows here factors, including knowledge, awareness, and understanding of environmental damage (Soares et al., 2021). Environmental knowledge affects pro-environmental behaviour (Liobikiené & Poškus, 2019) Social norms and lifestyle contribute to pro-environmental behaviour. The pro-environmental behaviour of females is affected by social

norms and lifestyle, while the lifestyle of males is affected by their views on specific policies this comes across as a sharp mutually exclusive differentiation which is not what was intended (Wut et al., 2021). There is also a difference in pro-environmental behaviour between the younger and older generations (Alzubaidi et al., 2021) explain.

Pro-environmental behaviour of university students is also affected by formal education. Environmental knowledge delivered through formal education can improve pro-environmental behaviour. Environmental systems, including political ecology, sustainable development, the environment and ecology, and environmental situations, affect pro-environmental behaviour (Janmaimool & Khajohnmanee, 2019). Values, new environmental paradigms, and personal norms also affect pro-environmental behaviour among students (S. Liu & Guo, 2018). You seem to be jumping from theme to theme. Reorganise your material so that it flows better

The novelty of this study compared to several previous studies lies in determining how environmental knowledge, environmental responsibility, value-belief-norm, and environmental education influence pro-environmental behaviour in Indonesian university students. I like to see a section on Objectives/Aims, Rationale, Research Questions

## Methods

### Research Design

This research uses a quantitative approach with survey methodology. The survey method is a research method that takes samples from a population using questionnaires as a data collection tool (Creswell & Creswell, 2017; Hoy & Adams, 2015). The survey aims to get a general picture of the characteristics of the population that can be seen from attitudes, values, beliefs, opinions, habits, behaviours, and others. In this study, the picture/information researchers want to get from respondents is pro-environmental behaviour seen from environmental knowledge, environmental responsibility, value–belief–norm, and environmental education.

The respondents in this study were students of geography study and geography education programmes from various public and private universities in Indonesia who were randomly selected. I'd be willing to bet there was no randomness involved; rather, availability sampling and self-selection The reason for choosing students of these programmes is the presence of environmental education courses in this study programme. Environmental education aims to change human attitudes and behaviour to have rational thinking, maintain the environment, and be responsible for the current and future quality of life. repetitive Four hundred seventy (470) students of geography study programs and geography education from various public and private universities in Indonesia have participated as research respondents. The universities included Universitas Lambung Mangkurat, Universitas PGRI Kanjuruhan, Universitas Khairun Ternate, Universitas Samudra, Universitas Negeri Makasar, Universitas Negeri Malang, IKIP PGRI Pontianak, Universitas Al Muslim, Universitas Widya Dharma, Universitas Hamzanwadi, Universitas Negeri Padang, Universitas Muhammadiyah Mataram, STIKIP Kei Raga Ternate, Universitas Tadulako, USK, Universitas Halu Oleo, Universitas Siliwangi, IKIP PGRI Palangkaraya, Universitas Nusa Cendana Kupang, Amikom Yogyakarta, and Universitas Negeri Jember. Data collection in this study used questionnaires filled out online through Google form and shared via WhatsApp group. The research instrument used was a questionnaire regarding the Likert scale.

The Smart PLS 3.0 Program was used to check our instruments' validity by looking at each construct indicator's loading factors. The standard requirement to test the validity of research instruments is that the loading factor must be more significant than 0.70 (Chan & Lay, 2018; Zürich et al., 2005). Reliability was tested by calculating the composite reliability—the range is 0.6 to 0.7 (Chan & Lay, 2018; Rasoolimanesh, 2022). The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behaviour (Y). **In a previous section on Objectives/RQs, you need to justify the selection of these**

**Figure 1** I don't think we need this Figure

*Theoretical framework*
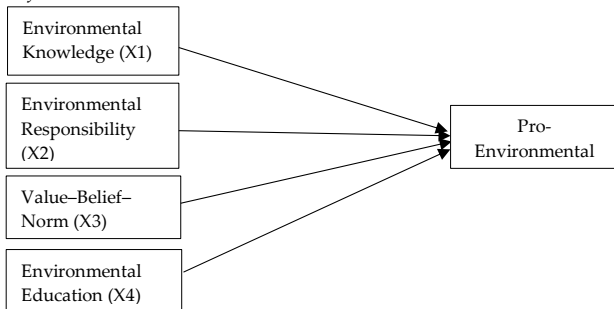


Data were analysed using the Structural Equation Modelling (SEM) Partial Least Square (PLS). SEM-PLS is a causal model explaining the effect of variables on the constructed variable (Chan & Lay, 2018). Data analysis should come under its own subheading

**Table 1** Tables need introducing.

*Research Variables*

| Variable | Indicator source? |
|---|---|
| Environmental knowledge (X1) | 16. Knowing daily environmental problems<br>17. Knowing the causes of environmental problems<br>18. Learning the solutions to solve environmental problems<br>19. Understanding the dependency of human beings on the environment<br>20. Knowing renewable energy |
| Environmental responsibility (X2) | 13. No littering<br>14. Keeping the environment clean<br>15. Using environmentally friendly energy and resources<br>16. Greening the surrounding areas |
| Value–belief–norm (X3) | 13. Believing that everything on earth is God's creation<br>14. Being thankful for what is available on earth<br>15. Sticking to the concept of cleanliness in doing religious rituals<br>16. Practicing religious advice to protect the environment |
| Environmental education (X4) | 13. Increasing understanding of environmental problems<br>14. Improving acceptance, assessment, organization, and personality characteristics in managing life in harmony with nature<br>15. Growing a love of the environment<br>16. Increasing interest in the environment |
| Pro-Environmental Behaviour (Y) | 46. Participating in events/seminars/workshops on environmental issues<br>47. Reducing the use of plastic<br>48. Replacing disposable drinking bottles with tumblers<br>49. Replacing food wrapping paper with lunch boxes<br>50. Buying items with a recyclable sign<br>51. Reusing usable things<br>52. Using rechargeable batteries<br>53. Sorting waste<br>54. Reusing things that are still suitable for use |

55. Disposing of phone batteries or electronic device batteries properly
56. Turning off electronic devices that are not in use
57. Using electronic devices with energy-saving features
58. Turn off the lights during daytime
59. Using water wisely
60. Using a water storage tank

Our research hypotheses are as follows:

Hypothesis 1

H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 2

H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 3

H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 4

H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behaviour

## Findings

### Outer Model

The outer model was used to check the validity and reliability of the model – that comes under Methods. Before hypothesis testing to predict the relationship between latent variables in a structural model, we first evaluated the outer model to verify indicators and latent variables for further analysis. The validity test evaluates the ability of research instruments to measure what they are intended to measure (Hair et al., 2017; Hair Jr et al., 2020). The reliability test evaluates the consistency of a measurement instrument in measuring a concept or the character of research respondents in answering questionnaire items or research instruments. The result is presented in discriminant validity (outer loadings), Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

**Table 2**

*Structural Model*

| Construct | Items | Loading Factors | Cronbach's alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|
| Environmental knowledge | X1.1 | 0.855 | 0.903 | 0.928 | 0.720 |
| | X1.2 | 0.866 | | | |
| | X1.3 | 0.857 | | | |
| | X1.5 | 0.837 | | | |
| | X1.5 | 0.826 | | | |
| | X2.1 | 0.855 | 0.874 | 0.914 | 0.726 |

| | | | | | |
|---|---|---|---|---|---|
| Environmental responsibility | X2.2 | 0.878 | | | |
| | X2.3 | 0.845 | | | |
| | X2.4 | 0.829 | | | |
| Value–belief–norm | X3.1 | 0.831 | | | |
| | X3.2 | 0.866 | 0.868 | 0.910 | 0.715 |
| | X3.3 | 0.838 | | | |
| | X3.4 | 0.848 | | | |
| Environmental education | X4.1 | 0.869 | | | |
| | X4.2 | 0.844 | 0.881 | 0.918 | 0.737 |
| | X4.3 | 0.874 | | | |
| | X4.4 | 0.846 | | | |
| Pro-Environmental Behaviour | Y1 | 0.747 | | | |
| | Y2 | 0.670 | | | |
| | Y3 | 0.614 | | | |
| | Y4 | 0.663 | | | |
| | Y5 | 0.678 | | | |
| | Y6 | 0.731 | | | |
| | Y7 | 0.744 | | | |
| | Y8 | 0.749 | 0.924 | 0.934 | 0.505 |
| | Y9 | 0.758 | | | |
| | Y10 | 0.755 | | | |
| | Y11 | 0.737 | | | |
| | Y12 | 0.746 | | | |
| | Y13 | 0.672 | | | |
| | Y14 | 0.670 | | | |

Table 2 shows that measuring discriminant validity through outer loadings ensures that each concept of the latent model is different from other variables. Outer loadings or loading factors begin the validity checking of a model. Should be in Methods An indicator is reliable if it has a correlation value of more than 0.70. An indicator is valid if its outer loading is between 0.50 – 0.60, so its presence is acceptable (Hair et al., 2020).

Table 2 shows that all indicators of the latent variables are valid and reliable because their outer loading values are between 0.60 and 0.70. Thus, all latent variables could explain the variable of each indicator that measured them. Discriminant validity can be determined using AVE for each construct or latent variable. The model has better discriminant validity if the AVE square root for each construct is greater than the correlation between the two constructs in the model.

Table 2 shows that the AVE value for all constructs is > 0.50. Therefore, convergent validity in the model being tested is acceptable. The Cronbach Alpha and composite reliability values for all constructs are also > 0.60, which means that all constructs have very good reliability. The results of the outer model analysis are presented in Figure 2.

**Figure 2**

*Model pro-environmental behaviour of university students in Indonesia*

**Measuring the Structural Model (Inner Model)**

**Coefficient of Determinant (R-square)**

The R-square value is used to assess the extent of influence certain independent latent variables have on the dependent latent variable. Using SmartPLS 3.0 software, Methods we obtained the following results.

**Table 3**

*Coefficient of Determinant (R-square)*

|  | R-square | R-square Adjusted |
|---|---|---|
| Environmental education | 0.463 | 0.462 |
| Environmental knowledge | 0.479 | 0.476 |
| Pro-environmental behaviour | 0.631 | 0.629 |
| Environmental responsibility | 0.468 | 0.466 |
| Value–belief–norm | 0.430 | 0.433 |

Table 3 shows the R-square value for environmental education is 0.463; this shows that environmental education has an influence of 46.3% on pro-environmental behaviour. The R-square value for environmental knowledge is 0.479; this indicates that environmental knowledge has a 47.6% influence on pro-environmental behaviour. The R-square value for environmental responsibility is 0.468; this shows that environmental responsibility has a 46.8% influence on pro-environmental behaviour. The R-square value for the value-belief-norm is 0.430; this indicates that Value-belief-norm has a 43.0% influence on pro-environmental behaviour. The R-square value for pro-environmental behaviour is 0.631, which indicates that environmental education, environmental knowledge, value-belief-norm, and environmental responsibility factors influence pro-environmental behaviour by 63.1%. no, the square of that – about 40%

**Hypothesis Testing**

The p-value is set at a significance level (α) of 5% or 0.05 to determine whether the hypothesis is accepted or rejected. If the p-value < 0.05, H0 is rejected, meaning an effect exists. Conversely, if the p-value > 0.05, H0 is accepted, indicating no effect exists. Table 4 presents the results of evaluating the structural model of the hypothesis test using the PLS method obtained from the SmartPLS 3.0 Bootstrapping Report. See earlier comment about types of hypothesis vs RQs. Some of this belongs in Methods

**Table 4**

*Path Coefficients*

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|---|---|
| Environmental education-> Pro-environmental behaviour | 0.153 | 0.154 | 0.059 | 2.611 | 0.009 |
| Environmental knowledge-> Pro-environmental Behaviour | 0.392 | 0.395 | 0.046 | 8.618 | 0.000 |
| Environmental responsibility -> Pro-environmental behaviour | 0.365 | 0.365 | 0.052 | 7.043 | 0.000 |
| Value–belief–norm-> Pro-environmental behaviour | 0.430 | 0.433 | 0.033 | 13.234 | 0.000 |

Table 4 shows that environmental education has a positive relationship with pro-environmental behaviour, with a p-value of 0.009 ($p < 0.05$). Environmental knowledge has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 ($p < 0.05$). Environmental responsibility has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 ($p < 0.05$). Value–Belief–Norm has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 ($p < 0.05$).

## Discussion

**Factors Affecting Pro-Environmental Behaviour of University Students**

The path coefficient analysis presented in Table 4 for testing the first hypothesis shows that H0; Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behaviour is rejected. This means that environmental knowledge has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Findings Based on the analysis results, most students were already concerned about the environment, such as environmental problems and the causes of such problems. Students also knew solutions to environmental problems and about renewable energy to overcome the problems. Renewable energy sources are environmentally friendly, do not pollute the environment, and do not contribute to climate change and global warming because the energy comes from sustainable natural sources, such as sunlight, wind, water, biofuels, and geothermal. Seems out of place here

Knowledge is crucial to determining behaviour. Students with environmental knowledge tend to change their behaviour due to education; this aligns with the view that environmental knowledge affects pro-environmental behaviour (Gifford & Nilsson, 2014). Knowledge is defined as a source of where environmental behaviour is formed and attitude is manifested (Kollmuss & Agyeman, 2002).

Developing students' environmental knowledge is important, especially on campus. A study in Canada reveals that more than 60% of the study respondents agree that one factor hindering pro-environmental behaviour is a lack of knowledge (Kennedy et al., 2009; Kennedy & Kmec, 2018). Other studies

also confirm that more profound and broader knowledge of environmental issues and solutions to such issues will increase the possibility of individuals taking action to protect the environment (Farrukh et al., 2022; Jensen, 2002; Kaiser, Ranney, et al., 1999; Kaiser, Wölfing, et al., 1999; Kollmuss & Agyeman, 2002; Latif et al., 2013). Individuals with sound knowledge of environmental issues tend to show pro-environmental behaviour. Previous studies show that knowledge relates to actions and becomes a predictor of actions (Neolaka, 2020). To sum up, individuals with sound knowledge of environmental issues and solutions to such issues tend to show pro-environmental behaviour to protect the environment. This is starting to read more like part of the Lit Review

(P. Liu et al., 2020) find a significant relationship between the level of knowledge and the pro-environmental behaviour of students—the higher the level of environmental knowledge, the better the pro-environmental behaviour of students and vice versa. (Fawehinmi et al., 2020) Reveal a positive and significant relationship between environmental knowledge and attitudes towards environmental sustainability. If environmental knowledge increases, attitudes towards environmental sustainability will also increase, and vice versa.

(Ardoin et al., 2020) provide an opinion that people with better environmental knowledge will be better aware of the environment and environmental issues. This is a truism and is universally held Thus, they will be motivated to act responsibly toward the environment. Developing environmental awareness through education has always been critical in building pro-environmental behaviour. Knowledge of people will guide them to determine whether their actions will be good or bad for the environment. Environmental knowledge can be in the form of knowledge of environmental issues, causes, effects, solutions, and how to become an environmentally responsible agent of change related to the problems (Fawehinmi et al., 2020).

The path coefficient analysis presented in Table 3 for testing the second hypothesis shows that H0: Environmental Responsibility of students has no positive and significant correlation with Pro-Environmental Behaviour is rejected. This means that environmental responsibility has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental responsibility is an action motivated by one's willingness to prevent environmental damage or preserve the environment. Our findings showed that the students had good environmental responsibility. They did not litter, cared for environmental cleanliness, used recyclable goods, and did greening of their surrounding areas.

Environmental responsibility is closely related to the ascription of responsibility. Initially, the ascription of responsibility is defined as a feeling of responsibility from the negative consequences of not behaving in a pro-social manner. This theory is widely applied in green behaviour because most people behave green based on their altruistic feelings, such as recycling, energy policies, and other green behaviours in general. Lit Rev – point out relevance to your own findings

Increased awareness and understanding of changing environmental issues and improved skills for environmentally responsible actions can be developed through environmental education (Jurdi-Hage et al., 2019). This is consistent with the university's role as an effective agent of change.

Building awareness to be environmentally responsible aims to preserve the environment, so human beings not only take benefit of the environment for their lives but also take care of and be accountable for preserving the environment. Individuals with high environmental awareness can improve pro-environmental behaviour (Zareie & Navimipour, 2016). In addition, students with higher environmental awareness show more pro-environmental behaviour (S.-C. Liu & Lin, 2015; S. Liu & Guo, 2018). As previously indicated, specific environmental awareness can lead to better predictability of environmentally responsible behaviour if certain pro-environmental behaviours are assessed.

As formal education institutions, universities must implement pro-environmental behaviour (Usaini et al., 2015). People are not born with pro-environmental behaviour—the behaviour is taught and shaped along with their developmental stages. Increased environmental responsibility will finally lead to positive changes toward pro-environmental behaviour.

The path coefficient analysis presented in Table 4 for testing the third hypothesis shows that H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behaviour is rejected. This means that environmental education has a significant and positive

relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Our findings confirmed that the students received environmental education, proven by increased environmental knowledge and understanding that they refused to damage the environment at any cost.

Education is crucial in forming pro-environmental behaviour (Iswari & Kusuma, 2022). Human behaviour greatly impacts the environment. Environmental knowledge gained through education is positively and significantly important to preserve the environment (Azhar et al., 2015; Erdogan & Ozsoy, 2007; Sontay et al., 2015). Environmental education teaches students the importance of preserving the environment—it increases students' awareness, directs students, and shapes their attitudes toward preserving the environment (Hassan & Pudin, 2011; Mulyana, 2009; Özalemdar, 2021). Environmental education aims to increase people's understanding and concern and is oriented toward preventing environmental damage and finding solutions to environmental issues.

The findings align with (Meyer, 2016), stating that specific policies, programmes, and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation.

The fourth hypothesis testing shows that H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behaviour is rejected. This means the value-belief-norm has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 (p < 0.05). Our findings showed that students had good value-belief-norm for pro-environmental behaviour, as seen from the willingness of students to protect the environment and support policies to preserve the environment. This aligns with (Mahat et al., 2020; Whitley et al., 2018), revealing that biosphere and altruistic values make students more willing to be involved in pro-environmental activities, such as supporting policies to protect the environment.

The value-belief-norm theory is proposed by (Stern et al., 1999), stating that value orientation can, directly and indirectly, affect pro-environmental behaviour. The theory assumes three value orientations related to environmental concerns relevant to understanding pro-environmental attitudes, preferences, and behaviour: altruistic, egoistic, and biosphere value orientations (Oreg & Katz-Gerro, 2006; Stern et al., 1999). Our findings strengthen the theory since the results show a direct contribution of value orientation toward pro-environmental behaviour.

Norms inform a person about acceptable and unacceptable behaviour. Norms are the rules of society regarding good and bad attitudes and actions that are permissible and not permissible. There are three types of norms: habits, prohibitions, and conventions this should come in Methods section (Kaiser et al., 2005, 2006). Personal norms are moral ethics and obligations towards something related to orientation in creating something. An ethical approach to dealing with environmental problems is needed. This approach is intended to determine attitudes, actions, and ethical perspectives and appropriately manage environmental care and its ecosystem (Hassan & Pudin, 2011; Liobikienė & Poškus, 2019).

The principle of respect for nature deals with a moral responsibility towards nature. Every part and object in this universe was created by God with specific purposes, regardless of whether it is for the benefit of humans or not. No gods and demons, please – except in a theological journal Therefore, humans are also responsible for protecting nature as part of the universe. This responsibility is individual and collective (Stern et al., 1999). Moral responsibility requires humans to take concrete initiatives, efforts, policies, and actions to protect the universe and everything in it. This means the preservation and destruction of nature is a shared responsibility of all humankind. This responsibility also manifests in warning, prohibiting, and punishing those who damage and endanger nature (Kurisu, 2015; Stern et al., 1999).

Building students' positive environmental values in educational institutions are essential as it should help solve environmental problems and improve environmental quality (Chen, 2015). This will help to create a knowledgeable society about environmental issues that will play a significant role in preserving the environment. Platitudes!

**Efforts to Improve Pro-Environmental Behaviour** – shouldn't this come before the current quantitative study?

Improving pro-environmental behaviour, especially among the younger generation, can be done through education. Building a character of caring for the environment through education is an effort the government of Indonesia takes to preserve the environment. Such character is manifested in attitudes and actions of preventing environmental damage and taking steps to repair the already-happen environmental damage. Some activities to form pro-environmental behaviour are: (1) caring for the environment, (2) reducing plastic use, (3) sorting waste, (4) reducing carbon emission, and (5) saving energy this belongs to the Intro!. Actions to repair environmental damage include (1) planting trees, (2) reusing goods, and (3) using environmentally friendly technology. The character of caring for the environment must be inculcated from an early age through fun learning. This is in line with the research results (Yüzüak & Erten, 2022), which suggest that environmental education be included in various disciplines and raise environmental awareness among individuals should become one of national education's primary objectives.

Other efforts to increase public awareness of the importance of protecting the environment can be carried out through informational and structural strategies. Informative strategies refer to interventions through campaigns or socialisation to increase knowledge to minimise environmentally damaging behaviour. For example, the reduce, reuse, and recycle (3R) campaign and creating eco-points for residential communities to collect metal, paper, glass, and organic waste for recycling. In addition to reducing waste, the 3R programme can also be a means of earning income in which people can deposit their waste to waste banks or recycling facilities.

Efforts to increase public awareness through structural strategies can be made through behavioural changes that affect behavioural decisions. This strategy focuses on external environmental planning that can support pro-environmental behaviour—for example, providing easily-accessible bins to avoid littering. *Direct* relevance to current study?

Governments, companies and other organisations can also improve people's pro-environmental behaviour through appropriate environmental policies primarily aimed at increasing self-motivation from the community to behave pro-environmentally. This can be done through activities including providing infrastructure that makes it easier for people to adopt pro-environmental behaviour, such as providing environmentally friendly objects at lower prices, providing pro-environmental education to students as early as possible, developing an in-depth understanding of waste recycling efforts through various media, and supervising the public in subsidy programs for people with pro-environmental behaviour and fines for violators of environmental policies. Ditto – all good stuff but fail to see connection with data arising in this study

## Conclusion and Implications

It is significant for everyone, especially the young generation, to behave pro-environmentally to reduce environmental problems. Our findings confirm that environmental knowledge has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Environmental responsibility has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental education has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). The value-belief-norm has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). That means students in university exhibit excellent pro-environmental behaviour but can you ever tell that from a questionnaire? Surely it has to be observed?, where factors of environmental knowledge, environmental responsibility, environmental education, and values influence this behaviour. This research implies that pro-environmental behaviour is crucial in minimizing environmental damage. Pro-environmental behaviour is essential to building the character of loving the environment since early childhood through formal education to ensure environmental preservation and sustainability.

## References

Alzubaidi, H., Slade, E. L., & Dwivedi, Y. K. (2021). Examining antecedents of consumers' pro-environmental behaviours: TPB extended with materialism and innovativeness. *Journal of Business Research*, *122*, 685–699.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224.

Azhar, A., Basyir, M. D., & Alfitri, A. (2015). Hubungan pengetahuan dan etika lingkungan dengan sikap dan perilaku menjaga kelestarian lingkungan.(we need translation) *Jurnal Ilmu Lingkungan*, *13*(1), 36–41.

Chan, S. H., & Lay, Y. F. (2018). Examining the reliability and validity of research instruments using partial least squares structural equation modeling (PLS-SEM). *Journal of Baltic Science Education*, *17*(2), 239.

Chen, M. (2015). An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in Taiwan. *Asian Journal of Social Psychology*, *18*(2), 145–151.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Erdogan, M., & Ozsoy, A. (2007). Graduate students' perspectives on the human-environment relationship. *Journal of Turkish Science Education*, *4*(2), 21–30.

Farrukh, M., Raza, A., Mansoor, A., Khan, M. S., & Lee, J. W. C. (2022). Trends and patterns in pro-environmental behaviour research: a bibliometric review and research agenda. *Benchmarking: An International Journal*.

Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behaviour of academics: The role of green human resource management and environmental knowledge. *International Journal of Manpower*, *41*(7), 879–900.

Fettahlıoğlu, P., & Aydoğdu, M. (2020). Developing environmentally responsible behaviours through the implementation of argumentation-and problem-based learning models. *Research in Science Education*. https://link.springer.com/article/10.1007/s11165-018-9720-0

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141–157.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123.

Hair Jr, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hassan, A., & Pudin, S. (2011). The informal environmental education value practices among adults in Sabah, Malaysia. *Journal of Turkish Science Education*, *8*(1), 19–28.

Hoy, W. K., & Adams, C. M. (2015). *Quantitative research in education: A primer* (Second Edi). Sage Publications.

Iswari, N., & Kusuma, A. B. (2022). Analysis of the factors that influence the environmental quality index in Bekasi Regency. *Jurnal Pengelolaan Sumber Daya Alam Dan Lingkungan*, *12*(4), 720–728.

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of environmental system knowledge in promoting university students' environmental attitudes and pro-environmental behaviours. *Sustainability*, *11*(16), 4270.

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, *8*(3), 325–334.

Jurdi-Hage, R., Hage, H. S., & Chow, H. P. H. (2019). Cognitive and behavioural environmental concern among university students in a Canadian city: Implications for institutional interventions. *Australian Journal of Environmental Education*, *35*(1), 28–61.

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behaviour with the value-belief-norm model in explaining conservation behaviour 1. *Journal of Applied Social Psychology*, *35*(10), 2150–2170.

**Commented [ss43]:** You need to add doi or links to all online articles.

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (2006). Ecological behaviour, environmental attitude, and feelings of responsibility for the environment. *European Psychologist*, *4*(2), 59–74. https://doi.org/10.1027//1016-9040.4.2.59

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*, *19*(1), 1–19. https://doi.org/10.1006/JEVP.1998.0107

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Why we don't" walk the talk": Understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, 151–160.

Kennedy, E. H., & Kmec, J. (2018). Reinterpreting the gender gap in household pro-environmental behaviour. *Environmental Sociology*, *4*(3), 299–310.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research*, *8*(3), 239–260.

Kurisu, K. (2015). *Pro-environmental behaviours*. Springer.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behaviour. *Journal of Environmental Psychology*, *43*, 112–124.

Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia-Social and Behavioural Sciences*, *105*, 866–874.

Liobikienė, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behaviour: modifying the value-belief-norm theory. *Sustainability*, *11*(12), 3324.

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviours?: The mediating role of environmental attitudes and behavioural intentions. *Science of the Total Environment*, *728*, 138126.

Liu, S.-C., & Lin, H. (2015). Exploring undergraduate students' mental models of the environment: Are they related to environmental affect and behaviour? *The Journal of Environmental Education*, *46*(1), 23–40.

Liu, S., & Guo, L. (2018). Based on environmental education to study the correlation between environmental knowledge and environmental value. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3311–3319.

Liu, X., Zou, Y., & Wu, J. (2018). Factors influencing public-sphere pro-environmental behaviour among Mongolian college students: A test of value–belief–norm theory. *Sustainability*, *10*(5), 1384.

Lozano, M., & Vallés, J. (2007). An analysis of the implementation of an environmental management system in a local public administration. *Journal of Environmental Management*, *82*(4), 495–511.

Mahat, H., Hashim, M., Saleh, Y., Nayan, N., & Norkhaidi, S. B. (2020). Transformation of Education for Sustainable Development through Low Carbon Schools Community Program. *Journal of Turkish Science Education*, *17*(3), 429–442.

Meyer, A. (2016). Heterogeneity in the preferences and pro-environmental behaviour of college students: The effects of years on campus, demographics, and external factors. *Journal of Cleaner Production*, *112*, 3451–3463.

Mulyana, R. (2009). Penanaman etika lingkungan melalui sekolah peduli dan berbudaya lingkungan. *Jurnal Tabularasa*, *6*(2), 175–180.

Neolaka, A. (2020). Pengaruh Pengetahuan Pro Environmental Terhadap Perilaku Ramah Lingkungan. *Prosiding Seminar Nasional Pascasarjana*, *1*(01), 14–21.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behaviour cross-nationally: Values, the theory of planned behaviour, and value-belief-norm theory. *Environment and Behaviour*, *38*(4), 462–483.

Otto & Pensini P, S. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, *47*, 88–94.

Özalemdar, L. (2021). The effect on environmental attitude of the active learning method applied in teaching the biology topic "Current Environmental Issues and Human" for 10th Grade Students. *Journal of Turkish Science Education*, *18*(2), 276–289. https://doi.org/10.36681/tused.2021.65

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, *106*, 3–10.

Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: A comprehensive composite-based approach. *Data Analysis Perspectives Journal*, *3*(2), 1–8.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behaviour. *Journal of Environmental Psychology*, *30*(3), 289–297.

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, *15*(2), 105–121.

Singh, N., & Gupta, K. (2013). Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*, *9*(1), 4–18. https://doi.org/10.1108/17471111311307787/FULL/XML

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: Knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials*, *412*, 125227.

Sontay, G., Gokdere, M., & Usta, E. (2015). A comparative investigation of sub-components of the environmental literacy at the secondary school level. *Journal of Turkish Science Education*, *12*(1), 19–28.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97.

Usaini, M. I., Abubakar, N. B., & Bichi, A. A. (2015). Influence of school environment on academic performance of secondary school students in Kuala Terengganu, Malaysia. *The American Journal of Innovative Research and Applied Sciences*, *1*(6), 203–209.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2018). Sustainability behaviours among college students: An application of the VBN theory. *Environmental Education Research*, *24*(2), 245–262.

Wut, T. M., Ng, P., Kan Mike, H.-K., & Fong Samuel, C. (2021). Does gender matter? Attitude towards waste charging policy and pro-environmental behaviours. *Social Responsibility Journal*, *17*(8), 1100–1115.

Yusliza, M. Y., Amirudin, A., Rahadi, R. A., Nik Sarah Athirah, N. A., Ramayah, T., Muhammad, Z., Dal Mas, F., Massaro, M., Saputra, J., & Mokhlis, S. (2020). An investigation of pro-environmental behaviour and sustainable development in Malaysia. *Sustainability*, *12*(17), 7083.

Yüzüak, A. V., & Erten, S. (2022). Teachers' Views About Turkey's Zero Waste Project (TZWP). *Journal of Turkish Science Education*, *19*(1), 71–81. https://doi.org/10.36681/tused.2022.110

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviours of people. *Computers in Human Behaviour*, *59*, 1–8.

Zilahy, G., & Huisingh, D. (2009). The roles of academia in regional sustainability initiatives. *Journal of Cleaner Production*, *17*(12), 1057–1066.

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behaviour and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138.

Zürich, F., Zingg, Æ. A., Biber, Æ. P., Zimmerman, D. L., Zimble, D. a., Evans, D. L., Carlson, G. C., Parker, R. C., Grado, S. C., Gerard, P. D., Zianis, D., Muukkonen, P., Mäkipää, R., Zhao, Y., Krzic, M., Bulmer, C. E., Schmidt, M. G., Simard, S. W., Zhao, D., … Leuven, K. U. (2005). A structural equation model analysis of postfire plant diversity. *Forest Ecology and Management*, *10*(1).

**(9) Hasil akhir berupa artikel yang sudah diperbaiki setelah proof reading**
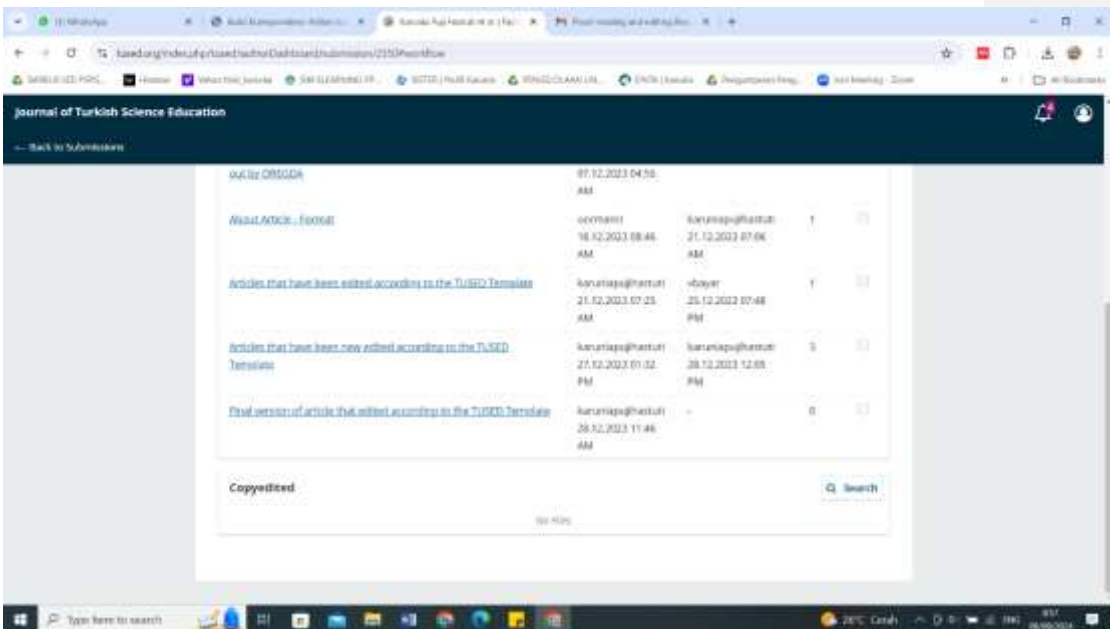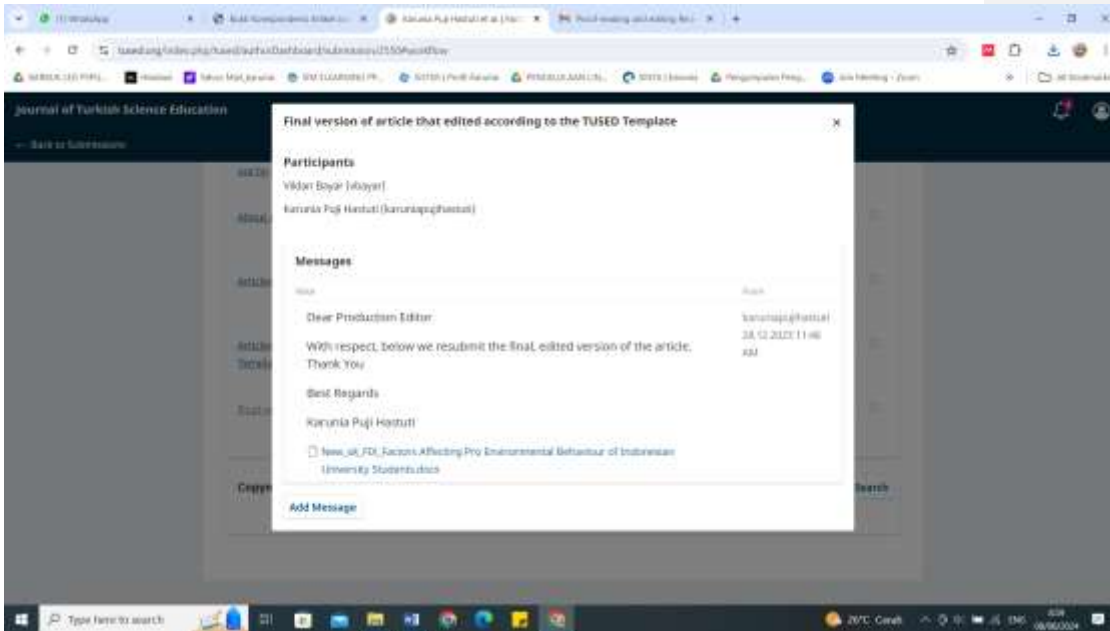
# Factors affecting pro-environmental behaviour of Indonesian university students

Karunia Puji Hastuti[1], Deasy Arisanty[2], Muhammad Muhaimin[3], Parida Angriani[4], Eva Alviawati[5], Nevy Farista Aristin[6], Akhmad Munaya Rahman[7]

[1] *Universitas Lambung Mangkurat, Indonesia, karuniapuji@ulm.ac.id, ORCID ID: 0000-0002-0813-7699*

[2] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0001-5937-2309*

[3] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-4957-6225*

[4] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0001-6847-8834*

[5] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0009-0003-3468-3954*

[6] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-1551-6654*

[7] *Universitas Lambung Mangkurat, Indonesia, ORCID ID: 0000-0002-1748-9717*

**ABSTRACT**

Environmental damage is a negative effect of human activities. The young generation is saddled with the burden of environmental damage left by the previous generations and must take on a role as an agent of change in improving the environment. This study analyses the pro-environmental behaviour of Indonesian students, the factors affecting such behaviour, and efforts to improve those behaviours. This research uses a quantitative approach with survey methods. Four hundred seventy (470) students in the department of geography and department of geography education from various public and private universities in Indonesia have participated as research respondents. The research instrument used was a questionnaire employing the Likert scale. The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behaviour (Y). Data were analysed using path analysis through partial least squares structural equation modelling (PLS-SEM) software version 3. Findings revealed high levels of pro-environmental behaviour, affected by environmental knowledge, environmental responsibility, value-belief-norm, and environmental education having convincing positive effects on forming environmental behaviour.

## Introduction

Environmental damage has been the topic of many discussions by governments, researchers, and local and international organisations. Their concerns have mostly been waste, pollution, deforestation, extreme climate change, global warming, ozone depletion, the greenhouse effect, and acid rain. Human behaviour dramatically impacts the environment (Gifford & Nilsson, 2014; Steg & Vlek, 2009). Most environmental damage happens due to human activities; the damage will affect our ecosystem now and in the future.

Awareness of environmental problems and efforts to preserve the environment are indispensable to prevent further damage to our only planetary home; this can be done through inculcating pro-environmental behaviour. Pro-environmental behaviour refers to conscious efforts to minimise the negative impact of human activities on the environment (Kollmuss & Agyeman, 2002). Pro-environmental behaviour can also be defined as actual or perceptual actions contributing to environmental conservation (Kurisu, 2015). The United Nations Commission on Sustainable Development (UN CSD) International Work Programme defines pro-

environmental behaviour as the use of products and services to fulfil primary needs and bring about a better quality of life while minimising the use of natural resources and reducing hazardous materials, waste, emission, and other pollutants (Jensen, 2002; Steg & Vlek, 2009).

Education is essential in raising awareness of environmental behaviour (Zilahy & Huisingh, 2009; Zsóka et al., 2013). Previous studies suggest that people with higher educational levels tend to care more about the quality of the environment and are motivated to be directly involved in environmental preservation due to their greater awareness of damage potential (Lozano & Vallés, 2007; Ramos et al., 2015). Universities play a crucial role in directing students to develop environmental awareness in both the social and physical environments (Meyer, 2016).

University students are intelligent young people who will become the nation's next intelligentsia—they must accordingly exhibit pro-environmental behaviour. Universities in Indonesia assist students in improving their pro-environmental behaviour through a course named *Pendidikan Lingkungan Hidup* (Environmental Education). The course is also provided to students majoring in Geography Education. The course teaches students the importance of the environment, environmental issues, and tangible actions to preserve the environment. Integrating this course into the curriculum will likely increase pro-environmental behaviour. Even though the effect of knowledge has not been ascertained precisely, some studies show that learning plays a crucial role in increasing pro-environmental behaviour; it also helps individuals to have alternative perspectives through the formation of arguments to support their beliefs and behaviour (Larson et al., 2015).

This aligns with the role of universities as effective agents of change. A study by mentions that specific policies, programmes and courses on the environment can affect student conceptions related to the environment because the students have more knowledge and skills for environmental preservation (Jurdi-Hage et al., 2019; Meyer, 2016). The research question in this research is: What factors affecting the pro-environmental behaviour of Indonesian University Students. The present study aims to analyse the pro-environmental behaviour of Indonesian students, the factors affecting such behaviour, and the efforts to improve those behaviours.

## Literature Review

Pro-environmental behaviour can be construed as actions that show concern for the environment in everyday life. The activities can be repetitive or just occasional. The measures deal with preserving natural resources and the environment, such as preserving specific natural resources (water, soil and air), reducing energy consumption (electricity, oil and gas), recycling (recycling paper, plastics, and others), and preserving life (animals and plants) (Erdogan & Ozsoy, 2007). Pro-environmental behaviour also refers to any actions to minimise environmental damage or to improve the environment (Scannell & Gifford, 2010). Pro-environmental behaviour includes recycling, which means reusing or remanufacturing what has been used.

### Environmental Knowledge

Environmental knowledge means knowledge and awareness of environmental problems and their solutions. The most crucial thing in any individual's environmental awareness is environmental knowledge, values, willingness to act, and actual behaviour that is influenced by several factors, including elements of intention and situation (Jensen, 2002; Latif et al., 2013).

Environmental knowledge is a process of acquiring values and concepts and developing skills. It is a necessary medium to understand and appreciate the interaction between humans and their culture and the physical environment (Latif et al., 2013; Zareie & Navimipour, 2016). Awareness of the environment is needed to recognise environmental problems and issues. Environmental knowledge can be held formally or informally by families, communities, governments and schools (P. Liu et al., 2020).

Knowledge can influence students' attitudes and behaviour toward the environment. Students with high environmental knowledge will be aware of the need to preserve their environment. According to (Otto & Pensini P, 2017) students' awareness of the environment will shape responsible environmental attitudes and behaviours. Based on the results of research by (Janmaimool & Khajohnmanee, 2019) there is a positive correlation between students' awareness of and attitudes toward the environment, so if students have a lot of knowledge about environmental issues, then they will become more aware of environmental issues that are

happening and this awareness encourages them to act responsibly towards the environment. According to (Jensen, 2002), behaviour based on knowledge will last longer than behaviour that is not based on knowledge. Research conducted by (Latif et al., 2013) found that factual knowledge is a variable that correlate with pro-environmental knowledge.

### Environmental Responsibility

Fettahlıoğlu & Aydoğdu, (2020) revealed that environmentally responsible behaviour seeks to preserve the environment and look for environmental problems. environmentally responsible citizenry refers to individual or group action aimed at doing the right thing to protect the environment in everyday life, such as recycling, energy conservation and reducing littering. According to (Kaiser, Ranney, et al., 1999), environmentally responsible behaviour contains several dimensions: recycling, avoiding purchases to minimise environmental impact as a form of green consumerism, being politically active in communities to influence decisions that impact the environment, and educating oneself about environmental awareness.

Singh & Gupta, (2013) argues that environmentally responsible behaviour measures a person's readiness to protect the environment actively. That's mean environmentally responsible behaviour is an environmental protection mechanism to reduce and prevent damage to environmental resources.

### Value-Belief-Norm

Young people are the key to facing environmental issues today and so on (Stern et al., 1999). A conceptual framework that can explain the relationship between environmental beliefs and pro-environmental behaviour is the Value Belief Norm (VBN) Theory. (Stern et al., 1999) explained, variables such as value orientation, New Ecological Paradigm (NEP), awareness of consequences, beliefs to be able to act, and individual norms are variables that can influence pro-environmental behaviour. VBN theory combines value, NEP, and norm-activation theories as causal chains that lead to pro-environmental behaviour. Several previous studies conducted by (Liobikienė & Poškus, 2019; Oreg & Katz-Gerro, 2006) have shown a positive relationship between VBN and pro-environmental behaviour.

### Environmental Education

Environmental education is an educational programme to encourage children as learners to exhibit rational and responsible understanding, awareness, attitudes, and behaviours about the mutual influence between residents and the environment in various aspects of human life (Kollmuss & Agyeman, 2002; Zsóka et al., 2013). Environmental education seeks to change behaviour and attitudes aiming to increase people's knowledge, skills, and awareness of environmental values and environmental issues, which in turn can move the community to play an active role in environmental conservation and safety efforts for the benefit of current and future generations. environmental education is about internalisation, directly or indirectly.

Pro-environmental behaviour refers to conscious efforts to minimise the negative impact of one's action on nature (both natural and artificial ecosystems), such as reducing natural resources and consumption, toxin, waste, and so forth (Kollmuss & Agyeman, 2002). Several factors affecting pro-environmental behaviour, environmental commitment and awareness, green lifestyle, and green self-efficacy positively affect the pro-environmental behaviour of young people (Yusliza et al., 2020). Holistic and systemic perspectives on the environment are crucial in promoting pro-environmental behaviour (P. Liu et al., 2020; X. Liu et al., 2018). Pro-environmental behaviour also increases with factors, including knowledge, awareness, and understanding of environmental damage (Soares et al., 2021). Social norms and lifestyle contribute to pro-environmental behaviour. There is also a difference in pro-environmental behaviour between the younger and older generations (Alzubaidi et al., 2021). The novelty of this study compared to several previous studies lies in determining how environmental knowledge, environmental responsibility, value-belief-norm, and environmental education influence pro-environmental behaviour in Indonesian university students.

**Methods**

## Research Design

This research uses a quantitative approach with survey methodology. The survey method is a research method that takes samples from a population using questionnaires as a data collection tool (Creswell & Creswell, 2017; Hoy & Adams, 2015). The survey aims to get a general picture of the characteristics of the population that can be seen from attitudes, values, beliefs, opinions, habits, behaviours, and others. In this study, the picture/information researchers want to get from respondents is pro-environmental behaviour seen from environmental knowledge, environmental responsibility, value–belief–norm, and environmental education.

## Data Collection

The respondents in this study were students of geography and geography education programmes from various public and private universities in Indonesia. The reason for choosing students of these programmes is the presence of environmental education courses in this study programme. Four hundred seventy (470) students participated as research respondents. The universities included Universitas Lambung Mangkurat, Universitas PGRI Kanjuruhan, Universitas Khairun Ternate, Universitas Samudra, Universitas Negeri Makasar, Universitas Negeri Malang, IKIP PGRI Pontianak, Universitas Al Muslim, Universitas Widya Dharma, Universitas Hamzanwadi, Universitas Negeri Padang, Universitas Muhammadiyah Mataram, STIKIP Kei Raga Ternate, Universitas Tadulako, USK, Universitas Halu Oleo, Universitas Siliwangi, IKIP PGRI Palangkaraya, Universitas Nusa Cendana Kupang, Amikom Yogyakarta, and Universitas Negeri Jember. Data collection in this study used questionnaires filled out online through Google form and shared via WhatsApp group.

## Data Analysis

The Smart PLS 3.0 Program was used to check our instruments' validity by looking at each construct indicator's loading factors. The outer model was used to check the validity and reliability of the model (Hair et al., 2020). The standard requirement to test the validity of research instruments is that the loading factor must be more significant than 0.70 (Chan & Lay, 2018; Zürich et al., 2005). Reliability was tested by calculating the composite reliability—the range is 0.6 to 0.7 (Chan & Lay, 2018; Rasoolimanesh, 2022). The research variables were environmental knowledge (X1), environmental responsibility (X2), value–belief–norm (X3), environmental education (X4), and pro-environmental behaviour (Y).

**Figure 1**

*Theoretical Framework*
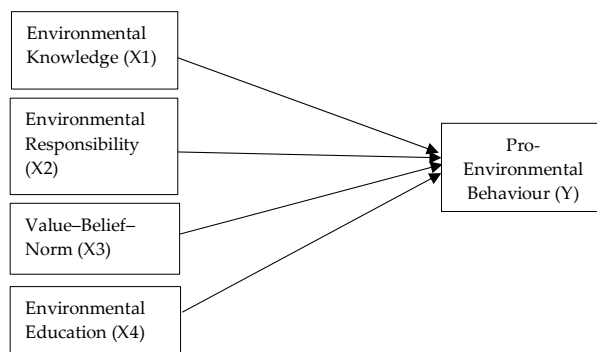
Data were analysed using the Structural Equation Modelling (SEM) Partial Least Square (PLS). SEM-PLS is a causal model explaining the effect of variables on the constructed variable (Chan & Lay, 2018).

**Table 1**

*Research Variables*

| Variable | Indicator |
|---|---|
| Environmental knowledge (X1) | 21. Knowing daily environmental problems |
| | 22. Knowing the causes of environmental problems |
| | 23. Learning the solutions to solve environmental problems |
| | 24. Understanding the dependency of human beings on the environment |
| | 25. Knowing renewable energy |
| Environmental responsibility (X2) | 17. No littering |
| | 18. Keeping the environment clean |
| | 19. Using environmentally friendly energy and resources |
| | 20. Greening the surrounding areas |
| Value–belief–norm (X3) | 17. Believing that everything on earth is God's creation |
| | 18. Being thankful for what is available on earth |
| | 19. Sticking to the concept of cleanliness in doing religious rituals |
| | 20. Practicing religious advice to protect the environment |
| Environmental education (X4) | 17. Increasing understanding of environmental problems |
| | 18. Improving acceptance, assessment, organization, and personality characteristics in managing life in harmony with nature |
| | 19. Growing a love of the environment |
| | 20. Increasing interest in the environment |
| Pro-Environmental Behaviour (Y) | 61. Participating in events/seminars/workshops on environmental issues |
| | 62. Reducing the use of plastic |
| | 63. Replacing disposable drinking bottles with tumblers |
| | 64. Replacing food wrapping paper with lunch boxes |
| | 65. Buying items with a recyclable sign |
| | 66. Reusing usable things |
| | 67. Using rechargeable batteries |
| | 68. Sorting waste |
| | 69. Reusing things that are still suitable for use |
| | 70. Disposing of phone batteries or electronic device batteries properly |
| | 71. Turning off electronic devices that are not in use |
| | 72. Using electronic devices with energy-saving features |
| | 73. Turn off the lights during daytime |
| | 74. Using water wisely |
| | 75. Using a water storage tank |

Our research hypotheses are as follows:

Hypothesis 1

H0: Environmental Knowledge of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 2

H0: Environmental Responsibility of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 3

H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behaviour

Hypothesis 4

H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behaviour

## Findings

### Outer Model

Before hypothesis testing to predict the relationship between latent variables in a structural model, we first evaluated the outer model to verify indicators and latent variables for further analysis. The validity test evaluates the ability of research instruments to measure what they are intended to measure (Hair et al., 2017; Hair Jr et al., 2020). The reliability test evaluates the consistency of a measurement instrument in measuring a concept or the character of research respondents in answering questionnaire items or research instruments. The result is presented in discriminant validity (outer loadings), Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

**Table 2**

*Structural Model*

| Construct | Items | Loading Factors | Cronbach's alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|
| Environmental knowledge | X1.1 | 0.855 | 0.903 | 0.928 | 0.720 |
| | X1.2 | 0.866 | | | |
| | X1.3 | 0.857 | | | |
| | X1.5 | 0.837 | | | |
| | X1.5 | 0.826 | | | |
| Environmental responsibility | X2.1 | 0.855 | 0.874 | 0.914 | 0.726 |
| | X2.2 | 0.878 | | | |
| | X2.3 | 0.845 | | | |
| | X2.4 | 0.829 | | | |
| Value–belief–norm | X3.1 | 0.831 | 0.868 | 0.910 | 0.715 |
| | X3.2 | 0.866 | | | |
| | X3.3 | 0.838 | | | |
| | X3.4 | 0.848 | | | |
| Environmental education | X4.1 | 0.869 | 0.881 | 0.918 | 0.737 |
| | X4.2 | 0.844 | | | |
| | X4.3 | 0.874 | | | |

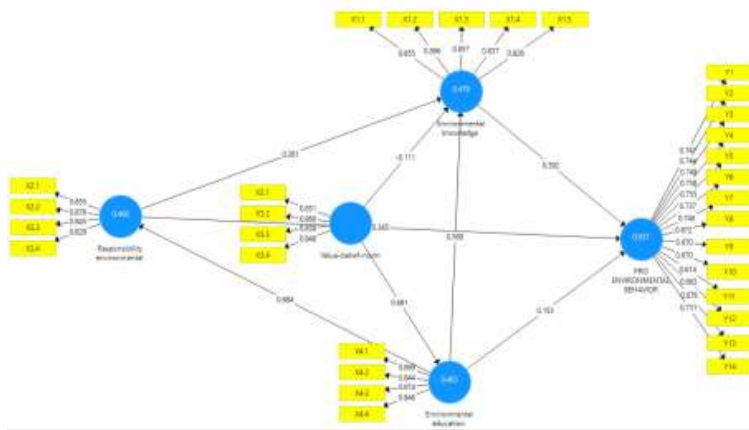| | | | | | |
|---|---|---|---|---|---|
| | X4.4 | 0.846 | | | |
| | Y1 | 0.747 | | | |
| | Y2 | 0.670 | | | |
| | Y3 | 0.614 | | | |
| | Y4 | 0.663 | | | |
| | Y5 | 0.678 | | | |
| Pro-Environmental Behaviour | Y6 | 0.731 | 0.924 | 0.934 | 0.505 |
| | Y7 | 0.744 | | | |
| | Y8 | 0.749 | | | |
| | Y9 | 0.758 | | | |
| | Y10 | 0.755 | | | |
| | Y11 | 0.737 | | | |
| | Y12 | 0.746 | | | |
| | Y13 | 0.672 | | | |
| | Y14 | 0.670 | | | |

Table 2 shows that measuring discriminant validity through outer loadings ensures that each concept of the latent model is different from other variables. An indicator is reliable if it has a correlation value of more than 0.70. An indicator is valid if its outer loading is between 0.50 – 0.60, so its presence is acceptable (Hair et al., 2020).

Table 2 shows that all indicators of the latent variables are valid and reliable because their outer loading values are between 0.60 and 0.70. Thus, all latent variables could explain the variable of each indicator that measured them. Discriminant validity can be determined using AVE for each construct or latent variable. The model has better discriminant validity if the AVE square root for each construct is greater than the correlation between the two constructs in the model.

Table 2 shows that the AVE value for all constructs is > 0.50. Therefore, convergent validity in the model being tested is acceptable. The Cronbach Alpha and composite reliability values for all constructs are also > 0.60, which means that all constructs have very good reliability. Figure 2 shows that the variables environmental knowledge, environmental responsibility, values-beliefs-norms, and environmental education have a high influence on Pro-Environmental Behaviour. This is proven by the loading factor value for each construct indicator being in the range of 0.6 – 0.7. The results of the outer model analysis are presented in Figure 2.

**Figure 2**

*Model Pro-Environmental Behaviour of University Students in Indonesia*

## Measuring the Structural Model (Inner Model)

## Coefficient of Determinant (R-square)

The R-square value is used to assess the extent of influence certain independent latent variables have on the dependent latent variable. Using SmartPLS 3.0 software, we obtained the following results.

**Table 3**

*Coefficient of Determinant (R-square)*

|  | R-square | R-square Adjusted |
|---|---|---|
| Environmental education | 0.463 | 0.462 |
| Environmental knowledge | 0.479 | 0.476 |
| Pro-environmental behaviour | 0.631 | 0.629 |
| Environmental responsibility | 0.468 | 0.466 |
| Value–belief–norm | 0.430 | 0.433 |

Table 3 shows the R-square value for environmental education is 0.463; this shows that environmental education has an influence of 46.3% on pro-environmental behaviour. The R-square value for environmental knowledge is 0.479; this indicates that environmental knowledge has a 47.6% influence on pro-environmental behaviour. The R-square value for environmental responsibility is 0.468; this shows that environmental responsibility has a 46.8% influence on pro-environmental behaviour. The R-square value for the value-belief-norm is 0.430; this indicates that Value-belief-norm has a 43.0% influence on pro-environmental behaviour. The R-square value for pro-environmental behaviour, which indicates that environmental education, environmental knowledge, value-belief-norm, and environmental responsibility factors influence pro-environmental behaviour by 40%.

## Hypothesis Testing

The p-value is set at a significance level ($\alpha$) of 5% or 0.05 to determine whether the hypothesis is accepted or rejected. If the p-value < 0.05, H0 is rejected, meaning an effect exists. Conversely, if the p-value > 0.05, H0 is accepted, indicating no effect exists. Table 4 presents the results of evaluating the structural model of the hypothesis test using the PLS method obtained from the SmartPLS 3.0 Bootstrapping Report.

**Table 4**

*Path Coefficients*

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|---|---|
| Environmental education-> Pro-environmental behaviour | 0.153 | 0.154 | 0.059 | 2.611 | 0.009 |
| Environmental knowledge-> Pro-environmental Behaviour | 0.392 | 0.395 | 0.046 | 8.618 | 0.000 |
| Environmental responsibility -> Pro-environmental behaviour | 0.365 | 0.365 | 0.052 | 7.043 | 0.000 |
| Value–belief–norm-> Pro-environmental behaviour | 0.430 | 0.433 | 0.033 | 13.234 | 0.000 |

Table 4 shows that environmental education has a positive relationship with pro-environmental behaviour, with a p-value of 0.009 (p < 0.05). Environmental knowledge has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 (p < 0.05). Environmental responsibility has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 (p < 0.05). Value–Belief–Norm has a positive relationship with pro-environmental behaviour, with a p-value of 0.000 (p < 0.05).

## Discussion

### Factors Affecting Pro-Environmental Behaviour of University Students

Environmental knowledge has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 (p < 0.05). Most students were already concerned about the environment, such as environmental problems and the causes of such problems. Students also knew solutions to environmental problems and about renewable energy to overcome the problems. Renewable energy sources are environmentally friendly, do not pollute the environment, and do not contribute to climate change and global warming because the energy comes from sustainable natural sources, such as sunlight, wind, water, biofuels, and geothermal.

Knowledge is crucial to determining behaviour. Students with environmental knowledge tend to change their behaviour due to education; this aligns with the view that environmental knowledge affects pro-environmental behaviour (Gifford & Nilsson, 2014).

Developing students' environmental knowledge is important, especially on campus. A study in Canada reveals that more than 60% of the study respondents agree that one factor hindering pro-environmental behaviour is a lack of knowledge (Kennedy et al., 2009; Kennedy & Kmec, 2018). Other studies also confirm that more profound and broader knowledge of environmental issues and solutions to such issues will increase the possibility of individuals taking-action to protect the environment (Farrukh et al., 2022; Jensen, 2002; Kaiser, Ranney, et al., 1999; Kaiser, Wölfing, et al., 1999; Kollmuss & Agyeman, 2002; Latif et al., 2013). Individuals with sound knowledge of environmental issues tend to show pro-environmental behaviour. Previous studies show that knowledge relates to actions and becomes a predictor of actions (Neolaka, 2020). To sum up, individuals with sound knowledge of environmental issues and solutions to such issues tend to show pro-environmental behaviour to protect the environment.

P. Liu et al., (2020) find a significant relationship between the level of knowledge and the pro-environmental behaviour of students—the higher the level of environmental knowledge, the better the pro-environmental behaviour of students and vice versa. Fawehinmi et al., (2020) reveal a positive and significant relationship between environmental knowledge and attitudes towards environmental sustainability. If environmental knowledge increases, attitudes towards environmental sustainability will also increase, and vice versa.

Ardoin et al., (2020) provide an opinion that people with better environmental knowledge will be better aware of the environment and environmental issues. Thus, they will be motivated to act responsibly toward the environment. Developing environmental awareness through education has always been critical in building pro-environmental behaviour. Knowledge of people will guide them to determine whether their actions will be good or bad for the environment. Environmental knowledge can be in the form of knowledge of environmental issues, causes, effects, solutions, and how to become an environmentally responsible agent of change related to the problems (Fawehinmi et al., 2020).

The path coefficient analysis presented in Table 3 for testing the second hypothesis shows that H0: Environmental Responsibility of students has no positive and significant correlation with Pro-Environmental Behaviour is rejected. This means that environmental responsibility has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental responsibility is an action motivated by one's willingness to prevent environmental damage or preserve the environment. Our findings showed that the students had good environmental responsibility. They did not litter, cared for environmental cleanliness, used recyclable goods, and did greening of their surrounding areas. Environmental responsibility is closely related to the ascription of responsibility. Initially, the ascription of responsibility is defined as a feeling of responsibility from the negative consequences of not behaving in a pro-social manner. This theory is widely applied in green behaviour because most people behave green based on their altruistic feelings, such as recycling, energy policies, and other green behaviours in general.

Increased awareness and understanding of changing environmental issues and improved skills for environmentally responsible actions can be developed through environmental education (Jurdi-Hage et al., 2019). This is consistent with the university's role as an effective agent of change.

Building awareness to be environmentally responsible aims to preserve the environment, so human beings not only take benefit of the environment for their lives but also take care of and be accountable for preserving the environment. Individuals with high environmental awareness can improve pro-environmental behaviour (Zareie & Navimipour, 2016). In addition, students with higher environmental awareness show more pro-environmental behaviour (S.-C. Liu & Lin, 2015; S. Liu & Guo, 2018). As previously indicated, specific environmental awareness can lead to better predictability of environmentally responsible behaviour if certain pro-environmental behaviours are assessed.

As formal education institutions, universities must implement pro-environmental behaviour (Usaini et al., 2015). People are not born with pro-environmental behaviour—the behaviour is taught and shaped along with their developmental stages. Increased environmental responsibility will finally lead to positive changes toward pro-environmental behaviour.

The path coefficient analysis presented in Table 4 for testing the third hypothesis shows that H0: Environmental Education of students does not have a positive and significant correlation with Pro-Environmental Behaviour is rejected. This means that environmental education has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Our findings confirmed that the students received environmental education, proven by increased environmental knowledge and understanding that they refused to damage the environment at any cost.

Education is crucial in forming pro-environmental behaviour (Iswari & Kusuma, 2022). Human behaviour greatly impacts the environment. Environmental knowledge gained through education is positively and significantly important to preserve the environment (Azhar et al., 2015; Erdogan & Ozsoy, 2007; Sontay et al., 2015). Environmental education teaches students the importance of preserving the environment—it increases students' awareness, directs students, and shapes their attitudes toward preserving the environment (Hassan & Pudin, 2011; Mulyana, 2009; Özalemdar, 2021). Environmental education aims to increase people's understanding and concern and is oriented toward preventing environmental damage and finding solutions to environmental issues.

The findings align with (Meyer, 2016), stating that specific policies, programmes and courses on the environment can affect the preferred construction of students related to the environment because the students have more knowledge and skills for environmental preservation.

The fourth hypothesis testing shows that H0: Value-belief-norm of students does not have a positive and significant correlation with Pro-Environmental Behaviour is rejected. This means the value-belief-norm has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). Our findings showed that students had good value-belief-norm for pro-environmental behaviour, as seen from the willingness of students to protect the environment and support policies to preserve the environment. This aligns with (Mahat et al., 2020; Whitley et al., 2018), revealing that biosphere and altruistic values make students more willing to be involved in pro-environmental activities, such as supporting policies to protect the environment.

The value-belief-norm theory is proposed by (Stern et al., 1999), stating that value orientation can, directly and indirectly, affect pro-environmental behaviour. The theory assumes three value orientations related to environmental concerns relevant to understanding pro-environmental attitudes, preferences, and behaviour: altruistic, egoistic, and biosphere value orientations (Oreg & Katz-Gerro, 2006; Stern et al., 1999). Our findings strengthen the theory since the results show a direct contribution of value orientation toward pro-environmental behaviour.

Norms inform a person about acceptable and unacceptable behaviour. Norms are the rules of society regarding good and bad attitudes and actions that are permissible and not permissible. There are three types of norms: habits, prohibitions, and conventions (Kaiser et al., 2005, 2006). Personal norms are moral ethics and obligations towards something related to orientation in creating something. An ethical approach to dealing with environmental problems is needed. This approach is intended to determine attitudes, actions, and ethical perspectives and appropriately manage environmental care and its ecosystem (Hassan & Pudin, 2011; Liobikienė & Poškus, 2019).

The principle of respect for nature deals with a moral responsibility towards nature. This responsibility is individual and collective (Stern et al., 1999). Moral responsibility requires humans to take concrete initiatives, efforts, policies, and actions to protect the universe and everything in it. This means the preservation and destruction of nature is a shared responsibility of all humankind. This responsibility also manifests in warning, prohibiting, and punishing those who damage and endanger nature (Kurisu, 2015; Stern et al., 1999).

Building students' positive environmental values in educational institutions are essential as it should help solve environmental problems and improve environmental quality (Chen, 2015). This will help to create a knowledgeable society about environmental issues that will play a significant role in preserving the environment.

## Efforts to Improve Pro-Environmental Behaviour

Improving pro-environmental behaviour, especially among the younger generation, can be done through education. Building a character of caring for the environment through education is an effort the government of Indonesia takes to preserve the environment. Such character is manifested in attitudes and actions of preventing environmental damage and taking steps to repair the already-happen environmental damage. Some activities to form pro-environmental behaviour are: (1) caring for the environment, (2) reducing plastic use, (3) sorting waste, (4) reducing carbon emission, and (5) saving energy. Actions to repair environmental damage include (1) planting trees, (2) reusing goods, and (3) using environmentally friendly technology. Caring for the environment must be inculcated from an early age through fun learning. This is in line with the research results (Yüzüak & Erten, 2022), which suggest that environmental education be included in various disciplines and raise environmental awareness among individuals should become one of national education's primary objectives.

Other efforts to increase public awareness of the importance of protecting the environment can be carried out through informational and structural strategies. Informative strategies refer to interventions through campaigns to increase knowledge to minimise environmentally damaging behaviour. For example, the reduce, reuse, and recycle (3R) campaign and creating eco-points for residential communities to collect metal, paper, glass, and organic waste for recycling. In addition to reducing waste, the 3R programme can also be a means of earning income in which people can deposit their waste to waste banks or recycling facilities.

Efforts to increase public awareness through structural strategies can be made through behavioural changes that affect behavioural decisions. This strategy focuses on external environmental planning that can support pro-environmental behaviour—for example, providing easily-accessible bins to avoid littering.

Governments, companies and other organisations can also improve people's pro-environmental behaviour through appropriate environmental policies primarily aimed at increasing self-motivation from the community to behave pro-environmentally. This can be done through activities including providing infrastructure that makes it easier for people to adopt pro-environmental behaviour, such as providing environmentally friendly objects at lower prices, providing pro-environmental education to students as early as possible, developing an in-depth understanding of waste recycling efforts through various media, and supervising the public in subsidy programs for people with pro-environmental behaviour and fines for violators of environmental policies.

## Conclusion and Implications

It is significant for everyone, especially the young generation, to behave pro-environmentally to reduce environmental problems. Our findings confirm that environmental knowledge has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). Environmental responsibility has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 7.043 and a p-value of 0.000 ($p < 0.05$). Environmental education has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 2.611 and a p-value of 0.009 ($p < 0.05$). The value-belief-norm has a significant and positive relationship with pro-environmental behaviour, evidenced by a t-statistic value of 13.234 and a p-value of 0.000 ($p < 0.05$). That means students in university exhibit excellent pro-environmental behaviour where factors of environmental knowledge, environmental responsibility, environmental education, and values influence this behaviour.

## References

Alzubaidi, H., Slade, E. L., & Dwivedi, Y. K. (2021). Examining antecedents of consumers' pro-environmental behaviours: TPB extended with materialism and innovativeness. *Journal of Business Research*, *122*, 685–699. https://doi.org/10.1016/j.jbusres.2020.01.017

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224. https://doi.org/10.1016/j.biocon.2019.108224

Azhar, A., Basyir, M. D., & Alfitri, A. (2015). The relationship between environmental knowledge and ethics with attitudes and behavior in preserving the environment. *Jurnal Ilmu Lingkungan*, *13*(1), 36–41. https://doi.org/10.14710/jil.13.1.36-41

Chan, S. H., & Lay, Y. F. (2018). Examining the reliability and validity of research instruments using partial least squares structural equation modeling (PLS-SEM). *Journal of Baltic Science Education*, *17*(2), 239. https://doi.org/10.33225/jbse

Chen, M. (2015). An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in Taiwan. *Asian Journal of Social Psychology*, *18*(2), 145–151. https://doi.org/10.1111/ajsp.12096

Creswell, J. W., & Creswell, J. D. (2017). *Research design: qualitative, quantitative, and mixed methods approaches*. Sage publications. ISBN: 978-1-4129-6557-6.

Erdogan, M., & Ozsoy, A. (2007). Graduate students' perspectives on the human-environment relationship. *Journal of Turkish Science Education*, *4*(2), 21–30.

Farrukh, M., Raza, A., Mansoor, A., Khan, M. S., & Lee, J. W. C. (2022). Trends and patterns in pro-environmental behaviour research: a bibliometric review and research agenda. *Benchmarking: An International Journal*. https://doi.org/10.1108/BIJ-10-2020-0521

Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behaviour of academics: the role of green human resource management and environmental knowledge. *International Journal of Manpower*, *41*(7), 879–900. https://doi.org/10.1108/IJM-07-2019-0347

Fettahlıoğlu, P., & Aydoğdu, M. (2020). Developing environmentally responsible behaviours through the implementation of argumentation-and problem-based learning models. *Research in Science Education*. https://link.springer.com/article/10.1007/s11165-018-9720-0

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141–157. https://doi.org./10.1002/ijop.12034

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123. https://doi.org/10.1504/IJMDA.2017.087624

Hassan, A., & Pudin, S. (2011). The informal environmental education value practices among adults in Sabah, Malaysia. *Journal of Turkish Science Education*, *8*(1), 19–28.

Hoy, W. K., & Adams, C. M. (2015). *Quantitative research in education: A primer* (Second Edi). Sage Publications. https://doi.org/10.4135/9781452272061

Iswari, N., & Kusuma, A. B. (2022). Analysis of the factors that influence the environmental quality index in Bekasi Regency. *Jurnal Pengelolaan Sumber Daya Alam dan Lingkungan*, *12*(4), 720–728. http://dx.doi.org/10.29244/jpsl.12.4.720–728

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of environmental system knowledge in promoting university students' environmental attitudes and pro-environmental behaviors. *Sustainability*, *11*(16), 4270. https://doi.org/10.3390/su11164270

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, *8*(3), 325–334. https://doi.org/10.1080/13504620220145474

Jurdi-Hage, R., Hage, H. S., & Chow, H. P. H. (2019). Cognitive and behavioural environmental concern among university students in a Canadian city: Implications for institutional interventions. *Australian Journal of Environmental Education*, *35*(1), 28–61. https://doi.org/10.1017/aee.2018.48

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior. *Journal of Applied Social Psychology*, *35*(10), 2150–2170. https://doi.org/10.1111/j.1559-1816.2005.tb02213.x

Kaiser, F. G., Ranney, M., Hartig, T., & Bowler, P. A. (2006). Ecological behavior, environmental attitude, and feelings of responsibility for the environment. *European Psychologist*, *4*(2), 59–74. https://doi.org/10.1027//1016-9040.4.2.59.

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*, *19*(1), 1–19. https://doi.org/10.1006/JEVP.1998.0107

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Why we don't" walk the talk": understanding the environmental values/behaviour gap in Canada. *Human Ecology Review*, 151–160. http://www.jstor.org/stable/24707539

Kennedy, E. H., & Kmec, J. (2018). Reinterpreting the gender gap in household pro-environmental behaviour. *Environmental Sociology*, *4*(3), 299–310. https://doi.org/10.1080/23251042.2018.1436891

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

Kurisu, K. (2015). *Pro-environmental behaviors*. Springer. ISBN : 978-4-431-55832-3.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, *43*, 112–124. https://doi.org/10.1016/j.jenvp.2015.06.004

Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia-Social and Behavioral Sciences*, *105*, 866–874. https://doi.org/10.1016/j.sbspro.2013.11.088

Liobikienė, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behavior: modifying the value-belief-norm theory. *Sustainability*, *11*(12), 3324. https://doi.org/10.3390/su11123324

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment*, *728*, 138126. https://doi.org/10.1016/j.scitotenv.2020.138126

Liu, S.-C., & Lin, H. (2015). Exploring undergraduate students' mental models of the environment: Are they related to environmental affect and behavior? *The Journal of Environmental Education*, *46*(1), 23–40. https://doi.org/10.1080/00958964.2014.953021

Liu, S., & Guo, L. (2018). Based on environmental education to study the correlation between environmental knowledge and environmental value. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3311–3319. https://doi.org/10.29333/ejmste/91246

Liu, X., Zou, Y., & Wu, J. (2018). Factors influencing public-sphere pro-environmental behavior among Mongolian college students: A test of value–belief–norm theory. *Sustainability*, *10*(5), 1384. https://doi.org/10.3390/su10051384

Lozano, M., & Vallés, J. (2007). An analysis of the implementation of an environmental management system in a local public administration. *Journal of Environmental Management*, *82*(4), 495–511. https://doi.org/10.1016/j.jenvman.2006.01.013

Mahat, H., Hashim, M., Saleh, Y., Nayan, N., & Norkhaidi, S. B. (2020). Transformation of education for sustainable development through low carbon schools community program. *Journal of Turkish Science Education*, *17*(3), 429–442. https://doi.org/10.1016/j.jclepro.2015.10.133

Meyer, A. (2016). Heterogeneity in the preferences and pro-environmental behavior of college students: The effects of years on campus, demographics, and external factors. *Journal of Cleaner Production*, *112*, 3451–3463. https://doi.org/10.1016/j.jclepro.2015.10.133

Mulyana, R. (2009). Instilling environmental ethics through schools that care and have an environmental culture. *Jurnal Tabularasa*, *6*(2), 175–180.

Neolaka, A. (2020). The influence of pro environmental knowledge on environmentally friendly behavior. *Prosiding Seminar Nasional Pascasarjana*, *1*(01), 14–21.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, *38*(4), 462–483. https://doi.org/10.1177/0013916505286012

Otto & Pensini P, S. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, *47*, 88–94. https://doi.org/10.1016/j.gloenvcha.2017.09.009

Özalemdar, L. (2021). The effect on environmental attitude of the active learning method applied in teaching the biology topic "current environmental issues and human" for 10th grade students. *Journal of Turkish Science Education*, *18*(2), 276–289. https://doi.org/10.36681/tused.2021.65

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: environmental

management for sustainable universities. *Journal of Cleaner Production*, *106*, 3–10. https://doi.org/10.1016/j.jclepro.2015.05.110

Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: a comprehensive composite-based approach. *Data Analysis Perspectives Journal*, *3*(2), 1–8.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology*, *30*(3), 289–297. https://doi.org/10.1016/j.jenvp.2010.01.010

Singh, N., & Gupta, K. (2013). Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*, *9*(1), 4–18. https://doi.org/10.1108/17471111311307787/FULL/XML

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials*, *412*, 125227. https://doi.org/10.1016/j.jhazmat.2021.125227

Sontay, G., Gokdere, M., & Usta, E. (2015). A comparative ınvestigation of sub-components of the environmental literacy at the secondary school level. *Journal of Turkish Science Education*, *12*(1), 19–28. https://doi.org/10.12973/tused.10130a

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97. http://www.jstor.org/stable/24707060

Usaini, M. I., Abubakar, N. B., & Bichi, A. A. (2015). Influence of school environment on academic performance of secondary school students in Kuala Terengganu, Malaysia. *The American Journal of Innovative Research and Applied Sciences*, *1*(6), 203–209.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2018). Sustainability behaviors among college students: an application of the VBN theory. *Environmental Education Research*, *24*(2), 245–262. https://doi.org/10.1080/13504622.2016.1250151

Yusliza, M. Y., Amirudin, A., Rahadi, R. A., Nik Sarah Athirah, N. A., Ramayah, T., Muhammad, Z., Dal Mas, F., Massaro, M., Saputra, J., & Mokhlis, S. (2020). An investigation of pro-environmental behaviour and sustainable development in Malaysia. *Sustainability*, *12*(17), 7083. https://doi.org/10.3390/su12177083

Yüzüak, A. V., & Erten, S. (2022). Teachers' views about turkey's zero waste project (TZWP). *Journal of Turkish Science Education*, *19*(1), 71–81. https://doi.org/10.36681/tused.2022.110

Zareie, B., & Navimipour, N. J. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*, 1–8. https://doi.org/10.1016/j.chb.2016.01.025

Zilahy, G., & Huisingh, D. (2009). The roles of academia in regional sustainability initiatives. *Journal of Cleaner Production*, *17*(12), 1057–1066. https://doi.org/10.1016/j.jclepro.2009.03.018

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138. https://doi.org/10.1016/j.jclepro.2012.11.030

Zürich, F., Zingg, Æ. A., Biber, Æ. P., Zimmerman, D. L., Zimble, D. a., Evans, D. L., Carlson, G. C., Parker, R. C., Grado, S. C., Gerard, P. D., Zianis, D., Muukkonen, P., Mäkipää, R., Zhao, Y., Krzic, M., Bulmer, C. E., Schmidt, M. G., Simard, S. W., Zhao, D., … Leuven, K. U. (2005). A structural equation model analysis of postfire plant diversity. *Forest Ecology and Management*, *10*(1). https://doi.org/10.1890/1051-0761(2006)016[0503:ASEMAO]2.0.CO;2