

Student's Environmental Sustainability Behavior: Does Education Matter?

Ahmad Nurkhin¹, S Martono¹, Ngabiyanto², Hasan Mukhibad¹, Almamnuhin Kholid³

¹Faculty of Economics and Business, Universitas Negeri Semarang

²Faculty of Social Science and Politics, Universitas Negeri Semarang

³Al Asror Islamic Boarding School, Semarang

Abstract. This paper aims to analyze the influence of sustainability education, knowledge, and attitude on student environmental sustainability behavior. This study also analyzes the influence of sustainability education on sustainability knowledge and attitude. With the PLS-SEM approach, this study took the object of students of Universitas Negeri Semarang (UNNES). A total of 256 students from five faculties have participated in filling out the research questionnaire. Validity and reliability analysis have been carried out, and continued with goodness-of-fit analysis and hypothesis testing (direct and indirect effects). The results of the study indicate that sustainability education has a positive effect on sustainability knowledge and attitude. Sustainability education has not been proven to have a direct effect on student environmental sustainability behavior. Sustainability education will affect students' environmental sustainability behavior through their sustainability attitude. Other results indicate that sustainability knowledge is also unable to determine student environmental sustainability behavior significantly. Sustainability knowledge will be able to determine student environmental sustainability behavior significantly if through sustainability attitude. Finally, a sustainability attitude has a positive effect on students' environmental sustainability behavior. This study pays attention to the importance of a sustainable attitude, which can act as a significant predictor and mediator.

1 Introduction

Education for sustainable development has become an important topic since the declaration of the United Nations Decade of Education for Sustainable Development (2005–2014) [1]. Over the past four decades, universities have intensified their initiatives to advance sustainability on campus. These initiatives involve programs to educate students on how to adopt sustainable practices during their time at university [2]. The sustainable university is a concept that was introduced into the scientific community in the early 21st century, when higher education institutions began to be viewed as indispensable disseminators of sustainability principles and practices [3].

*Corresponding author: ahmadnurkhin@mail.unnes.ac.id

Sustainability aspects in higher education encompass educational, operational, and governance areas [4]. Higher education institutions enhance students' awareness and behavior of sustainability through education for sustainable development. They should adopt interactive and learner-centered teaching methods and integrate education for sustainable development into the curriculum [5].

Universitas Negeri Semarang (UNNES) is a campus that pays attention to sustainability issues through its vision and mission, "To Become a Reputable World-class University, Pioneer of Excellence in Education with Conservation Perspective". UNNES has been known as a conservation campus and continues to step forward to contribute to environmental issues and sustainable development goals (SDGs). UNNES' recognition as a conservation campus is evident in the UI GreenMetrics ranking results. The ranking is designed to reveal the results of an online survey on current conditions and policies related to sustainability initiatives and institutional development at universities around the world. This ranking is expected to encourage greater focus on issues such as global climate change, clean energy, water conservation, waste recycling, green transportation, and education and research that focuses on sustainability. The ranking results during 2020-2024 show that UNNES has experienced positive results, namely being ranked 5th nationally and continuing to increase in the world ranking (see Table 1). In the QS World University Rankings: Sustainability 2025, UNNES is ranked 1001-1020. UNNES continues to strive to implement initiatives and policies in the field of conservation and sustainability, and encourages the formation of students who have a behavior and concern for sustainability issues.

In the last decade, universities have increased their efforts to improve the understanding of the determinants of students' pro-environmental behavior, especially psychological factors [6]. The extended parallel process model (EPPM) can be used to predict students' sustainability behavior intentions [7]. The theory of planned behavior can be used to understand students' intentions and behaviors on campus sustainability issues (recycling), and the results show that attitude has a significant effect on intentions and intentions, and self-determined motivation has a significant effect on recycling behavior [8].

This study attempts to analyze the determinants of student environmental sustainability behavior by linking attitude and knowledge factors and presenting education factors. There are various research results to explain student sustainability behavior and awareness [2,5,9]. Knowledge and attitude correlate significantly and positively with behavior [10]. Consistent with previous studies, there is a significant relationship between sustainability awareness and increased sustainable behavior [2]. Knowledge about sustainability can significantly affect students' environmental attitudes [9]. Environmental knowledge has not been shown to have a significant effect on students' pro-environmental behavior [11]. Attitude has been shown to have a significant effect on students' waste separation behavior, while knowledge has no significant effect [12]. In addition, environmental intelligence has a positive effect on students' environmental behavior through environmental knowledge and attitudes [13].

The results of the study established the importance of sustainability education on knowledge, attitudes, and behaviors [14]. Environmental education significantly determined waste separation behaviors of primary and secondary school students [12]. Education for sustainable development in Chinese universities improved students' sustainability cognition and behaviors [5]. Different teaching styles have been shown to significantly influence student sustainability consciousness (knowledge and attitude dimensions) [15]. Contrary to

previous research, educational program variety did not have a statistically significant impact on student attitudes toward sustainability [1].

This study aims to analyze the impact of sustainability education on students' environmental sustainability behavior. In addition, the analysis that will be conducted is about the impact of sustainability education on the level of knowledge and attitudes of students regarding sustainability issues. Structural equation model (SEM) analysis is used in this study. Continuing previous studies [4,13,14], this study will analyze the relationship between students' knowledge, attitudes, and sustainability behavior with sustainability education as a newly added variable.

2 Materials and methods

SEM analysis is used to analyze the impact of sustainability education on student sustainability knowledge, attitude, and behavior. The research population is active students at Universitas Negeri Semarang, consisting of nine (9) faculties, namely Education and Psychology, Language and Arts, Social and Political Sciences, Mathematics and Natural Sciences, Engineering, Sports Science, Economics and Business, Law, and Medicine. The sample is students who have taken conservation education courses as compulsory university courses. A total of 256 students from five faculties (Language and Art, Social Sciences and Politics, Mathematics and Natural Sciences, Economics and Business, and Law) have participated in filling out the research questionnaire.

The endogenous variables in this study are sustainability knowledge, attitude, and behavior. While the exogenous variable is sustainability education. The research model is shown in Figure 1. Sustainability education will determine the level of sustainability knowledge, attitude, and behavior. Sustainability knowledge and attitude can also determine student sustainability behavior. In addition, sustainability knowledge and attitude can also act as mediators of the influence of sustainability education on student sustainability behavior.

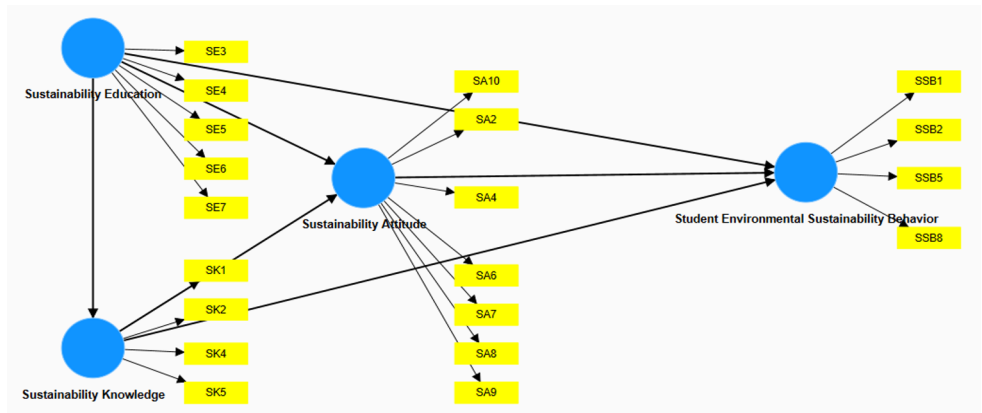


Fig. 1. Research model

The instrument was developed from the various opinions of previous researchers [4,13] to measure sustainability education, knowledge, attitude, and behavior. Table 1 describes the measurement of research variables. The sustainability education variable consists of 7

items, the sustainability knowledge variable consists of 5 items, the sustainability attitude variable consists of 10 items, and the student environmental sustainability behavior variable consists of 10 items. After the validity test was conducted, the valid items of each variable are shown in Table 1 and Figure 1.

Table 1. Measurement of research variables

Research Variables	Description and Measurement	Reference	Number of Statement Items
Student Environment Sustainability Behavior	Student behavior in implementing environmental and sustainability policies and programs on campus.	[4,13]	4
Sustainability Attitude	Students' attitudes towards understanding sustainability issues in general, and the policies implemented by the campus.	[4,13]	7
Sustainability Knowledge	The level of student knowledge about sustainability issues and campus policies on sustainability issues and SDGs.	[4,13]	4
Sustainability Education	Sustainability education programs are implemented by the campus and integrated into the curriculum (lectures) and student extracurricular activities.	[4]	5

The data collection technique used was a closed questionnaire distributed via Google Forms to respondents. The Google Form link was shared via student WhatsApp groups through lecturers in several faculties. The questionnaire was in the form of a closed statement on a 5-point Likert scale from a score of 1, indicating disagreement, to 5, indicating strongly agree. The data analysis technique used was PLS-SEM using SMART-PLS version 4.0 software. Outer model analysis was carried out by testing the validity, reliability, and significance of the indicators of each variable. The inner model test was then carried out for the structural model analysis. The next analysis carried out was goodness of fit and hypothesis testing. Goodness of fit was carried out through the analysis of the indices used, such as R-squared, Q-squared, F-squared, and SRMR (Standardized Root Mean Squared Residual). Hypothesis testing was carried out to determine the direct and indirect effects of the relationship between sustainability education, knowledge, attitude, and behavior.

3 Results and discussion

The research was conducted for two months in April-May 2025 with 256 students from five faculties at UNNES as respondents. The description of the respondents is shown in Table 2. The most respondents came from the Faculty of Language and Art, as many as 131 students (51.2%), and the least from the Faculty of Law, as many as 25 students (9.8%). There were more female respondents than male students, as many as 196 people (76.6%). And the

respondents came more from students from the 2024 batch, as many as 180 people, or 70.3%.

Table 2. Respondent description

Description		Frequency	Percentage
Faculty			
	Language and Art	131	51.2
	Social Sciences and Politics	33	12.9
	Mathematics and Natural Sciences	38	14.8
	Economics and Business	29	11.3
	Law	25	9.8
	Sub-Total	256	100
Gender			
	Female	196	76.6
	Male	60	23.4
	Sub-Total	256	100
Force			
	2021	14	5.5
	2022	26	10.2
	2023	36	14.1
	2024	180	70.3
	Sub-Total	256	100

Validity and reliability testing are shown in Tables 3 and 4. The results are shown in Table 5. The outward loadings of each indicator in Table 3 are more than 0.70, which means the item is valid. There are several invalid indicators (SSB3, SSB4, SSB6, SSB7, SSB9, SSB10, SA1, SA3, SA5, SE1, SE2, and SK3), so they are not included in the next analysis. Table 4 shows the results of the construct reliability and validity analysis. The average variance extracted (AVE) value of the research variables is more than 0.50, which indicates that all indicators are valid and convergent in forming their respective variables. The Cronbach's alpha and composite reliability values of all variables are more than 0.70, so they can be declared reliable.

Table 3. Outer loadings results

	Student Environmenta l Sustainability Behavior	Sustainability Attitude	Sustainability Education	Sustainabilit y Knowledge
SSB1	0.769			
SSB2	0.725			
SSB5	0.704			
SSB8	0.768			
SA10		0.831		
SA2		0.745		
SA4		0.798		
SA6		0.719		
SA7		0.792		
SA8		0.765		

	Student Environmenta l Sustainability Behavior	Sustainability Attitude	Sustainability Education	Sustainabilit y Knowledge
SA9		0.809		
SE3			0.844	
SE4			0.886	
SE5			0.863	
SE6			0.908	
SE7			0.871	
SK1				0.789
SK2				0.736
SK4				0.733
SK5				0.716

Table 4. Results of construct reliability and validity analysis

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Student Environmental Sustainability Behavior	0.729	0.736	0.830	0.551
Sustainability Attitude	0.893	0.897	0.916	0.610
Sustainability Education	0.923	0.924	0.942	0.765
Sustainability Knowledge	0.732	0.741	0.832	0.554

The next analysis is the goodness-of-fit test and model formation. Table 5 shows the results of the model test with the indicators R^2 , F^2 , and Q^2 . It is known that the value of R^2 Student Environmental Sustainability Behavior is 0.275, which means the model is considered in the moderate category. Sustainability education, knowledge, and attitude are only able to explain 27.5% of the student environmental sustainability behavior variable. R^2 of the sustainability attitude is 0.549, which indicates a strong model and means that sustainability education and knowledge can explain the sustainability attitude by 54.9%. Table 5 also shows the magnitude of the F-square. The influence of sustainability education, knowledge, and attitude on student environmental sustainability behavior is included in the weak category because it is between 0.02 and 0.15. The influence of sustainability education on sustainability knowledge is included in the strong category because the value of F^2 is more than 0.35. The influence of sustainability knowledge on sustainability attitude is also included in the strong influence category. In addition, the Q^2 predict value of student environmental sustainability behavior and sustainability attitude is 0.129 and 0.378, or greater than 0, so that it can be stated that the model is able to predict endogenous variables well. The Standardized Root Mean Square (SRMS) value is 0.076 or less than 0.08, which indicates that the research model can be stated as fit. The Normed Fit Index (NFI) value is 0.802, which is close to 1, so that it can be stated that the model is appropriate.

Table 5. Goodness-fit-model results

R-Square				
	R-square	R-square adjusted		
Student Environmental Sustainability Behavior	0.275	0.266		
Sustainability Attitude	0.549	0.545		
Sustainability Knowledge	0.479	0.477		
F-Square				
	Student Environmental Sustainability Behavior	Sustainability Attitude	Sustainability Education	Sustainability Knowledge
Sustainability Attitude	0.132			
Sustainability Education	0.003	0.076		0.921
Sustainability Knowledge	0.000	0.336		
Q-Square				
	Q ² predict	RMSE	MAE	
Student Environmental Sustainability Behavior	0.129	0.946	0.717	
Sustainability Attitude	0.378	0.820	0.541	
Sustainability Knowledge	0.472	0.736	0.592	
Model fit test				
	Saturated model	Estimated model		
SRMR	0.076	0.076		
d_ ULS	1,202	1,202		
d_ G	0.410	0.410		
Chi-square	599,393	599,393		
NFI	0.802	0.802		

Table 6 shows the results of hypothesis testing (direct and indirect effects). The p-value of the influence of sustainability education on student environmental sustainability behavior is 0.165 or greater than the significance value (0.05), so that it can be stated that sustainability education has no significant effect. Sustainability education is proven to have a positive effect on sustainability knowledge and attitude, with a p-value of 0.000 or less than 0.05 and coefficients of 0.693 and 0.256. Sustainability knowledge is proven to be able to positively influence sustainability attitude with a p-value of 0.000 and a coefficient of 0.541. However, sustainability knowledge is not able to determine student environmental sustainability behavior significantly, with a p-value of 0.402 or greater than 0.05. Finally, sustainability attitude has a positive effect on student environmental sustainability behavior significantly, with a p-value of 0.000 and a coefficient of 0.449.

Table 6 also shows the results of indirect influence testing. Sustainability education can determine student environmental sustainability behavior indirectly through sustainability attitude, but it is not proven to have an indirect effect through sustainability knowledge. Sustainability education can affect sustainability attitude through sustainability knowledge. Finally, sustainability knowledge can determine student environmental sustainability behavior through sustainability attitude significantly.

Table 6. Hypothesis testing results (direct and indirect effects)

	Original sample (O)	Sample mean (M)	Standar d deviatio n (STDEV)	T statistics (O/STDEV)	P values
Direct Effect					
Sustainability Education -> Sustainability Knowledge	0.692	0.693	0.038	18,347	0.000
Sustainability Education -> Sustainability Attitude	0.256	0.257	0.075	3,421	0.000
Sustainability Education -> Student Environmental Sustainability Behavior	0.070	0.074	0.072	0.974	0.165
Sustainability Knowledge -> Sustainability Attitude	0.540	0.541	0.057	9,525	0.000
Sustainability Knowledge -> Student Environmental Sustainability Behavior	0.022	0.030	0.089	0.247	0.402
Sustainability Attitude -> Student Environmental Sustainability Behavior	0.461	0.449	0.121	3,810	0.000
Indirect Effect					
Sustainability Education -> Sustainability Attitude -> Student Environmental Sustainability Behavior	0.118	0.114	0.043	2,736	0.003
Sustainability Education -> Sustainability Knowledge -> Student Environmental Sustainability Behavior	0.015	0.021	0.062	0.245	0.403
Sustainability Education -> Sustainability Knowledge -> Sustainability Attitude -> Student Environmental Sustainability Behavior	0.172	0.169	0.053	3,224	0.001
Sustainability Knowledge -> Sustainability Attitude -> Student Environmental Sustainability Behavior	0.249	0.244	0.073	3,418	0.000

Sustainability education has been proven to influence sustainability knowledge and attitude, but it cannot determine student environmental sustainability behavior directly. Indirectly, sustainability education can influence students' environmental sustainability behavior through their sustainability attitude. The results of the study indicate that a sustainable attitude is an important element in influencing students' environmental sustainability behavior. Sustainability attitude has been proven to have a direct influence and can significantly mediate the influence of sustainability education on student environmental sustainability behavior. Sustainability education will have an impact on student behavior when student attitudes have been formed. Sustainability education will not have an impact on student behavior, even though their knowledge is included in the good category.

Education is an important element in shaping students' knowledge, attitudes, and behaviors [14]. Education for sustainable development in Chinese universities can improve students' sustainability cognition and behaviors [5]. This study only found that sustainability education can determine sustainability knowledge and attitudes, but has no significant effect on sustainability behavior. This finding does not support previous research results that the variety of educational programs does not have a statistically significant impact on students' attitudes towards sustainability [1].

Interesting results obtained that knowledge cannot significantly influence students' sustainable behavior. This finding is in line with previous research results that environmental knowledge has not been proven to have a significant effect on students' pro-environmental behavior [11]. Knowledge has also been shown to have no significant effect on students' waste separation behavior [12]. However, there are previous research results that found that knowledge correlates significantly and positively with sustainable behavior [10].

Sustainability knowledge has a significant effect on sustainability attitude. The knowledge possessed by students can determine the attitude that will be taken toward environmental and sustainability issues. This finding supports the results of previous studies that also obtained the same results, that knowledge about sustainability can significantly influence students' environmental attitudes [9].

Positive sustainability attitudes always result in sustainable behavior in students [11]. This finding is in line with previous studies that found a positive and significant correlation between attitudes and sustainable behavior [10]. Attitudes have been shown to have a significant effect on students' waste separation behavior, while knowledge has no significant effect [12]. The attitudes that have been formed will encourage students to behave in a pro-environmental manner.

4 Conclusion

This study attempts to analyze the relationship between students' sustainability knowledge, attitudes, and behavior with sustainability education as a new variable to be added. The results of the study indicate that the role of sustainability education is very important because it can significantly influence students' sustainability knowledge and attitudes. However, sustainability education does not have a direct influence on student behavior. Sustainability education has an indirect influence on behavior through attitude. The results of this study also emphasize the importance of a sustainability attitude, which can directly influence student behavior and can act as a mediator of the influence of sustainability knowledge on students' sustainability behavior. Other results indicate that

sustainability knowledge can influence sustainability attitude and does not have a significant effect on behavior.

The suggestion that can be given is that universities should pay attention to implementing sustainability education that can improve sustainability knowledge and student attitudes. The indirect impact is an increase in student sustainability behavior. Sustainability education can be included in the curriculum or through supporting activities. In addition, campaigns and the initiation of sustainability programs must continue to be carried out by involving students in real terms. In addition, this study was limited to students at one of the conservation universities in Indonesia. In addition, this study has limitations in the preparation of research instruments. Many statement items are invalid. Further researchers can develop better instruments according to the conditions of the observation objects.

References

- [1] N. Pennell and G. Sabau, *International Journal of Sustainability in Higher Education* 25, 669 (2024)
- [2] G. Cogut, N. J. Webster, R. W. Marans, and J. Callewaert, *International Journal of Sustainability in Higher Education* 20, 1240 (2019)
- [3] R. Lozano and M. Barreiro-Gen, *Sustainable Development* 27, 965 (2019)
- [4] A. F. Radwan and E. M. A. S. Khalil, *International Journal of Sustainability in Higher Education* 22, 964 (2021)
- [5] F. Zhong, X. Ma, X. Jiang, Y. Mao, and X. Lyu, *International Journal of Sustainability in Higher Education* head-of-print, (2024)
- [6] A. Bertossi and F. Marangon, *International Journal of Sustainability in Higher Education* 23, 522 (2022)
- [7] E. K. Perrault and S. K. Clark, *International Journal of Sustainability in Higher Education* 19, 32 (2018)
- [8] M. Cho, *International Journal of Sustainability in Higher Education* 20, 1042 (2019)
- [9] A. B. A. Avelar and M. C. Farina, *International Journal of Sustainability in Higher Education* 23, 1749 (2022)
- [10] H. Li, *Discover Sustainability* 6, (2025)
- [11] D. C. Null and J. Asirvatham, *International Journal of Sustainability in Higher Education* 24, 660 (2023)
- [12] D. Zhang, J. Chen, L. Liu, M. Hao, and S. Morse, *Environ Res Commun* 5, (2023)
- [13] M. Torroba Diaz, A. Bajo-Sanjuan, Á. M. Callejón Gil, A. Rosales-Pérez, and L. López Marfil, *International Journal of Sustainability in Higher Education* 24, 1489 (2023)
- [14] S. M.A., R. Agrawal, R. T. Syed, T. Arumugam, and P. K., *International Journal of Sustainability in Higher Education* 26, 852 (2025)
- [15] A. Nousheen and F. Tabassum, *International Journal of Sustainability in Higher Education* 25, 1214 (2024)