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Evaluating Green Behavior Index in Vocational Education for Sustainable Campus Development

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Abstract

Vocational education plays a strategic role in supporting sustainable development, particularly through the establishment of environmentally conscious campuses. Although various sustainability initiatives have been implemented in higher education institutions, structured measurement of student behavior remains limited. This study evaluates the application of the Green Behavior Index (GBI) as a behavioral measurement tool while assessing environmental behavior in a vocational education context. The instrument covers six key dimensions: energy use, waste management, water conservation, carbon emissions, healthy lifestyles, and fuel consumption. A quantitative survey method was employed, involving 1,018 respondents consisting of students, lecturers, and educational staff. The minimum sample size was determined using the Slovin formula, and data were collected through a voluntary response sampling method using an online questionnaire distributed via Google Forms. Data were analyzed using descriptive statistics and inferential tests, including analysis of variance and advanced comparisons. The results indicate that respondents, particularly students, exhibit strong environmentally friendly behaviors in routine aspects, such as energy conservation and sanitation, but remain weak in behaviors that require systemic efforts, including emission control and participation in environmental programs. No significant influence of demographic factors was found, indicating that internal and contextual factors have a greater impact on differences in behavior. These findings provide an empirical basis for developing more effective and personalized sustainability policies in vocational education. Improvements to the behavioral measurement tool are also recommended to capture the complexity of sustainable practices across different groups within the academic community.

1. Introduction

Vocational education plays a crucial role in supporting sustainable development, particularly in creating environmentally friendly campuses (Rocha et al., 2025; Tung et al., 2023). As global challenges such as climate change and other environmental crises increase, educational institutions worldwide, including Indonesia, are increasingly encouraged to adopt sustainable practices (Abulibdeh, 2024; Suklun & Bengü, 2024). Universities, as

higher education institutions, not only serve as teaching centers but also act as living laboratories that integrate green technology and foster environmental management through research and educational programs (Hatos & Szombathelyi, 2025; Imran et al., 2024). One of the key elements in realizing a sustainable campus is students' environmental awareness and behavior, which requires appropriate measuring tools for evaluation. The Green Behavior Index (GBI) is a tool used to measure students' environmentally friendly behavior. While originally developed to assess student behavior, recent studies suggest that pro-environmental behavior instruments can also be applied to broader academic communities, including lecturers and institutional staff, as they collectively contribute to campus sustainability practices (Hansmann et al., 2020; Yuriev et al., 2020). Although not exclusively designed for vocational education, the GBI has been adopted in this context due to its relevance in assessing skills-based sustainable practices (Felgentreff et al., 2025). In fact, many campuses worldwide, including in Indonesia, have implemented sustainability programs such as waste management and energy savings (Brennan et al., 2015; Fissi et al., 2021), but the evaluation of student behavior through a structured approach, such as the GBI, is still limited (Maknun et al., 2018; Zheng & Zhang, 2024). In fact, this kind of evaluation is vital as a basis for developing educational policies that support the realization of a sustainable campus (Maknun et al., 2018).

Previous studies have identified the relationship between vocational education and sustainability, but not many have specifically applied a behavioral measurement framework, such as the GBI, especially in Indonesia (Zheng & Zhang, 2024). At the global level, existing measurement tools have different characteristics: Greendex focuses on individual sustainable consumption behavior on a broad scale (Priyankara et al., 2025), while UI Green Metric measures campus sustainability performance from a policy and infrastructure perspective (Domingos et al., 2024). The GBI provides a more targeted approach to evaluating green behavior in educational settings. Research Li et al. (2023) revealed that 68% of vocational teachers still lack understanding of green technology, even though some already have positive attitudes towards the environment. This finding demonstrates the importance of instruments that can measure not only knowledge but also actual behavior. Study Kamis et al. (2020) responded by developing a green skills module that combines theory and practice, although it did not specifically test the GBI. Furthermore, Putri et al. (2025) emphasized that green technology competency and perception of long-term benefits are key factors in shaping sustainable behavior in vocational students. Hence, they need to be considered in measuring the GBI. Furthermore, Nikoloudakis & Rangoussi (2024) proved that project-based learning is effective in introducing circular economy principles, but there has been no measurement of its effectiveness using behavioral indicators such as the GBI. Meanwhile, green skills models in India and Indonesia focus on technology integration without touching on quantitative measurements of green behavior (Chandrasekar et al., 2023).

The main gap in previous research lies in the tendency to use measurement tools such as Greendex and UI Green Metric (Kamal et al., 2021; Tshivhase & Bisschoff, 2023). However, these tools have limitations in capturing the dimensions of individual vocational students' behavior related to environmental awareness, especially in Indonesia. Therefore, this study attempts to fill this gap by evaluating the application of GBI in the context of vocational education at the Faculty of Vocational Studies, Universitas Negeri Surabaya. While the primary focus remains on students, this study also considers lecturers and educational staff as part of the academic community influencing sustainable campus behavior. Through the evaluation of GBI, this study aims to (RQ1) Provide an objective overview of vocational students' engagement in environmentally friendly practices; (RQ2) Identify factors influencing such behavior; and (RQ3) Provide an empirical basis for developing more effective education policies. The contribution of this research lies not only in evaluating existing sustainability programs but also in creating a vocational education environment that not only focuses on developing technical skills but also fosters environmental awareness and behavior among students.

2. Theoretical Background

Research on evaluating GBI in the context of vocational education requires a strong theoretical foundation to understand the complexities of sustainable behavior on campus. Therefore, this theoretical framework is built on three main aspects: the theory of pro-environmental behavior, GBI measurement instruments, and the role of vocational education in shaping sustainable behavior. However, general pro-environmental behavior theory has several limitations, particularly in explaining the inconsistency between environmental attitudes and actual behavior (attitude–behavior gap), as well as in capturing the influence of underlying psychological and normative factors. The Theory of Planned Behavior (TPB) is one of the main frameworks in understanding the determinants of pro-environmental behavior. TPB shows high effectiveness in predicting sustainable behavior in students, although there are variations in the influence of its components on actual actions (Ateş, 2020; de Leeuw et al., 2015). Meanwhile, the Value-Belief-Norm (VBN) model provides a more comprehensive perspective by tracing the causal chain from personal values to personal norms as a form of intrinsic motivation. Research on Indonesian students found that VBN can explain 20-31% of the variance in pro-environmental behavior, where biospheric and altruistic values have a significant influence (Greaves et al., 2013).

In the context of measurement, the GBI offers a different approach compared to traditional instruments such as UI GreenMetric or STARS. While UI GreenMetric focuses on assessing institutional infrastructure, the GBI is specifically designed to measure individual student behavior with strong content validity (CVI 0.80–0.90). These advantages make the GBI an appropriate tool for evaluating sustainable behavioral transformation at the individual level (Negm, 2024; Roy, 2023; Yuriev et al., 2020). Vocational education plays a crucial role in shaping sustainable behavior due to its practical, industry-oriented nature. However, research shows a gap between positive attitudes toward sustainability and actual behavioral implementation. Furthermore, the development of green skills in vocational education often does not align with the needs of the green labor market (Gkargkavouzi et al., 2019). Therefore, integrating sustainability principles into vocational curricula and practices is crucial to encourage more concrete behavioral changes.

3. Method

3.1 Research Design

This study employs a quantitative approach, utilizing a survey method, to evaluate the Green Behavior Index (GBI) among Vocational Faculty students in support of sustainable campus development. While the primary focus of the study is on students, the research also includes lecturers and educational staff to provide a broader contextual understanding of environmental behavior within the academic community. The research design focused on measuring six dimensions of environmentally friendly behavior, including energy conservation, waste management, water utilization, carbon emissions, healthy lifestyles, and fuel use. Data were collected through a structured questionnaire and statistically analyzed to identify behavioral patterns and the factors that influence them.

3.2 Population and Sample

The population in this study consisted of all students and academic staff from the Faculty of Vocational Studies, Universitas Negeri Surabaya, totaling N = 3,862. The minimum sample size was calculated using the Slovin formula with a margin of error of 5% (e = 0.05), yielding a result of 363 respondents.

$$n = \frac{N}{1 + N(e^2)} = \frac{3.862}{1 + 3.862\ (0.05^2)} = 363 \quad (1)$$

To enhance the robustness and generalizability of the findings, a larger sample was pursued. Data collection was carried out through a voluntary response sampling method. A structured questionnaire was distributed electronically via Google Forms. The survey link was disseminated through program coordinators to students across all study programs within the faculty. The programs represent a diverse range of fields, including Engineering and Technology (e.g., Automotive, Electrical, Civil, Mechanical), Administration and Management (e.g., Public Administration, Informatics Management), Creative Industries (e.g., Graphic Design, Media Production, Culinary Arts, Fashion Design), and Sports Science (e.g., Sports Coaching, Performance Analysis). The survey was also shared with lecturers and educational staff via faculty communication channels.

This approach successfully gathered a total of 1,018 respondents. The final sample composition was as follows: 487 first-year students (47.8%), 183 second-year students (18.0%), 127 third-year students (12.5%), 103 fourth-year students (10.1%), 99 lecturers (9.7%), and 19 educational staff (1.9%). Although lecturers and educational staff were included (approximately 11.6% of the sample), their inclusion was intended to provide broader contextual insight into environmental behavior within the academic community. Accordingly, their responses were treated as complementary data, while the primary analysis remained focused on student behavior, in line with the original design and target population of the GBI instrument. This distribution provides a diverse cross-section of the academic community within the faculty. It is noteworthy that students from several technical programs (e.g., Engineering, Automotive) have prior exposure to foundational environmental concepts through mandatory courses such as "Occupational Health, Safety, and Environment" and "Introduction to the World of Work", which touch upon principles of sustainable development. This research was conducted in Indonesia, a context where specific environmental challenges, such as urban air pollution in Surabaya, directly influence the relevance of the green behavior dimensions being measured.

3.3 Research Instruments

The primary instrument was a closed-ended questionnaire with a Likert scale ranging from 1 to 4 (1 = Never, 4 = Always). The measurement indicators were adapted from the established Green Behavior Index (GBI) framework and contextualized for vocational education settings. The indicators represent general, behavior-based environmental practices (e.g., energy use, water use, waste habits), making them applicable across different

respondent groups regardless of their level of technical knowledge or expertise. The instrument was further validated through expert judgment to ensure content relevance and construct alignment with the GBI framework. The instrument specifications are detailed in Table 1.

Table 1 *GBI measurement instrument specifications*

No.	Behavioral Dimensions	Measurement Indicators	Number of Items
1	Energy-saving	Energy-saving lamp usage ratio	1
2	Waste disposal	The habit of sorting waste	2
		Treatment of used goods	
3	Water use	The habit of using water when bathing	3
		Laundry habit	
		The habit of turning off the water tap	
4	Carbon Emission	Vehicle emission test frequency	2
		Machine maintenance routine	
5	Healthy Living Behavior	Bowel movements	3
		Use of healthy toilets	
		Environmental program participation	
6	Fuel Usage	Monthly fuel consumption volume	2
		Mode choice	
		Total	13

3.4 Data Collection Procedures

Data were collected through an electronic questionnaire (Google Forms) distributed via email and class groups over four weeks. This study employed a voluntary response sampling method, which is a non-probability sampling technique where participation was entirely based on respondents' willingness to complete the survey. Therefore, the sample cannot be considered randomly selected, and the findings should be interpreted with this limitation in mind. Respondents were given a written explanation of the study's purpose, data confidentiality, and right to withdraw. Anonymity was guaranteed to minimize social bias.

3.5 Data Analysis

Data analysis in this study focused on identifying environmentally friendly behavior patterns of students based on the six dimensions of GBI. Data from lecturers and educational staff were analyzed descriptively to support interpretation, but inferential conclusions were primarily drawn based on student responses. Data obtained through questionnaires were transformed into numerical form and processed using quantitative statistical analysis (Ogiemwonyi et al., 2023). The initial stage involved descriptive analysis to observe the general trends of respondents' behavior, which were reviewed through the average value, standard deviation, and variance for each indicator (Sun et al., 2019). Following this, an inferential analysis was conducted to examine the differences between dimensions and the relationships between variables. The ANOVA test was used to determine significant differences between the average scores of the GBI dimensions (Lu et al., 2017), while the Tukey test was conducted to identify pairs of dimensions that had significant differences (Hansmann et al., 2020). In addition, the chi-square test was applied to evaluate whether the demographic characteristics of respondents influenced the measured green behavior (Dlamini et al., 2021).

3.6 Validity and Reliability

The instrument's validity was tested through content validity by two environmental experts and one vocational education expert, and construct validity by factor analysis (KMO > 0.7). Reliability was measured using Cronbach's Alpha ($\alpha \geq 0.7$ for all dimensions), indicating good internal consistency. A pilot test was conducted on 30 students outside the sample.

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4. Results and Discussion

4.1 Descriptive Results

The descriptive analysis of the GBI among vocational students showed significant variations in environmentally friendly behavior practices across various dimensions. Energy-saving light bulb usage was recorded at a mean score of 3.26 (scale 1-4), indicating that most students have adopted energy-saving habits, with a standard deviation of 1.03, suggesting fairly good consistency among respondents. However, waste sorting habits remained relatively low with a mean of only 2.33, supported by a variance of 0.66, reflecting behavioral disparities in this regard. In contrast, the treatment of used items achieved a score of 3.17, indicating a higher awareness of waste reuse. In the water utilization dimension, the habit of turning off water taps stood out with the highest score (3.69) and a low standard deviation (0.53), indicating uniformity in positive behavior. However, clothing washing methods still need improvement, with a mean of 2.55 and a high variance (1.57), suggesting the need for educational intervention. In the carbon emissions aspect, the vehicle emission test frequency was a weak point, with the lowest score (1.88), supported by a standard deviation of 0.93, confirming a lack of awareness. All values have been standardized to the original Likert scale (1–4) to ensure consistency between the statistical table and the descriptive narrative.

Table 2 *Recapitulation of descriptive statistics of GBI indicators*

No.	Variable	Mean	StDev	Variance
1	Energy-saving light bulb usage	3.26	1.03	1.06
2	Waste sorting habits	2.33	0.81	0.66
3	Treatment of used items	3.17	1	0.99
4	Water usage habits while bathing	3.14	0.38	0.15
5	Laundry habit	2.55	1.25	1.57
6	Habit of turning off water taps	3.69	0.53	0.28
7	Vehicle emission test frequency	1.88	0.93	0.86
8	Machine maintenance routine	2.95	1	1.01
9	Defecation habits	3.91	0.3	0.09
10	Use of healthy toilets	3.95	0.26	0.07
11	Participation in environmental	1.92	0.75	0.56
12	Monthly fuel consumption volume	3.04	0.96	0.93
13	Mode choice	2.17	1.45	2.11

Table 2 summarizes descriptive statistics for several key variables. On the other hand, dimensions of healthy living behavior, such as the use of healthy toilets and defecation habits, achieved near-perfect scores (3.95 and 3.91, respectively), with minimal variances (0.07 and 0.09), confirming that sanitation practices have become the norm. However, participation in environmental programs remained low (1.92), indicating a lack of active student involvement in campus initiatives. These findings overall underscore that while vocational students demonstrate good environmental awareness in practical areas such as energy conservation and sanitation, dimensions requiring systemic commitment, such as carbon emission management and participation in environmental programs, still require serious attention. The high variance in some indicators (e.g., laundry habit) also suggests the need for a more personalized approach to sustainability education.

4.2 Statistical Analysis and Interpretation

The heatmap visualization in Figure 1 reveals an interesting distribution pattern of green behaviors among vocational students. The abbreviations displayed on the x-axis represent specific study programs within the Faculty of Vocational Studies (e.g., FashDez for Fashion Design and AutoEng for Automotive Engineering). As shown by the color gradation, the energy efficiency and healthy behavior dimensions stand out with more intense color, indicating consistently high scores across all respondent groups. In contrast, the carbon emission and fuel consumption dimensions appear more muted, reflecting relatively low scores. This spatial pattern corroborates previous descriptive findings and provides a visual illustration of the disparities between GBI dimensions.

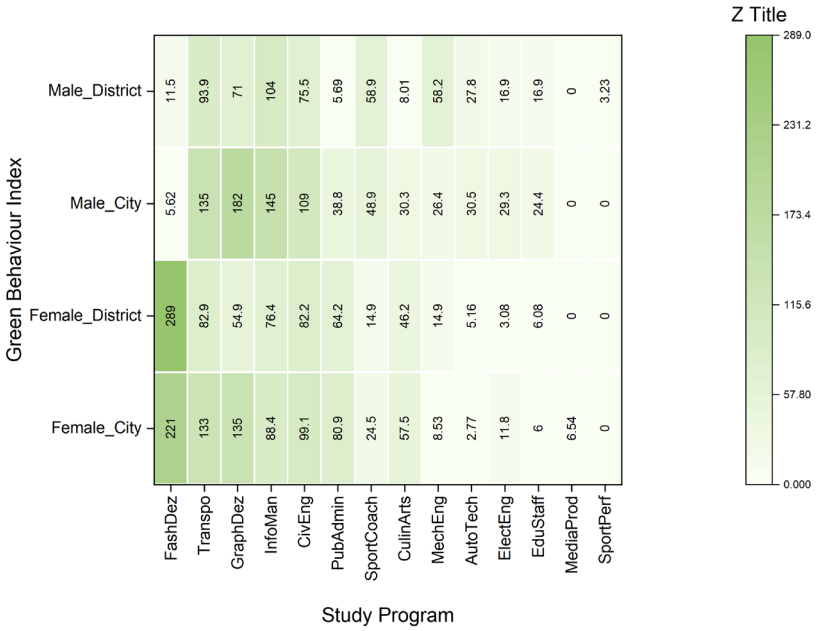

Fig. 1 *Heatmap of GBI scores distribution by dimensions and respondent groups. Note: AutoEng = Automotive Engineering; ElecEng = Electrical Engineering; CivEng = Civil Engineering; MechEng = Mechanical Engineering; PubAdm = Public Administration; InfMgmt = Informatics Management; FashDez = Fashion Design; CulArt = Culinary Arts; MedProd = Media Production; SportSci = Sports Science*

Further analysis using the chi-square test (Table 3) revealed no significant relationship between demographic variables and overall green behavior practices. The p-values of 0.104 (Pearson) and 0.103 (Likelihood Ratio), which exceed the 0.05 level of significance, indicate that factors such as gender or geographic location do not statistically influence GBI. These results are consistent with the random pattern observed in the heatmap, where there is no systematic color grouping by demographic category.

Table 3 *Chi-Square test results of demographic variables and GBI scores association*

	Chi-Square	DF	P-Value
Pearson	2.649	1	0.104
Likelihood Ratio	2.652	1	0.103

More significant findings were revealed through ANOVA analysis (Table 4), where the F-value of 245.87 with a p-value of 0.000 firmly rejected the null hypothesis, confirming the existence of a significant mean difference in at least one pair of GBI dimensions. The magnitude of the Adj SS factor (672.3) compared to Error (3336.8) indicates that the inter-group variation is much more dominant than the intra-group variation, as also reflected in the heatmap visualization, which shows a clear color difference between columns.

Table 4 *ANOVA test results for mean differences of GBI scores across dimensions*

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	5	672.3	134.451	245.87	0.000
Error	6102	3336.8	0.547		
Total	6107	4009.1			

Tukey's post-hoc test (Table 5) provides details on these specific differences. As seen in the Difference of Means column, the energy efficiency dimension consistently outperforms the other four dimensions, except for healthy behaviors, where the difference is only 0.0049 points (p-value 1.000). The most significant difference is recorded between energy efficiency and carbon emissions (-0.8522, T-value -26.00), a finding that aligns with the palest colored area in the heatmap for the emissions dimension. The narrow 99.56% confidence interval and adjusted p-value of 0.000 confirm the significance of this finding.

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Table 5 *Tukey test results for pairwise differences of GBI dimensions' means*

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Waste Manage - Energy Effic	-0.5118	0.0328	(-0.6052, -0.4184)	-15.61	0.000
Water Usage - Energy Effic	-0.1392	0.0328	(-0.2326, -0.0458)	-4.25	0.000
Carbon Emiss - Energy Effic	-0.8522	0.0328	(-0.9456, -0.7588)	-26.00	0.000
Healthy Beha - Energy Effic	-0.0049	0.0328	(-0.0983, 0.0885)	-0.15	1.000
Fuel Consump - Energy Effic	-0.6611	0.0328	(-0.7545, -0.5677)	-20.17	0.000
Water Usage - Waste Manage	0.3726	0.0328	(0.2792, 0.4660)	11.37	0.000
Carbon Emiss - Waste Manage	-0.3404	0.0328	(-0.4338, -0.2470)	-10.38	0.000
Healthy Beha - Waste Manage	0.5069	0.0328	(0.4135, 0.6003)	15.46	0.000
Fuel Consump - Waste Manage	-0.1493	0.0328	(-0.2427, -0.0559)	-4.56	0.000
Carbon Emiss - Water Usage	-0.7130	0.0328	(-0.8064, -0.6196)	-21.75	0.000
Healthy Beha - Water Usage	0.1343	0.0328	(0.0408, 0.2277)	4.10	0.001
Fuel Consump - Water Usage	-0.5219	0.0328	(-0.6153, -0.4285)	-15.92	0.000
Healthy Beha - Carbon Emiss	0.8472	0.0328	(0.7538, 0.9407)	25.85	0.000
Fuel Consump - Carbon Emiss	0.1911	0.0328	(0.0977, 0.2845)	5.83	0.000
Fuel Consump - Healthy Beha	-0.6562	0.0328	(-0.7496, -0.5628)	-20.02	0.000

Individual confidence level = 99.56%

Interpretation of these results leads to three main conclusions: First, the consistency of findings between the heatmap, ANOVA, and Tukey's test validates that the main challenges of GBI implementation lie in dimensions that require specialized infrastructure (e.g., emission testing) or radical lifestyle changes (e.g., fuel reduction). Second, the absence of demographic effects (as indicated by the chi-square) suggests that policy interventions should be universal rather than segmented. Third, the similarity in scores between energy efficiency and healthy behaviors (non-significant differences) suggests that practices integrated into daily routines are more easily adopted than those requiring external efforts.

In relation to RQ2, these findings indicate that green behavior is primarily influenced by contextual and structural factors rather than demographic characteristics. Specifically, behaviors associated with routine daily practices (e.g., energy use and sanitation) tend to show higher adoption levels, whereas behaviors requiring external support, infrastructure availability, or institutional engagement (e.g., emission control and environmental program participation) demonstrate lower performance. This suggests that the level of behavioral complexity, resource dependency, and institutional facilitation are key factors influencing the variation in green behavior across dimensions.

5. Discussion

The results of this study revealed significant variations in environmentally friendly behavior practices among vocational students, with the dimensions of energy saving and healthy living behavior recording the highest scores. In contrast, the dimensions of carbon emissions and environmental program participation remained relatively low. This finding is in line with research Stern (2022), which highlights the importance of a specific approach in assessing green behavior, where dimensions that are practical and have immediate benefits tend to be more easily adopted. However, dimensions that require long-term commitment or systemic changes, such as carbon emission management, still face significant challenges. Study Zheng & Zhang (2024) reinforces this, which found that vocational students' environmental awareness is often limited to aspects directly related to everyday life.

Further statistical analysis revealed that demographic factors, such as gender or study program, did not significantly influence GBI. This finding is consistent with research Liobikienė & Poškus (2019), which emphasized that environmentally friendly behavior is more influenced by internal factors, such as knowledge, attitudes, and perceived benefits, than by external demographic factors. However, significant differences between GBI dimensions revealed through ANOVA and Tukey tests indicate that environmental education approaches need to be tailored to the characteristics of each dimension. For example, the waste management dimension, which has a low score, requires more intensive intervention, as suggested by Espinoza et al. (2025) in the context of vocational students' environmental literacy.

The low level of student engagement in environmental programs is also a critical finding in this study. This reinforces the results of studies Espinoza et al. (2025) and Piyapong (2020), which state that a lack of motivation or awareness of long-term impacts often hampers active participation in sustainability initiatives. On the other

hand, high scores on the healthy lifestyle behavior dimension indicate that social norms and daily habits can be strong drivers for the adoption of sustainable practices, as explained by Bloyd Null et al. (2023) and Nantale et al. (2023) in the context of green technology adoption. The implication of these findings is the need to develop more holistic and personalized education policies. As proposed by Ho et al. (2024), integrating circular economy principles and project-based approaches can be a solution to increase student engagement in sustainable practices. Furthermore, instruments such as the GBI need to be continuously refined to capture the complex dynamics of green behavior, especially in the context of skills-based vocational education.

6. Limitations and Future Research

This study has several limitations that should be acknowledged. The use of a voluntary response sampling method, while practical for gathering a large sample, carries a potential for self-selection bias. The findings are also context-specific to a single vocational faculty in Indonesia, which may affect their generalizability. Regarding curriculum integration, topics of sustainability are currently introduced through the mandatory 'Occupational Health, Safety, and Environment' course; however, the approach remains largely theoretical, and plans to develop more applied modules, while present, are not yet part of a comprehensive faculty-wide policy. Building on these findings and limitations, future research should pursue several directions. A comparative study employing stratified random sampling across multiple vocational institutions would enhance the external validity of the results. As the institution moves towards more applied sustainability education, a longitudinal or quasi-experimental design would be highly valuable to quantitatively assess the impact of such curricular interventions on actual green behavior. Supplementing this with qualitative inquiry would provide deeper insight into the underlying motivations and barriers students face, particularly in underperforming dimensions such as program participation and emission control.

7. Conclusion

This study provides a successful objective overview of vocational students' engagement in environmentally friendly practices, based on the six dimensions of the GBI. The analysis reveals that most students have exhibited positive behaviors in practical aspects integrated into their daily routines, such as energy conservation and healthy living. However, engagement remains low in dimensions that require systemic commitment and lifestyle changes, such as reducing carbon emissions and participating in campus environmental programs. Factors influencing students' green behavior were identified through an analysis of differences between dimensions and their relationship to respondent characteristics. High-scoring dimensions tend to correlate with behaviors that individuals easily adopt, while low-scoring dimensions indicate the need for more intensive structural support and education. There was no significant effect of demographic factors on overall GBI scores, suggesting that internal and contextual factors are more dominant in shaping behavior. These findings provide a strong empirical basis for developing more effective and sustainable vocational education policies. Learning approaches that integrate circular economy principles, project-based learning, and the strengthening of a green campus culture need to be expanded to encourage more equitable behavioral transformation. The GBI instrument has also proven to be a viable evaluation tool for assessing the effectiveness of environmental policy interventions and programs in vocational education.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Warju and Thomas Köhler;* ***data collection:*** *Sudirman Rizki Ariyanto and Komarudin ;* ***analysis and interpretation of results:*** *Warju, Thomas Köhler, and Sudirman Rizki Ariyanto;* ***draft manuscript preparation:*** *Thomas Köhler, Sudirman Rizki Ariyanto, and Komarudin. All authors reviewed the results and approved the final version of the manuscript.*

References

Abulibdeh, A. (2024). Towards zero-carbon, resilient, and community-integrated smart schools and campuses: A review. *World Development Sustainability*, *5*, 100193. https://doi.org/10.1016/j.wds.2024.100193

Ateş, H. (2020). Merging Theory of Planned Behavior and Value Identity Personal norm model to explain pro-environmental behaviors. *Sustainable Production and Consumption*, *24*, 169–180. https://doi.org/10.1016/j.spc.2020.07.006

Bloyd Null, D., Feeser, K., & Kurtzhals, G. (2023). An assessment of environmental literacy, behaviors, attitudes and lifestyle factors of college students. *Journal of American College Health*, *71*(8), 2485–2494. https://doi.org/10.1080/07448481.2021.1975720

Brennan, L., Binney, W., Hall, J., & Hall, M. (2015). Whose Job Is That? Saving the Biosphere Starts at Work. *Journal of Nonprofit & Public Sector Marketing*, *27*(3), 307–330. https://doi.org/10.1080/10495142.2015.1053348

Chandrasekar, B., Ranjan Thakur, R., & Setyorini, D. (2023). 9 Vocational and skill training systems in India and Indonesia: A comparative analysis with an application to green sector skills. In *Private Sector Development in an Emerging World* (pp. 143–160). De Gruyter. https://doi.org/10.1515/9783111071251-010

de Leeuw, A., Valois, P., Ajzen, I., & Schmidt, P. (2015). Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: Implications for educational interventions. *Journal of Environmental Psychology*, *42*, 128–138. https://doi.org/10.1016/j.jenvp.2015.03.005

Dlamini, S., Tesfamichael, S. G., & Mokhele, T. (2021). Socio-demographic determinants of environmental attitudes, perceptions, place attachment, and environmentally responsible behaviour in Gauteng province, South Africa. *Scientific African*, *12*, e00772. https://doi.org/10.1016/j.sciaf.2021.e00772

Domingos, J. M. F., Marques, D. G., Campos, V., & Nolasco, M. A. (2024). Analysis of the Water Indicators in the UI GreenMetric Applied to Environmental Performance in a University in Brazil. *Sustainability*, *16*(20), 9014. https://doi.org/10.3390/su16209014

Espinoza, I. I. B., Alcaraz, J. L. G., López, A. J. G., Reza, J. R. D., & Romero, J. L. (2025). Environmental knowledge to create environmental attitudes generation toward solar energy purchase. *Sustainable Futures*, *9*, 100558. https://doi.org/10.1016/j.sftr.2025.100558

Felgentreff, E. S., Jakubka, D., Knapp, S., & Bernhardt-Römermann, M. (2025). The garden biodiversity index: A self-assessment tool for evaluating biodiversity in private gardens. *Landscape and Urban Planning*, *263*, 105449. https://doi.org/10.1016/j.landurbplan.2025.105449

Fissi, S., Romolini, A., Gori, E., & Contri, M. (2021). The path toward a sustainable green university: The case of the University of Florence. *Journal of Cleaner Production*, *279*, 123655. https://doi.org/10.1016/j.jclepro.2020.123655

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit. *Resources, Conservation and Recycling*, *148*, 145–156. https://doi.org/10.1016/j.resconrec.2019.01.039

Greaves, M., Zibarras, L. D., & Stride, C. (2013). Using the theory of planned behavior to explore environmental behavioral intentions in the workplace. *Journal of Environmental Psychology*, *34*, 109–120. https://doi.org/10.1016/j.jenvp.2013.02.003

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. https://doi.org/10.1016/j.jclepro.2020.121864

Hatos, H., & Szombathelyi, M. K. (2025). Indicators of sustainability in vocational education and training institutions. *International Journal of Innovative Research and Scientific Studies*, *8*(3), 1674–1679. https://doi.org/10.53894/ijirss.v8i3.6859

Ho, O., Iyer-Raniga, U., Sylva, K., Sivapalan, S., Dissanayaka, S. M., & Sadykova, C. (2024). Circular economy education: student feedback from five higher education institutions in the Asia Pacific. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-07-2023-0292

Imran, M., Almusharraf, N., & Abdellatif, M. S. (2024). Education for a Sustainable Future: The Impact of Environmental Education on Shaping Sustainable Values and Attitudes among Students. *International Journal of Engineering Pedagogy (IJEP)*, *14*(6), 155–171. https://doi.org/10.3991/ijep.v14i6.48659

Kamal, F., Fard, R. F., Hoveida, A. S., Gharlipour, Z., & Rahimi, N. R. (2021). Designing and evaluating the validity and reliability of environmental behavior tools. *Iranian Journal of Health and Environment*, *14*(2), 285–298.

Kamis, A., Herrera, L. M., Montenegro, P. L. Y., Alwi, A., Nashir, I. M., Kob, C. G. C., & Kiong, T. T. (2020). Modified Delphi technique in analysing contents of green skills module for design and technology subject. *Journal of Technical Education and Training*, *12*(1 Special Issue), 49–56. https://doi.org/10.30880/jtet.2020.12.01.005

Li, H., Khattak, S., Lu, X., & Khan, A. (2023). Greening the Way Forward: A Qualitative Assessment of Green Technology Integration and Prospects in a Chinese Technical and Vocational Institute. *Sustainability*, *15*(6), 5187. https://doi.org/10.3390/su15065187

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

Lu, H., Liu, X., Chen, H., Long, R., & Yue, T. (2017). Who contributed to "corporation green" in China? A view of public- and private-sphere pro-environmental behavior among employees. *Resources, Conservation and Recycling*, *120*, 166–175. https://doi.org/10.1016/j.resconrec.2016.12.008

Maknun, J., S. Barliana, M., Cahyani, D., Dalil H., N., & Dahar Minghat, A. (2018). Evaluation of Vocational School (SMK) Studentsâ€™ Environmental Literacy. *International Journal of Engineering & Technology*, *7*(4.33), 178–181. https://doi.org/10.14419/ijet.v7i4.33.23554

Nantale, H., Tibaingana, A., & Mutunzi Kitunzi, A. (2023). Social Norms, Contextual Factors and Sustainable Consumption Behaviours among Urban Households in the Greater Kampala Metropolitan Area. *African Journal of Business and Economic Research*, *18*(4), 77–100. https://doi.org/10.31920/1750-4562/2023/v18n4a4

Negm, E. (2024). Recognizing the impact of value-belief-norm theory on pro-environmental behaviors of higher education students: considering aspects for social-marketing applications. *International Journal of Sustainability in Higher Education*, *25*(2), 289–305. https://doi.org/10.1108/IJSHE-04-2023-0135

Nikoloudakis, N., & Rangoussi, M. (2024). Introducing Green, Eco-Friendly Practices and Circular Economy Principles in Vocational Education Through a Novel Analysis-Synthesis Method: Design, Implementation and Evaluation. *International Journal for Research in Vocational Education and Training*, *11*(3), 429–459. https://doi.org/10.13152/IJRVET.11.3.5

Ogiemwonyi, O., Alam, M. N., Alshareef, R., Alsolamy, M., Azizan, N. A., & Mat, N. (2023). Environmental factors affecting green purchase behaviors of the consumers: Mediating role of environmental attitude. *Cleaner Environmental Systems*, *10*, 100130. https://doi.org/10.1016/j.cesys.2023.100130

Piyapong, J. (2020). Factors Affecting Environmental Activism, Nonactivist Behaviors, and the Private Sphere Green Behaviors of Thai University Students. *Education and Urban Society*, *52*(4), 619–648. https://doi.org/10.1177/0013124519877149

Priyankara, H. A. C., Premathilaka, U., & Navaratne, C. M. (2025). Green Consumer Behavior Index (GCBI): Evaluation of Consumer's Green Behaviour Towards Sustainable Consumption and Eco-conscious Society. In *Climate Change Adaptation in the Built Environment* (pp. 587–617). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-75826-3_24

Putri, G. E., Sudira, P., Sofyan, H., Mutohhari, F., Saputro, I. N., & Ramadhan, M. A. (2025). Determining green technology usage behaviour in vocational education and learning. *Multidisciplinary Science Journal*, *7*(9), 2025347. https://doi.org/10.31893/multiscience.2025347

Rocha, O. R. da, Morales, L., & Coetzer, J.-H. (2025). Education for Sustainable Development. In *Geoeconomics of the Sustainable Development Goals* (pp. 20–43). Routledge. https://doi.org/10.4324/9781032655857-4

Roy, S. K. (2023). Impact of green factors on undergraduate students' green behavioral intentions: A hybrid two-stage modeling approach. *Heliyon*, *9*(10), e20630. https://doi.org/10.1016/j.heliyon.2023.e20630

Stern, N. (2022). Towards a carbon neutral economy: How government should respond to market failures and market absence. *Journal of Government and Economics*, *6*, 100036. https://doi.org/10.1016/j.jge.2022.100036

Suklun, H., & Bengü, E. (2024). Raising Awareness of Sustainable Development Goals in Higher Education Institutions. *Research in Educational Administration and Leadership*, *9*(1), 39–72. https://doi.org/10.30828/real.1357661

Sun, Y., Liu, N., & Zhao, M. (2019). Factors and mechanisms affecting green consumption in China: A multilevel analysis. *Journal of Cleaner Production*, *209*, 481–493. https://doi.org/10.1016/j.jclepro.2018.10.241

Tshivhase, L., & Bisschoff, C. (2023). A conceptual model to measure and manage the implementation of green initiatives at South African public universities. *Frontiers in Sustainability*, *4*. https://doi.org/10.3389/frsus.2023.1237514

Tung, T. M., Lan, D. H., Cuc, T. T. K., & Oanh, V. T. K. (2023). Significance of Higher Education in Transmitting Knowledge of Sustainable Developments: Insights from Vietnam. *International Society for the Study of Vernacular Settlements*, *10*(11), 11–18. https://doi.org/10.61275/ISVSej-2023-10-11-01

Yuriev, A., Dahmen, M., Paillé, P., Boiral, O., & Guillaumie, L. (2020). Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review. *Resources, Conservation and Recycling*, *155*, 104660. https://doi.org/10.1016/j.resconrec.2019.104660

Zheng, L., & Zhang, R. (2024). Pro-Environmental Behaviors and Environmental Value Orientation of Vocational College Students in China. *Sustainability*, *16*(22), 9694. https://doi.org/10.3390/su16229694