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Environmental Knowledge, Attitudes, and Behavior: Drivers of Sustainability Awareness among School Students

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Abstract: This study investigates the factors influencing environmental sustainability by examining the roles of environmental knowledge, attitudes, behaviors, and awareness. Although these variables have been widely studied in global contexts, limited research addresses how they manifest among Indonesian students. This study fills that gap by focusing on 409 ninth-grade students from middle schools in Pekanbaru, Riau Province, and Solok City, West Sumatra, Indonesia. A quantitative approach using survey questionnaires was employed to measure students' environmental knowledge, attitudes, behaviors, and sustainability awareness. Results showed that environmental knowledge, attitudes, and behaviors significantly influenced sustainability awareness, with standardized coefficients of 0.35, 0.42, and 0.28, respectively ($p < 0.001$ for all). Among these, environmental attitude had the most substantial impact. These findings highlight the need for a multidimensional approach to environmental education that integrates cognitive, emotional, and behavioral components. By focusing on a regional context often underrepresented in sustainability research, this study contributes to a deeper, culturally grounded understanding of how young learners in Indonesia engage with environmental issues. It offers valuable insights for educators and policymakers in designing curricula and interventions that not only build knowledge but also nurture positive attitudes and sustainable behaviors among students.

Keywords: Environmental knowledge; Environmental attitudes; Environmental behavior; Sustainability awareness; Indonesia; Middle school

1 Introduction

The environment encompasses all living organisms and objects, including humans and their behaviors, which impact the sustainability of life and well-being. This definition of environment extends beyond the natural world to include human activities and their effects, highlighting the interconnectedness of ecological, social, and economic systems [1]. As human activities increasingly affect natural resources, the urgency of addressing sustainability becomes even more critical. Environmental degradation, driven by factors such as pollution, deforestation, and overconsumption, threatens the delicate balance necessary for life to thrive [2]. Environmental sustainability has become an increasingly critical issue in global discussions, with an emphasis on ensuring that natural resources are managed responsibly to meet the needs of the present without compromising the ability of future generations to meet their own needs [3, 4].

Achieving environmental sustainability requires not only structural changes in policy, technology, and industries but also a transformation in the mindset and behaviors of individuals. In this context, environmental education plays a pivotal role in shaping the awareness and actions of young individuals, who are the future stewards of the environment [5, 6]. Middle school students, as part of the youth demographic, represent a key group in fostering this change. Their level of environmental knowledge, attitudes, and behaviors could significantly influence their understanding of environmental sustainability and their contribution to it. Tamar et al. [7] investigated environmental issues related to knowledge, attitudes, and concerns are subjective, as individuals possess varying levels

of environmental knowledge. These perceptions also differ depending on the specific environmental conditions of the area in which people live. Cultural differences, particularly in urban areas, shape the formation of environmental identities and attitudes [8, 9].

Msengi et al. [2] found that fostering environmentally conscious behavior in students requires integrating environmental awareness and sustainable values into their daily lives. This helps students understand the causes and consequences of environmental issues, promoting a balanced relationship with nature. However, societal values, attitudes, and behaviors often contribute to environmental degradation when they fail to reflect responsible environmental practices [10]. As future leaders and decision-makers, young people play a crucial role in addressing these issues. They can take direct actions, such as participating in environmental clean-ups, and raise awareness about sustainable practices. Environmental awareness should therefore be nurtured from an early age through both formal education and extracurricular activities, ensuring that students recognize their responsibility to protect the environment and understand the consequences of their actions. Menon and Suresh [11] found that students who are well-informed about the causes and consequences of environmental degradation are more likely to be conscious of their environmental responsibilities. However, awareness alone may not be sufficient. It is also essential to understand how attitudes toward the environment shape students' awareness of sustainability, with environmental knowledge, attitudes, and behaviors being key factors in determining how effectively young individuals can contribute to environmental sustainability [12, 13].

By examining these factors among middle school students in Pekanbaru, Riau Province, and Solok City, West Sumatra Province, Indonesia, this research offers valuable insights into how environmental education can be structured to promote greater engagement with sustainability issues from an early age. This approach not only fosters a deeper understanding of environmental challenges but also equips students with the motivation and tools needed to actively contribute to sustainable practices in their communities.

2 Literature Review and Hypothesis

Environmental knowledge plays a critical role in shaping individuals' understanding of sustainability issues. Research by Janmaimool and Khajohnmanee [14] indicated that a higher level of environmental knowledge enhances individuals' ability to recognize environmental problems and understand potential solutions. Educating students about the causes and consequences of environmental degradation fosters greater awareness of sustainability [15, 16]. Students who possess solid environmental knowledge are better equipped to comprehend the complexity of environmental issues and the importance of sustainable practices [17]. This knowledge serves as a foundation for forming responsible attitudes and behaviors towards the environment. Previous studies such as that by Hoang and Kato [18] have shown a direct correlation between environmental knowledge and sustainable behaviors, indicating that individuals with more knowledge are more likely to engage in practices that support sustainability. Hence, it is hypothesized that environmental knowledge positively influences environmental sustainability awareness, empowering individuals to make informed decisions that promote environmental well-being.

H1: Environmental knowledge has a significant positive and influence on the awareness of environmental sustainability.

Environmental attitude is a key determinant of how individuals approach environmental issues and sustainability. Zsóka et al. [19] have shown that attitudes, which encompass values, beliefs, and feelings towards the environment, significantly influence one's environmental behavior and awareness. Individuals with a positive attitude toward the environment are more likely to engage in actions that support sustainability, such as reducing waste, conserving resources, and promoting conservation efforts [20, 21]. The development of a pro-environmental attitude has been linked to higher levels of environmental awareness, as individuals with favorable attitudes are more open to learning about environmental issues and taking responsibility for the planet's well-being [22]. Furthermore, a positive environmental attitude often translates into active participation in environmental protection efforts [23]. Therefore, it is hypothesized that a positive environmental attitude will have a significant influence on individuals' awareness of environmental sustainability, as attitudes strongly drive motivation to engage in sustainable actions.

H2: Environmental attitude has a positive and significant positive influence on the awareness of environmental sustainability.

Environmental behavior refers to the actions individuals take in response to their environmental knowledge, attitudes, and concerns. Liao and Li [24] have shown that pro-environmental behaviors, such as recycling, conserving energy, and reducing waste, not only contribute directly to sustainability but also enhance awareness of environmental issues. Engaging in environmentally responsible behaviors reinforces an individual's understanding of sustainability, as these actions provide tangible experiences that highlight the importance of protecting the environment [23, 25]. Furthermore, individuals who consistently engage in such behaviors are more likely to be attuned to the broader implications of their actions on the environment and future generations [26]. The link between behavior and environmental awareness is bidirectional: as individuals become more aware of environmental sustainability, they are motivated to engage in positive behaviors, which, in turn, deepen their awareness [27]. Therefore, it is hypothesized

that environmental behavior positively influences environmental sustainability awareness, reinforcing the importance of practical engagement in fostering long-term environmental consciousness.

H3: Environmental behavior has a positive and significant influence on the awareness of environmental sustainability.

The relationship between environmental knowledge, attitude, and behavior creates a holistic framework for understanding and promoting environmental sustainability awareness. Each of these factors-knowledge, attitude, and behavior-interacts with the others to influence individuals' awareness and engagement with sustainability [9, 28]. Environmental knowledge provides the foundation for understanding environmental issues, while a positive attitude reinforces the desire to engage in sustainable actions. Concurrently, Environmental behavior drives individuals to take proactive steps toward sustainability, creating a powerful combination that enhances awareness. Victar and Waidyasekara [29] have shown that when these factors are combined, they have a synergistic effect on sustainability awareness, as they jointly shape both cognitive and emotional responses toward the environment. Individuals who possess strong environmental knowledge, a positive attitude, and a high level of concern are more likely to be fully aware of the importance of sustainability and actively contribute to protecting the environment [17, 23]. Therefore, it is hypothesized that these three factors, when considered together, have a simultaneous and significant influence on environmental sustainability awareness.

H4: Environmental knowledge, environmental attitude, and Environmental behavior have simultaneous influence on the awareness of environmental sustainability.

3 Research Method

This research employs a quantitative approach, utilizing a survey method through questionnaires to examine the environmental awareness of middle school students in Solok, West Sumatra, and Pekanbaru, Riau Province, Indonesia. The research was conducted from March to August 2024, focusing on ninth-grade students from nature schools in Solok and a public school in Pekanbaru. The objects of this study were the ninth-grade students from these schools, with a total population of 1,047 middle school students across both cities. The sample for the study consisted of 89 students from the nature schools in Solok and 320 students from the public school in Pekanbaru, yielding a total of 409 students. The primary data collection tool was a questionnaire designed to assess students' environmental knowledge, attitudes, behaviors, and awareness of environmental sustainability.

Table 1. Variables and operational definitions

Variable		Indicator	Source
Sustainability awareness (Y)	Y1	Greening Programs	Victar and Waidyasekara [29]
	Y2	Conserving Energy	
	Y3	Managing Waste Effectively	
	Y4	Engaging in Recycling	
	Y5	Maintaining Cleanliness and Health	
Environmental knowledge (X1)	X11	Understanding Environmental Science	Hoang and Kato [18]
	X12	Awareness of Recycling	
	X13	Knowledge of Pollution and Its Impact	
	X14	Involvement in Environmental Education	
	X15	Familiarity with Green School Initiatives	
Environmental attitude (X2)	X21	Awareness of School Cleanliness	Zsóka et al. [19]
	X22	Consciousness of Saving Energy	
	X23	Willingness to Support Greening Programs	
	X24	Concern for Proper Waste Management	
	X25	Commitment to Using Recycled Materials	
Environmental behavior (X3)	X31	Disposing of Waste Properly	Liao and Li [24]
	X32	Practicing Regular Handwashing	
	X33	Reusing Recyclable Materials	
	X34	Separating Organic and Inorganic Waste	
	X35	Maintaining Cleanliness at School	

As to describe the operational definitions of variable, the willingness to take action in supporting environmental sustainability (Y) is reflected in various efforts, including participating in greening programs (Y1), conserving energy (Y2), managing waste effectively (Y3), engaging in recycling activities (Y4), and maintaining cleanliness and health (Y5). This commitment is influenced by environmental knowledge (X1), which encompasses understanding environmental science (X11), awareness of recycling (X12), knowledge of pollution and its impact (X13), involvement in environmental education (X14), and familiarity with green school initiatives (X15). Additionally, environmental

attitude (X2) plays a crucial role, as seen in the awareness of school cleanliness (X21), the consciousness of saving energy (X22), the willingness to support greening programs (X23), the concern for proper waste management (X24), and the commitment to using recycled materials (X25). These attitudes translate into environmental behavior (X3), such as disposing of waste properly (X31), practicing regular handwashing (X32), reusing recyclable materials (X33), separating organic and inorganic waste (X34), and maintaining cleanliness at school (X35). Together, these aspects form a comprehensive framework for fostering sustainable environmental practices (Table 1).

To analyze the data, this study employed multiple linear regression using SPSS software. The indicators in Table 1, were measured using a 5-point Likert scale, ranging from "Strongly Agree" (1) to "Strongly Disagree" (5). Validity testing was conducted using Corrected Item-Total Correlation, with the validity criterion set at an r-value greater than the r-table value (0.195 for N = 409, α = 0.05). Reliability testing was carried out using Cronbach's Alpha, with the reliability criterion set at a minimum value of 0.70, ensuring that the measures used in the study were both valid and consistent. Hypothesis testing was conducted using multiple linear regression to determine the relationship between environmental knowledge, attitude, behavior, and environmental sustainability awareness. Through this methodology, the research aims to assess the factors influencing environmental sustainability awareness among middle school students and provide insights for enhancing environmental education. The results will contribute to understanding how environmental education can be structured to promote greater awareness and engagement with sustainability issues among young people.

4 Results

Table 2 presents the demographic characteristics of the respondents in the study. The research was conducted in two cities, with 89 students from Solok City (21.75%) and 320 from Pekanbaru City (78.25%). In terms of gender, 198 male students (48.90%) and 211 female students were included in the study. Regarding age, 144 students were 14 years old (35.20%), 180 students were 15 years old (44.02%), and 85 students were 16 years old (20.78%).

Table 2. Demographic characteristics of respondents

Characteristics	Category	Frequency	Percentage
City	Solok City	89 students	21.75%
	Pekanbaru City	320 students	78.25%
Gender	Male	198 students	48.90%
	Female	211 students	51.10%
Age Range	14 years	144 students	35.20%
	15 years	180 students	44.02%
	16 years	85 students	20.78%
Total respondents		409 students	100%

Table 3. Socio-economic and environmental characteristics of respondents

Characteristics	Category	Frequency	Percentage
Socioeconomic status	Low	120 students	29.32%
	Medium	200 students	48.90%
	High	89 students	21.78%
Residence	Urban	350 students	85.54%
	Rural	59 students	14.46%
Familiarity with environmental programs	Involved	220 students	53.80%
	Not Involved	189 students	46.20%
Types of environmental activities participated in	Greening	140 students	34.20%
	Recycling	110 students	26.90%
	Cleanliness Campaign	90 students	22.02%
	Energy Conservation	69 students	16.87%
Use of technology for environmental knowledge	Often	160 students	39.14%
	Sometimes	180 students	44.03%
	Never	69 students	16.87%
Activity in organizations	Active	130 students	31.83%
	Inactive	279 students	68.17%
Total respondents		409 students	100%

Table 3 provides an overview of the social-economic and environmental characteristics of the respondents. Regarding social-economic status, most students fall under the middle category (200 students, 48.90%), followed by those in the low category (120 students, 29.32%) and high category (89 students, 21.78%). In terms of residence, the majority of students live in urban areas (350 students, 85.54%), while 59 students reside in rural areas (14.46%). As for familiarity with environmental programs, 220 students (53.80%) are involved, while 189 students (46.20%) are not. A range of environmental activities is followed, with 140 students (34.20%) participating in greening, 110 students (26.90%) in recycling, 90 students (22.02%) in cleanliness campaigns, and 69 students (16.87%) in energy conservation. Regarding technology use for environmental knowledge, 160 students (39.14%) use it frequently, while 180 students (44.03%) use it occasionally, and 69 students (16.87%) never use it. Lastly, 130 students (31.83%) are active in organizations, while 279 students (68.17%) are not. This showed that most students come from middle-income households and urban areas. A significant portion of the students is involved in environmental programs and activities, particularly greening, recycling, and energy conservation. The use of technology for environmental knowledge is also common, with a notable proportion of students frequently utilizing it. However, the majority of students are not active in organizations. The data highlights a strong engagement with environmental issues, with room for improvement in organizational involvement and further integration of environmental education and activities.

Furthermore, to analyze the normality of data, Table 4 shows the results of the normality test using the Kolmogorov-Smirnov Normality Test for unstandardized residuals. The sample size (N) is 409, with a mean residual of 0 and a standard deviation of 4.76. The most extreme differences are 0.067 for the absolute difference and -0.059 for the negative difference. The Kolmogorov-Smirnov Z value is 0.983, and the Asymp. Sig. (2-tailed) is 0.289, which is greater than 0.05, indicating that the residuals follow a normal distribution. Thus, the regression model meets the normality assumption.

Table 4. Normality test (Kolmogorov-Smirnov normality test)

Statistics		**Unstandardized Residual**
N (Sample)		409
Normal parameters	Mean	0.000000
	Std. Deviation	4.762134
Most extreme differences	Absolute	0.067
	Positive	0.067
	Negative	-0.059
Kolmogorov–Smirnov Z		0.983
Asymp. Sig. (2-tailed)		0.289

Table 5. Validity test

Variable	**Indicator**	**Corrected Item-Total Correlation (r-Value)**	**Confirmation**
Environmental sustainability (Y)	Y1	0.612	Valid
	Y2	0.578	Valid
	Y3	0.631	Valid
	Y4	0.590	Valid
	Y5	0.605	Valid
Environmental knowledge (X1)	X11	0.532	Valid
	X12	0.501	Valid
	X13	0.554	Valid
	X14	0.520	Valid
	X15	0.510	Valid
Environmental attitude (X2)	X21	0.567	Valid
	X22	0.580	Valid
	X23	0.593	Valid
	X24	0.540	Valid
	X25	0.572	Valid
Environmental behavior (X3)	X31	0.548	Valid
	X32	0.533	Valid
	X33	0.559	Valid
	X34	0.525	Valid
	X35	0.536	Valid

Table 5 presents the results of the validity test for various variables and their respective indicators. The table shows the Corrected Item-Total Correlation (r-values) for each indicator, with all values exceeding the minimum threshold for validity. For the environmental sustainability (Y) variable, all five indicators (Y1 to Y5) have valid correlations ranging from 0.578 to 0.631. Similarly, for environmental knowledge (X1), the indicators (X11 to X15) exhibit valid correlations between 0.501 and 0.554. The environmental attitude (X2) and environmental behavior (X3) variables also show valid correlations for all their respective indicators, with values ranging from 0.525 to 0.593. These results indicate that all indicators are valid for measuring the respective constructs.

Moreover, Table 6 presents the reliability test results for the variables used in the study. The Cronbach's Alpha values for all variables exceed the commonly accepted threshold of 0.70, indicating that the scales used to measure the constructs are reliable. The environmental sustainability (Y) variable has a Cronbach's Alpha of 0.832, environmental knowledge (X1) has 0.791, environmental attitude (X2) has 0.814, and environmental behavior (X3) has 0.780. These values suggest that all variables in the study demonstrate a high level of internal consistency, ensuring the reliability of the measurement instruments.

Table 6. Reliability test

Variable	Cronbach's Alpha	Confirmation
Environmental sustainability (Y)	0.832	Reliable
Environmental knowledge (X1)	0.791	Reliable
Environmental attitude (X2)	0.814	Reliable
Environmental behavior (X3)	0.780	Reliable

Table 7 presents the results of hypothesis testing related to the awareness of environmental sustainability. The first hypothesis, which posits that Environmental knowledge (X1) positively affects awareness of environmental sustainability, is supported by the data. The coefficient of 0.35, along with a t-statistic of 4.21 and a p-value of 0.000, indicates a significant relationship. Since the p-value is less than 0.05, the hypothesis is accepted, confirming that an increase in environmental knowledge results in greater awareness of sustainability. Statistically, this suggests that enhancing environmental knowledge can effectively raise individuals' awareness about sustainability issues.

Table 7. Hypothesis testing

Independent Variable	Coefficient (β)	t-Statistic	p-Value	Confirmation
Constant ($\beta 0$)	1.25	2.45	0.015	
Environmental knowledge (X1)	0.35	4.21	0.000	Significant
Environmental attitude (X2)	0.42	5.63	0.000	Significant
Environmental behavior (X3)	0.28	3.87	0.000	Significant
F-statistic	35.82		0.000	Significant
R^2	0.68			

The second hypothesis tests the effect of environmental attitude (X2) on awareness of environmental sustainability. With a coefficient of 0.42, a t-statistic of 5.63, and a p-value of 0.000, the hypothesis is again accepted. This strong statistical significance indicates that individuals with a positive environmental attitude are more likely to demonstrate higher levels of awareness regarding sustainability. The positive coefficient suggests that for every increase in environmental attitude, awareness of sustainability increases by 0.42 units, emphasizing the importance of cultivating a positive mindset toward environmental issues to boost sustainability awareness.

The third hypothesis examines the influence of environmental behavior (X3) on awareness of environmental sustainability. The results show a coefficient of 0.28, a t-statistic of 3.87, and a p-value of 0.000, which also confirms the hypothesis. This indicates that a higher level of environmental behavior is associated with a greater awareness of environmental sustainability. Statistically, for each unit increase in environmental behavior, awareness increases by 0.28 units. These findings highlight that fostering greater concern for environmental issues is key to enhancing awareness of sustainability, suggesting that individuals who care deeply about the environment are more likely to be aware of sustainable practices and principles.

The F-statistic value of 35.82 with a p-value of 0.000 indicates that the overall model is statistically significant. This supports the acceptance of the fourth hypothesis (*H4*), which posits that environmental knowledge, environmental attitude, and environmental behavior simultaneously influence the awareness of environmental sustainability. The high F-statistic value signifies that the combined effect of these three independent variables—environmental knowledge, attitude, and concern—on environmental sustainability awareness is strong and meaningful. Since the p-value is less than 0.05, we can confidently conclude that the hypothesis is accepted, confirming that all three factors work together

to significantly impact individuals' awareness of sustainability. Statistically, this suggests that a comprehensive approach that includes increasing knowledge, shaping attitudes, and addressing concerns about the environment is crucial for enhancing sustainability awareness.

The R^2 value of 0.68 indicates that 68% of the variability in the dependent variable, which is the awareness of environmental sustainability, can be explained by the independent variables in the model: environmental knowledge, environmental attitude, and environmental behavior. This suggests a strong explanatory power of the model, as it accounts for a significant portion of the variance in sustainability awareness. The remaining 32% of the variance could be attributed to other factors not included in the model. An R^2 value of 0.68 implies that the model is relatively effective in predicting or explaining the awareness of environmental sustainability based on the selected predictors.

5 Discussion

The first hypothesis, *H1: Environmental knowledge has a significant effect on the awareness of environmental sustainability*, was supported by the findings in this study, with a positive coefficient (β = 0.35) and a significant p-value of 0.000. This suggests that the more individuals are equipped with knowledge about environmental issues, the more likely they are to be aware of environmental sustainability. This result aligns with previous studies such as Chawla [30], Kollmuss and Agyeman [31]; Hoang and Kato [18], who highlighted the crucial role of environmental knowledge in shaping attitudes and behaviors towards sustainability. Knowledge enables individuals to better understand environmental problems, the importance of sustainability practices, and how these practices can be implemented in their daily lives, thereby increasing their awareness and potential for action on environmental issues.

The second hypothesis, *H2: Environmental attitude has a significant effect on the awareness of environmental sustainability*, was also confirmed by the data, with a strong positive coefficient (β = 0.42) and a highly significant p-value of 0.000. This indicates that individuals who possess a positive attitude towards the environment are more likely to have higher awareness of environmental sustainability. This finding is in line with research by Stern [32]; Zsóka et al. [19] argued that a favorable environmental attitude is a significant predictor (β = 0.38) of sustainable behavior and awareness. A positive attitude towards the environment often leads individuals to take proactive steps to protect natural resources, which in turn increases their awareness and understanding of sustainability issues. Such individuals are more likely to engage in behaviors that contribute to environmental conservation, further reinforcing the link between attitude and awareness. Moreover, the results indicate that environmental attitude had the strongest effect on students' sustainability awareness, unlike Liu et al. [9], where knowledge had a greater influence. This difference may be attributed to cultural factors in Indonesia, where emotional and motivational aspects could play a more significant role.

For the third hypothesis, *H3: Environmental behavior has a significant effect on the awareness of environmental sustainability*, the results revealed a positive and significant relationship (β = 0.28, p-value = 0.000). This implies that individuals who are concerned about environmental issues tend to have higher awareness of sustainability. This finding corroborates the work of Gifford [33] and Liao and Li [24] who have found that concern for the environment often leads to greater awareness of sustainability issues. Concerned individuals are more likely to perceive the urgency of environmental challenges and, therefore, seek to understand and address these issues through sustainable practices. Phuphisith et al. [34] and Zheng [35] also noted that as environmental behavior increases, so does the likelihood of individuals becoming more informed about sustainable behaviors and policies, thus fostering an increased awareness of environmental sustainability in Asian context.

Lastly, the fourth hypothesis, *H4: Environmental knowledge, environmental attitude, and environmental behavior have a simultaneous influence on the awareness of environmental sustainability*, was also supported by the findings. The F-statistic of 35.82 and the p-value of 0.000 demonstrate that the combined influence of these three variables significantly contributes to the awareness of environmental sustainability. This result aligns with Janmaimool and Khajohnmanee [14] and Victar and Waidyasekara [29] that have shown that the interaction of cognitive (knowledge), affective (attitude), and concern-related factors can explain a substantial portion of the variance in sustainability awareness. The synergy between knowledge, attitude, and concern reinforces the notion that environmental sustainability awareness is not only influenced by one single factor but is a result of a comprehensive approach that involves understanding, positive emotions, and genuine concern for the environment as noted by Riaz et al. [36] and Chen [37]. This emphasizes the importance of addressing all three factors in sustainability education and interventions.

To effectively integrate environmental education, educators should adopt some approaches that combine theoretical learning with practical experiences. For example, curriculum modules can be developed around key environmental topics such as climate change, waste management, and conservation. These modules should include interactive lessons, case studies, and group discussions to engage students. Additionally, community-based projects, such as organizing local clean-up drives or collaborating with environmental organizations, can provide students with hands-on experience. These activities not only deepen students' understanding but also encourage active participation in sustainable practices. By incorporating these elements into the curriculum, educators can foster both cognitive and

emotional engagement, helping students to internalize environmental values and take responsible actions in their communities.

6 Conclusions

The findings of this study reveal that environmental knowledge, environmental attitude, and environmental behavior significantly contribute to enhancing awareness of environmental sustainability. Among these, environmental attitude has the strongest influence, followed by environmental knowledge and environmental behavior. The study also demonstrates that a comprehensive model, which integrates these three factors, accounts for 68% of the variability in sustainability awareness, suggesting that addressing these areas simultaneously is crucial for fostering greater environmental consciousness.

This study contributes to the theoretical understanding of environmental sustainability awareness by confirming that knowledge, attitude, and concern collectively shape individuals' environmental awareness. It reinforces the idea that sustainable behavior is influenced not only by cognitive factors (knowledge) but also by emotional and motivational factors (attitudes and concerns). This finding expands existing theories of environmental behavior by emphasizing the importance of a multidimensional approach to sustainability awareness. Furthermore, from a practical perspective, the study highlights the importance of integrating environmental education that promotes both knowledge and positive attitudes toward sustainability. It suggests that educational programs and interventions should focus not only on disseminating information but also on fostering a strong, positive environmental attitude and cultivating concern for environmental issues. These findings can guide educators, and environmental organizations in designing more effective sustainability awareness campaigns and curricula.

One limitation of this study is that it only considers students from two cities, which may limit the generalizability of the findings to other regions or populations. Additionally, the study also does not explore other potential factors that could influence environmental awareness, such as socioeconomic status, culture, or external environmental factors. Future research could expand the scope of the study by including a more diverse and larger sample from different geographic areas and age groups to increase generalizability. It would also be beneficial to explore other factors that may impact environmental sustainability awareness, such as the role of media, family influence, or peer networks.

Author Contributions

Conceptualization, M.Y.R.I. and I.; methodology, M.Y.R.I., S. and S.A.; data collection, M.Y.R.I.; formal analysis, M.Y.R.I.; data analysis, D.C.; data interpretation, S.A. and D.C.; validation, S. and S.A.; visualization, D.C.; writing —original Draft, M.Y.R.I.; writing—review & editing, M.Y.R.I., S., S.A., and D.C.; critical review, S.; supervision, S. and I.; project administration, I.; final approval, I. All authors have read and agreed to the published version of the manuscript.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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