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Research Artikel

DETERMINANTS OF ENVIRONMENTAL BEHAVIOUR AMONG SENIOR HIGH SCHOOL STUDENTS IN BOGOR CITY: A MULTIDIMENSIONAL ANALYSIS OF ENVIRONMENTAL LITERACY COMPONENTS

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Abstract

Environmental degradation requires not only technological solutions, but also environmentally responsible behavior shaped through education. This study examines the influence of environmental literacy components—knowledge, skills, and character—on environmental behavior among senior high school students in Bogor City. The researchers used a quantitative correlational design with 167 eleventh-grade students selected through purposive sampling. Data was collected using 9 multiple-choice items for environmental knowledge, 8 items for environmental skills, and Likert-scale questionnaires consisting of 8 items for environmental character and 12 items for environmental behavior. Data was analyzed using descriptive statistics, Pearson correlation, and multiple linear regression. The results show that students' environmental literacy is moderate across all domains. Correlation analysis indicates weak relationships between cognitive components and environmental behavior, while behavior shows the strongest correlation with overall environmental literacy (r = 0,745). However, regression analysis reveals that knowledge, skills, and character do not significantly predict environmental behavior, either individually or simultaneously (R^2 = 0,029, p > 0,05). These findings indicate a gap between cognitive understanding and actual environmental action. The study concludes that cognitive and affective components do not solely determine environmental behavior, and that more complex mechanisms involving contextual, motivational, and experiential factors influence it. Therefore, environmental education should integrate cognitive learning with affective development and experiential learning to bridge the gap between understanding and behavior and to promote sustainable environmental action among students.

Keywords: *Environmental behavior; environmental education; environmental literacy; instruments, students.*

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INTRODUCTION

Environmental degradation, including pollution, climate change, and ecosystem disruption, continues to escalate globally and poses significant threats to sustainability (Mulu & Kivuva, 2025). Addressing these challenges requires not only technological solutions but also the development of environmentally responsible citizens through education (Andriansyah et al., 2025). In this context, environmental education serves as a key driver in shaping students' awareness, knowledge, and behaviour toward environmental sustainability ((Hajj-Hassan et al., 2024).

Many experts widely recognize environmental literacy as a key competency for fostering responsible environmental behaviour. Researchers generally conceptualize it as a multidimensional construct encompassing cognitive, affective, and behavioural domains, including knowledge, skills, attitudes or character, and actual environmental actions. (Fajeriadi et al., 2024; Ritonga et al., 2025). Furthermore, Chao (2024) and Xiong et al. (2025) argue that environmental literacy represents not merely knowledge acquisition, but an integrated system that enables people to translate understanding into real-world sustainable practices. Chao (2024) demonstrates that environmental literacy development differs across educational tracks, while Xiong et al. (2025) stress the importance of pedagogical strategies that connect knowledge with behavioural engagement to strengthen sustainability outcomes.

However, despite increasing attention to environmental literacy in educational contexts, a persistent gap remains between students' cognitive understanding and their actual environmental behaviour. Several studies report that students may demonstrate high levels of environmental knowledge but fail to apply it in daily life consistently. For example, Cahyani et al. (2025),, in a study of senior high school students, found that although students achieved relatively high scores in environmental knowledge, this did not translate into consistent pro-environmental attitudes and behaviours. Similarly, Nurfadillah et al. (2024) reported that students with good conceptual understanding of environmental issues still showed limited engagement in environmentally responsible practices in everyday contexts. This inconsistency suggests that cognitive achievement alone is insufficient to predict environmental behaviour, indicating the importance of affective and behavioural determinants.

Multiple behavioural frameworks explain the formation of environmental behaviour. Recent developments in the Value–Belief–Norm (VBN) theory emphasize that pro-environmental behaviour is primarily driven by personal norms, environmental values, and moral obligations rather than by knowledge alone (Han, 2021; Wang et al., 2023). In addition, contemporary studies highlight that cognitive understanding must be mediated by environmental attitudes, affective engagement, and normative beliefs before it is translated into actual behaviour (Burgos-Espinoza et al., 2025; Miller et al., 2022).

These perspectives suggest that environmental character, attitudes, and internalized values play a central role in shaping sustainable behaviour. Recent studies indicate that affective dimensions, such as environmental attitudes and personal values, are often stronger predictors of pro-environmental behaviour than cognitive knowledge alone. For example, Miller et al. (2022) found that environmental attitudes consistently showed stronger predictive power for pro-environmental behaviour across multiple countries than efficacy and cognitive factors. Likewise, Liu and Li (2021) demonstrated that personal responsibility and normative factors significantly mediate environmental concern into behavioural action. These findings reinforce the argument that environmental behaviour is shaped not only by knowledge acquisition but also by internalized values, attitudes, and social-contextual influences.

Empirical studies support this multidimensional perspective. Ardoin et al. (2020), in a systematic review of environmental education outcomes, found that many intervention programs successfully improve students' environmental knowledge and skills but produce limited effects on actual behavioural change when educators do not adequately integrate affective engagement and real-life application. Similarly, M Monroe et al.

(2019) reported that climate change education programs often emphasize cognitive understanding but struggle to translate this knowledge into sustained pro-environmental behaviour among learners. Furthermore, research indicates that experiential and participatory learning approaches are more effective at fostering environmental behaviour than traditional cognitive-based instruction. Studies have shown that learning activities involving hands-on environmental experiences, community-based projects, and reflective practices are more likely to strengthen students' behavioural commitment toward sustainability.

In the Indonesian context, researchers have studied environmental literacy among senior high school students across various regions, including Adiwiyata schools that aim to integrate environmental awareness into school culture. However, findings indicate that while such programs improve students' environmental knowledge, behavioural outcomes remain inconsistent, highlighting a gap between learning outcomes and real-life environmental practices (Maghfiroh & Kartijono, 2024; Susilowati et al., 2018).

Despite these contributions, most existing studies examine environmental literacy in a fragmented manner, focusing on knowledge, attitudes, or behaviour separately. Few studies have comprehensively analyzed the interrelationships among multiple environmental literacy components and their combined influence on environmental behaviour, particularly at the senior high school level.

Therefore, this study aims to address this gap by examining the determinants of environmental behaviour among senior high school students in Bogor City through a multidimensional analysis of environmental literacy components, including knowledge, skills, and character. Specifically, this study investigates how these components interact in explaining environmental behaviour and identifies the most influential determinant among them.

The findings of this study contribute to the ongoing development of environmental literacy research by providing empirical evidence that cognitive components, such as knowledge and skills, do not automatically translate into pro-environmental behaviour. This study addresses the ongoing need to understand better the gap between environmental understanding and behavioural implementation among students. The results also strengthen the theoretical perspective that environmental literacy is a multidimensional construct involving cognitive, affective, and behavioural dimensions. In practice, the findings have implications for designing environmental education strategies that integrate experiential, value-based, and behavioural approaches to more effectively promote sustainable behaviour among students.

METHODS

This study employed a quantitative descriptive-correlational design to examine the relationships among environmental literacy components and environmental behaviour among senior high school students. Researchers conducted the study in five public senior high schools in Bogor City, Indonesia: SMA Negeri 2, SMA Negeri 4, SMA Negeri 7, SMA Negeri 9, and SMA Negeri 10. All eleventh-grade students at these schools made up the population, and the researchers selected 167 students through purposive sampling. The study used purposive sampling to ensure that all participants had previously been exposed to environmental education content within biology learning, thereby ensuring homogeneity of learning experience relevant to environmental literacy measurement.

The study investigated three independent variables, namely environmental knowledge, environmental skills, and environmental character, as well as one dependent variable, environmental behaviour. Environmental literacy was not treated as a single composite dependent variable to avoid construct overlap and ensure clearer analytical separation among cognitive, affective, and behavioural components.

Data were collected using a combination of test and questionnaire instruments. Researchers measured environmental knowledge with 9 multiple-choice items and assessed environmental

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skills with 8 items. Researchers measured environmental character and environmental behaviour using Likert-scale questionnaires consisting of 8 and 12 statements, respectively, with a five-point response scale ranging from strongly disagree (1) to strongly agree (5).

All instruments were first evaluated for content validity through expert judgment to ensure clarity, relevance, and alignment with the constructs of environmental literacy. In addition to expert validation, the cognitive instruments (knowledge and skills) were empirically tested for reliability using ANATES V4, which indicated acceptable reliability coefficients (≥ 0,70).

Although the researchers did not subject the Likert-scale instruments to large-scale pilot testing, they evaluated them through expert judgment and readability assessment to ensure clarity, relevance, and appropriateness for the target respondents (Boateng et al., 2018). Educational researchers commonly adopt this approach when adapting instruments for contextual studies.

Thus, the instruments used in this study were considered valid for measuring environmental literacy components, with cognitive instruments supported by empirical reliability testing and affective-behavioural instruments supported by expert validation.

The overall environmental literacy score was obtained by summing all item scores across domains. The knowledge and skills domains consisted of multiple-choice items scored dichotomously. In contrast, the character and behaviour domains used a 5-point Likert scale (ranging from 1 to 5); the minimum possible score was not zero. Consequently, the theoretical score range of environmental literacy in this study was 29 to 117.

The researchers classified students' environmental literacy levels using a statistical approach based on the mean and standard deviation (M ± SD). In this procedure, the researchers categorised scores greater than or equal to the mean plus one standard deviation ($X \geq M + SD$) as high, classified scores within the range of $M - SD$ to less than $M + SD$ ($M - SD \leq X < M + SD$) as moderate, and classified scores lower than the mean minus one standard deviation ($X < M - SD$) as low. This data-driven categorisation approach enables an objective interpretation of the score distribution by accounting for the variability in students' responses (Mellyzar et al., 2024). This categorisation was applied to the knowledge, skills, character, behaviour, and overall environmental literacy domains, as presented in Table 1.

Table 1. Criterion for Grouping Environmental Literacy

Domains	High	Moderate	Low
Knowledge	≥8,98	6,06 – 8,97	<6,06
Skill	≥7,94	4,52 – 7.93	<4,52
Character	≥20,06	14,44 – 20,05	<14,44
Behaviour	≥38,16	29,38 – 38,15	<29,38
Total Environmental Literacy	≥70,83	58,71 – 70,82	<58,71

Note: Cut-off points were calculated based on mean ± standard deviation of empirical data.

Data analysis used descriptive statistics, including means, standard deviations, and percentages, to describe the distribution of each variable. In addition, researchers conducted a Pearson correlation analysis to identify relationships among environmental knowledge, skills, character, and behaviour. They also performed a multiple linear regression analysis to assess the predictive power of the independent variables on environmental behaviour. The researchers specified the regression model as follows (Gurung, 2024):

$$B = \beta 0 + \beta 1K + \beta 2S + \beta 3C + e$$

where B represents environmental behaviour, K represents environmental knowledge, S represents environmental skills, and C represents environmental character.

Before conducting the regression analysis, the researchers performed classical assumption tests to ensure the validity of the model and the reliability of the regression results. The normality test showed that the data followed a normal distribution ($p > 0,05$), indicating that the data met the normality assumption. The multicollinearity test revealed that tolerance values ranged from 0.614 to 0.984 and Variance Inflation Factor (VIF) values ranged from 1,015 to 1,628, indicating no multicollinearity among the independent variables.

The researchers tested the linearity assumption using an ANOVA-based linearity test, and the results indicated a linear relationship between the independent variables and environmental behaviour (deviation from linearity $p > 0,05$). In addition, the homoscedasticity test indicated that the residuals were evenly distributed and lacked a clear pattern, confirming that the homoscedasticity assumption was satisfied.

These results indicate that the data met all classical assumptions of multiple linear regression, ensuring that the researchers used an appropriate regression model and obtained statistically valid results.

RESULTS AND DISCUSSION

Table 2 shows that students' environmental literacy across all domains—Knowledge (M = 7,52), Skills (M = 6,23), Character (M = 17,25), and Behaviour (M = 33,77)—falls within the moderate category. The overall environmental literacy score (M = 64,77, SD = 6,06) is also classified as moderate. These results indicate that students have a balanced but not yet optimal level of environmental literacy across cognitive, affective, and behavioural domains, suggesting the need for further improvement, particularly in strengthening pro-environmental behaviour.

Table 2. Descriptive Statistics of Studaents' Environmental Literacy Scores

Domain	N	Observed Max Score	Mean (M)	SD	Category
Knowledge	167	9	7.52	1.46	Moderate
Skills	167	8	6.23	1.71	Moderate
Character	167	24	17.25	2.81	Moderate
Behaviour	167	51	33.77	4.39	Moderate
Total Environmental Literacy	167	84	64.77	6.06	Moderate

Figure 1 shows the distribution of students' environmental literacy levels across four domains. Overall, most students are in the moderate category in all domains, particularly in Behaviour (73,05%) and Character (69,46%), indicating that students' environmental attitudes and actions are generally at an intermediate level. In the cognitive domain, Knowledge (49,70%) and Skills (50,30%) also show that nearly half of the students are in the moderate category, with a smaller proportion in the high category. The highest proportion of high achievement is found in Skills (33,53%), while knowledge shows a relatively lower high category (28.14%).

Meanwhile, the low category remains relatively similar across domains, especially in Character and Behaviour (16,17%), suggesting that a minority of students still demonstrate low environmental awareness and practices. Overall, these findings indicate that students' environmental literacy is predominantly at a moderate level, with limited proportions achieving high-level performance across all domains.

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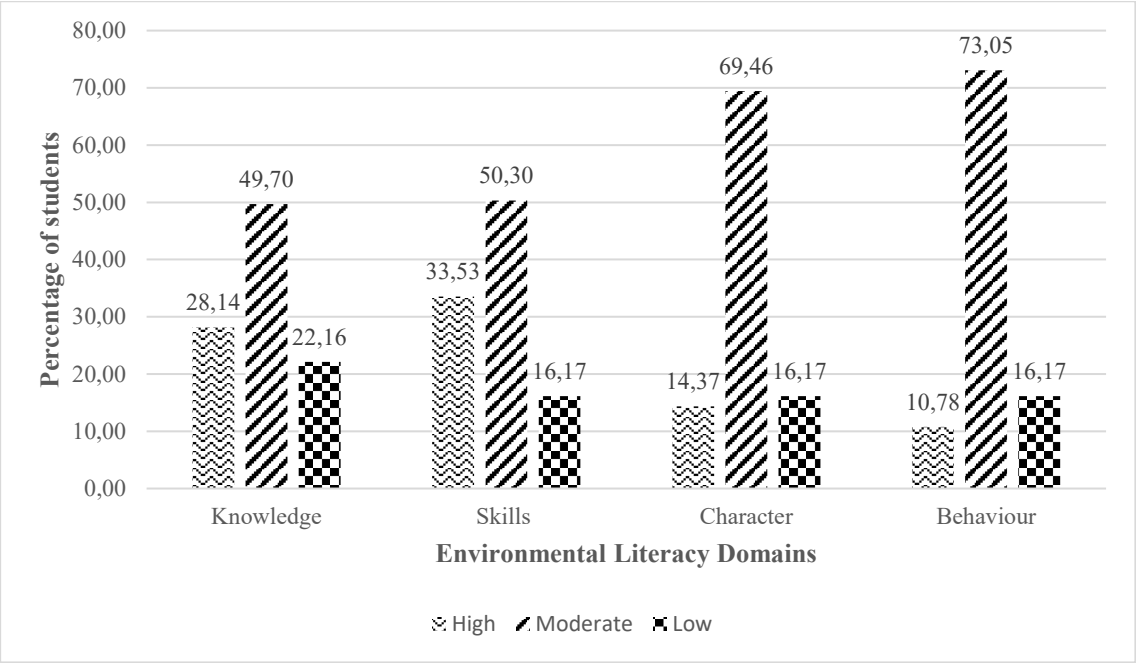

Figure 1. Distribution of Environmental Literacy Categories in Each Domain

Table 3 shows the correlation among environmental literacy domains (Knowledge, Skills, Character, Behaviour) and overall Environmental Literacy (EL).

Table 3. Correlation between environmental literacy domains

Variabel	K	S	C	B
K	—			
S	0,614**	—		
C	0,073	-0,031	—	
B	0,017	-0,104	0,099	—
EL	0,461**	0,341**	0,545**	0,745**

Note: *(p<0.05); **(p<0.01); K=Knowledge; S=Skills; C=Character; B=Behaviour; EL=Environmental Literacy

The results of correlation between environmental literacy domains indicate that knowledge and skills are significantly and positively correlated (r = 0,614, p < 0,01), while no significant relationships are found between cognitive domains (Knowledge and Skills) and affective-behavioural domains (Character and Behaviour).

Similarly, character and behaviour are weakly correlated and not significant (r = 0,099). However, all domains show significant positive correlations with overall EL. Behaviour has the strongest relationship with EL (r = 0,745), followed by Character (r = 0,545), Knowledge (r = 0,461), and Skills (r = 0,341). Overall, these findings suggest that environmental literacy is more strongly influenced by behavioural and affective aspects than cognitive aspects, indicating a gap between knowledge and actual environmental behaviour.

Table 4. Multiple Regression Results (Dependent Variable: Environmental Behavior)

Predictor	β (Standardized)	t-value	Sig.	VIF
Knowledge	0,067	1,198	0,232	1,628
Skills	-0,074	-1,772	0,078	1,621
Character	0,088	1,093	0,276	1,015

Table 4 presents the results of multiple regression analysis examining the influence of Knowledge, Skills, and Character on Environmental Behaviour. The results show that none of the predictors significantly affect environmental behaviour at the 0,05 level.

Knowledge has a small positive effect (β = 0,067, p = 0,232), but it is not statistically significant. Skills shows a negative but also non-significant relationship with behaviour (β = -0,074, p = 0,078), indicating a weak inverse tendency. Character similarly has a positive but non-significant effect (β = 0,088, p = 0,276).

The VIF values (1,015–1,628) indicate no multicollinearity problems among the predictors. Overall, the model suggests that knowledge, skills, and character do not significantly predict environmental behaviour in this study.

Table 5. Model Summary

Statistic	Value
R	0,169
R^2	0.,29
Adjusted R^2	0,011
F-statistic	1,600
Sig.	0,191

Table 5 shows the model summary of the multiple regression analysis with Environmental Behaviour as the dependent variable. The results indicate a very weak relationship between the predictors (Knowledge, Skills, and Character) and Environmental Behaviour, as shown by the correlation coefficient (R = 0,169).

The coefficient of determination (R^2 = 0,029) means that only 2,9% of the variance in environmental behaviour can be explained by the three predictors, while the remaining 97,1% is influenced by other factors not included in the model. The adjusted R^2 (0,011) further confirms that the explanatory power of the model is very low after adjustment for sample size and number of predictors.

The F-test result (F = 1,600, p = 0,191) shows that the overall regression model is not statistically significant. This indicates that Knowledge, Skills, and Character, when considered together, do not significantly predict Environmental Behaviour in this study.

The researchers conducted all assumption tests using SPSS, and the results showed that the data met the required criteria (p > 0,05 for normality; VIF < 10).

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Discussion

This finding is consistent with previous research showing that environmental knowledge does not directly lead to behavioural change (Cahyani et al., 2025; Nurfadillah et al., 2024). The correlation results also support this pattern, as knowledge shows no significant relationship with environmental behaviour (r = 0,017), indicating that cognitive understanding alone is insufficient to drive behavioural action.

Influence of Knowledge on Behaviour

The results show that environmental knowledge does not significantly influence environmental behaviour. This finding indicates that knowledge alone is insufficient to shape environmentally responsible actions. This finding is consistent with Hanafi et al. (2023), who reported that environmental literacy does not always correspond directly to students' environmental behaviour, suggesting a persistent gap between cognitive understanding and behavioural implementation.

Influence of Skills on Behaviour

Environmental skills also do not have a significant effect on environmental behaviour. This finding suggests that environmental skills alone cannot produce behavioural change without support from motivation and the surrounding social context. Aquan et al. (2025) emphasized that a combination of internal and external factors, including social environment and personal motivation, influences environmental behaviour.

Influence of Character on Behaviour

Character does not significantly influence environmental behaviour in this study. This finding indicates that environmental character alone is not sufficient to ensure consistent behavioural action without reinforcement from the social environment and habitual practices. Smith and Kingston (2021) explain that pro-environmental behaviour is shaped by complex interactions between personal values, social norms, and contextual factors, highlighting that behavioural formation depends on both internal dispositions and external reinforcement.

Simultaneous Influence of Predictors

The regression results indicate that knowledge, skills, and character simultaneously do not significantly predict environmental behaviour. This finding suggests a clear gap between the cognitive (knowledge and skills), affective (character), and behavioural dimensions of environmental literacy. Kollmuss and Agyeman (2002) similarly highlighted a persistent attitude–behaviour gap in environmental contexts, where knowledge and awareness do not automatically translate into action.

The multiple regression analysis confirms that knowledge, skills, and character do not significantly predict environmental behaviour. Although the character shows a positive tendency, its effect is not statistically significant, indicating that internalized values alone are insufficient to explain behavioural outcomes in this sample directly.

Environmental behaviour reflects more complex mechanisms that extend beyond individual cognitive and affective factors. These findings also align with the Value-Belief-Norm (VBN) theory, which emphasises that personal norms activated by values, beliefs, and contextual conditions—rather than knowledge alone—drive pro-environmental behaviour.

Firmansyah et al. (2023) similarly reported that internal motivation and environmental awareness influence behavioural intention, while Husamah et al. (2025) emphasized the importance of action competence in the development of environmental literacy.

Although regression analysis shows that knowledge, skills, and character are not significant predictors, correlation results show that environmental behaviour has the strongest relationship with overall environmental literacy (r = 0,745), followed by environmental character (r = 0,545). These results indicate that behavioural and affective dimensions are more closely associated with environmental literacy compared to cognitive components.

One possible explanation is that environmental education in schools still emphasises conceptual understanding rather than experiential learning and values internalisation. As

a result, students may understand environmental issues theoretically but fail to translate this understanding into daily behaviour.

Marlina et al. (2024) support this interpretation by finding that cognitive-oriented learning improves knowledge but has a limited impact on behaviour, and Rubini et al. (2023) emphasize the effectiveness of experiential and interactive learning in promoting environmental action.

Overall, these findings highlight the need to strengthen affective and experiential dimensions in environmental education. Integrating value-based learning, real-world environmental engagement, and reflective practices is essential to bridge the gap between knowledge and behaviour and to foster sustainable environmental action among students.

This study contributes to the environmental literacy literature by empirically confirming that knowledge, skills, or character alone do not determine environmental behaviour, and that a complex interplay of cognitive, affective, and contextual factors influences it.

Novelty of the Study

This study contributes to the existing literature by providing empirical evidence that environmental literacy is a multidimensional construct in which behavioural and affective components show stronger associations with overall environmental literacy than cognitive components. Unlike previous studies that tend to emphasise the direct relationship between knowledge and behaviour, this study demonstrates that knowledge and skills do not significantly predict environmental behaviour. At the same time, character also shows a non-significant direct effect. This finding highlights the limited explanatory power of cognitive components in predicting actual environmental behaviour in the studied context.

Implications

The findings have important implications for environmental education practice. First, the results suggest that improving students' environmental behaviour cannot rely solely on cognitive-oriented instruction. Second, educators should redesign environmental education to strengthen affective dimensions such as environmental values, responsibility, and character formation. Third, experiential and context-based learning approaches are needed to bridge the gap between knowledge and behavioural application. These implications highlight the importance of integrating the cognitive, affective, and behavioural domains in developing environmental literacy.

Limitations of the Study

This study has several limitations. First, the use of a cross-sectional design limits the ability to infer causal relationships between variables. Second, the researchers conducted the study in a limited geographic area, which may affect the generalisability of the findings to other educational contexts. Third, although experts validated the instruments and the researchers tested the reliability of the cognitive components, the researchers did not subject the affective-behavioural instruments to large-scale pilot testing. Future studies may address these limitations by employing longitudinal designs and broader sampling techniques.

Future Research Directions

Future studies should explore more complex models of environmental behaviour using advanced statistical approaches, such as Structural Equation Modelling (SEM), to examine indirect and mediating effects among variables. In addition, future studies should incorporate contextual and psychosocial variables, such as social norms, environmental attitudes, and school climate, to better explain environmental behaviour. Expanding research across different regions and educational levels is also necessary to enhance the generalisability of findings.

CONCLUSION

This study concludes that students' environmental literacy is moderate across the knowledge, skills, character, and behaviour domains. However, environmental behaviour is not significantly influenced by knowledge, skills, or character, either individually or simultaneously. The findings indicate a persistent gap between cognitive understanding and behavioural

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implementation, suggesting that environmental literacy does not automatically translate into environmental action. Among the three predictors, none show a statistically significant direct effect on environmental behaviour, although behavioural and affective dimensions demonstrate stronger associations with overall environmental literacy.

These results imply that more complex mechanisms beyond cognitive and affective components influence environmental behaviour, and that contextual, motivational, and experiential factors likely contribute to it. Therefore, strengthening environmental education requires a shift from knowledge-centred instruction toward a more holistic approach that integrates cognitive understanding, affective development, and experiential learning. Such integration is essential to bridge the gap between environmental knowledge and actual behavioural practice.

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