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The Role of Continuing Education in Environmental Education Management

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Abstract

Global environmental issues such as climate change, ecosystem degradation, and increased waste demand sustainable education strategies to foster pro-environmental awareness and attitudes continuously. Continuing education is an important approach to strengthening environmental education management, as it can shape broader public understanding, skills, and participation. This study aims to analyse the influence of continuing education on environmental education management in educational institutions that have implemented sustainability-based programmes. This study uses a quantitative approach with an explanatory design. The research population comprises educators, educational staff, and participants in environmental education programmes. The Lemeshow technique determined the sample, resulting in 68 respondents selected through purposive sampling based on their active involvement in sustainable education programmes. The research instrument was a questionnaire with a five-point Likert scale, while data analysis was performed using the Partial Least Squares–Structural Equation Modelling (PLS-SEM) method using SmartPLS 4.0. The results showed that continuing education positively affected the effectiveness of environmental education management. Sustainable education has been proven to strengthen the capacity of individuals and institutions to manage environmental education in a consistent, focused, and sustainable manner. These findings confirm that the success of environmental education management depends not only on policies or curricula but also on the quality of the implementation of continuing education carried out systematically. The implications of this research provide a theoretical and practical basis for developing continuing education strategies in supporting environmental education management in various contexts.

Keywords: sustainable education, environmental education management.

1 Introduction

The complexity of global environmental issues such as climate change, ecosystem damage, and increased waste volume makes ecological issues one of the biggest challenges of the 21st century. Environmental education is a key strategy in building awareness, attitudes, and environmentally friendly behaviour among various levels of society. The challenge is how to ensure that the education process can occur consistently, adaptively, and relevantly with social and technological developments. Thus, the urgency of this research lies in the effort to find patterns of environmental education management that are theoretical, applicable, sustainable, and capable of having a real impact on natural resource management.

The focus on continuing education in environmental education management is based on its characteristics, which differ from formal education. Continuing education emphasises flexible,

participatory, lifelong learning that reaches broad groups of people outside formal educational institutions (Sterling, 2010). Continuing education has greater potential to encourage active community involvement than school-based curriculum models, making it more suitable for addressing complex, multidisciplinary, and intergenerational environmental issues.

This study has two main variables: continuing education (independent) and environmental education management (dependent). The relationship between the two lies in the contribution of continuing education to improving the understanding, skills, and attitudes of individuals and institutions in managing environmental education. The more effective the implementation of continuing education, the stronger the performance of environmental education management in integrating sustainability principles into programmes, policies, and practical environmental education (Chen et al., 2019). Therefore, the relationship between these variables needs to be tested empirically to determine the extent of the influence of sustainable education on the effectiveness of environmental education management.

Several previous studies have confirmed the important role of continuing education in environmental issues (Nurwidodo et al., 2020; Suryandari, 2022). However, the results obtained are not entirely consistent. Some studies have found a significant impact on increasing environmental awareness and management practices (Park & Lee, 2023), while other studies have revealed limitations in implementation due to weak policy support, limited resources, and suboptimal implementation (Jickling & Sterling, 2017; Huckle, 2021). These differing results indicate a research gap that needs to be bridged, particularly through a quantitative approach that can test the influence of continuing education on environmental education management.

Based on this gap, this study offers novelty through empirical analysis using SmartPLS to comprehensively test the relationship between continuing education and environmental education management. The new contribution of this study lies in integrating the concept of lifelong learning with environmental education management practices within the sustainable development framework. The research findings are expected to provide conceptual and practical guidance for policymakers, educational institutions, and the community in designing adaptive, inclusive, and impactful sustainable education programmes. Thus, the main objective of this study is to analyse and prove the role of continuing education in improving the effectiveness of environmental education management.

2 Literature Review

Continuing Education

Continuing education is a lifelong learning process that provides opportunities for individuals to continuously develop their knowledge, skills, and competencies in response to social, economic, and technological dynamics. Unlike formal education, which is linear and limited to certain levels, continuing education emphasises flexibility, active participation, and adaptability according to the needs of individuals and communities (Brockett & Hiemstra, 2019).

From a sustainable development perspective, continuing education fosters critical awareness and proactive community behavior towards various environmental issues. This is because continuing education serves as a means of knowledge transfer and an effort to encourage changes in attitudes and behaviour that align with sustainability principles (Longworth, 2021). Research by Ramos et al. (2021) shows that community-based continuing education programmes can strengthen individuals' capacity to make decisions related to environmental issues, ranging from waste management to resource conservation.

Furthermore, continuing education is a strategic instrument for building environmental literacy in the community. Activities such as short courses, training, and community-based programmes have proven

effective in increasing practical understanding and skills in addressing everyday environmental issues (Beiswenger & Stoltenberg, 2020). Therefore, continuing education is a key factor that directly contributes to the effectiveness of environmental education management.

Environmental Education Management

Environmental education management is defined as planning, organising, implementing, and evaluating educational programmes aimed at increasing the community's and students' awareness, knowledge, and skills in preserving the environment. Tilbury (2020) emphasises that successful environmental education management must integrate sustainability values into policies, curricula, learning strategies, and practical fieldwork.

Strengthening environmental education management is related to formal curricula and participatory strategies that involve the wider community. Manni et al.'s findings (2022) reveal that the success of environmental education management is greatly influenced by multi-stakeholder collaboration, including the government, educational institutions, civil society organisations, and the private sector.

This shows that environmental education management requires an inclusive collaborative approach. Furthermore, research by Barth & Rieckmann (2022) confirms that the quality of environmental education management significantly impacts pro-environmental behaviour among the younger generation. Well-managed programmes can increase student involvement in various environmental activities, ranging from conservation and waste management to climate change mitigation efforts. Thus, environmental education management can be positioned as a dependent variable whose success is determined by various external factors, one of which is sustainable education.

Hypothesis Development

The Relationship between Continuing Education and Environmental Education Management

Continuing education is a lifelong learning approach designed to improve individuals' knowledge, skills, and attitudes in facing social and environmental changes. The Lifelong Learning theory emphasises that learning does not stop at formal education but must continue throughout life so that individuals can adapt to new challenges, including environmental issues (Jarvis, 2019).

In the context of the environment, continuing education strengthens individuals' and communities' capacity to understand sustainability issues, internalise pro-environmental values, and apply them in their daily lives. Empirical studies support this. For example, research by Ramos et al. (2021) shows that community-based continuing education programmes significantly increase community participation in environmental management. Similarly, Barth and Rieckmann (2022) assert that individual involvement in continuing education encourages the formation of more effective, adaptive, and collaborative environmental education management.
Based on this theoretical foundation and empirical findings, the first hypothesis of this study can be formulated as follows:

H1: Continuing Education has a positive effect on Environmental Education Management.

The Relationship between Continuing Education and the Effectiveness of Environmental Education Management Implementation

The effectiveness of environmental education management implementation depends not only on the existence of policies or curricula, but also on the quality of the human resources involved. Continuing education is an important means of improving the capacity of educators, managers, and the community to implement environmental education programmes more consistently. Capacity Building theory

explains that strengthening competencies through continuing education can strengthen the effectiveness of organisations in achieving their goals (Eade, 1997).
Recent research by Manni et al. (2022) emphasises the importance of a participatory approach in continuing education, which has been proven to influence the successful implementation of environmental education programmes. In addition, Tilbury (2020) also shows that integrating continuing education into educational institution policies can result in more effective, measurable, and sustainable environmental management practices. Thus, continuing education not only influences the existence of environmental education management but also the level of its implementation effectiveness.
Based on the theoretical basis and previous research results, the second hypothesis can be formulated as follows:

H2: Continuing education positively affects the effectiveness of environmental education management implementation.

3 Research Method

This study applies a quantitative approach with an explanatory design, as its main focus is to empirically explain the influence of Continuing Education on Environmental Education Management. The selection of a quantitative explanatory design is based on its ability to test the relationship between variables measurably through statistical analysis, so that the research results have a higher level of objectivity, validity, and potential for generalisation (Creswell & Creswell, 2018).

The research population included educators, educational staff, and participants in environmental education programmes at various institutions implementing sustainable learning. The sample size was determined using the Lemeshow formula, which is commonly applied in social research to determine the minimum sample size from a large population with a certain margin of error (Lemeshow et al., 1990). Based on the calculation, a sample of 68 respondents was obtained. The sample was selected using purposive sampling with specific criteria: respondents who were actively involved in continuing education programmes and had experience in environmental education management. This technique was chosen to make the respondents' responses relevant to the research objectives (Etikan, Musa, & Alkassim, 2016).

The research instrument was a questionnaire with a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), which was used to measure respondents' perceptions of the constructs of Continuing Education and Environmental Education Management. The indicators used to construct the instrument were adapted from theoretical studies and previous research, then tested through a pilot test to assess content validity, clarity of questions, and internal reliability of the instrument (Hair et al., 2019). Data collection was carried out using a combination of online and offline methods, adjusting to field conditions and respondent accessibility.

Data analysis used the Partial Least Squares–Structural Equation Modelling (PLS-SEM) technique with the help of SmartPLS 4.0 software. The analysis was conducted in two stages: first, evaluation of the outer model to test convergent validity, discriminant validity, and composite reliability to ensure that the indicators could represent the constructs consistently. Second, evaluation of the inner model aimed to assess the relationship between latent variables through R-Square values, path coefficients, t-statistics, p-values, and effect size measures (f^2). This stage allowed for simultaneous hypothesis testing and provided an overview of the strength of the influence between variables in the research model (Hair, Ringle, & Sarstedt, 2021).

With this approach, the study is expected to provide a comprehensive understanding of the contribution of continuing education in improving the effectiveness of environmental education management. PLS-SEM is considered appropriate because it can handle models with reflective indicators and a moderate

sample size and can produce stronger estimates of the complex relationships between variables in social science studies (Sarstedt et al., 2020).

4 Results and Discussion

Research Results

Respondent Characteristics

Respondent characteristics are presented to provide an overview of the research participants' profiles. This information is important because it can show the diversity of respondents' backgrounds that could potentially influence their perceptions of the research variables, namely Continuing Education and Environmental Education Management. The distribution of respondents based on gender, age, highest level of education, and experience in participating in environmental education programmes is shown in Table 1 below.

Table 1. Respondent Characteristics

Characteristics	Category	Number (n=68)	Percentage
Gender	Male	35	51.5
	Female	33	48.5
Age	Under 25 years old	8	11.8
	26–35 years	27	39.7
	36–45 years	25	36.8
	Over 45 years old	8	11.8
Highest level of education	High School/Vocational School	6	8.8
	Diploma	7	10.3
	Bachelor's Degree (S1)	40	58.8
	Master's Degree (S2)	15	22
Experience in Environmental Education Program	< 1 year	10	14.7
	1–2 years	18	26.5
	> 2 years	40	58.8

Source: Primary data processed, 2025

The results in Table 1 show that the research respondents were relatively balanced between males (51.5%) and females (48.5%). In terms of age, most respondents were in the productive age group, namely 26–35 years (39.7%) and 36–45 years (36.8%), so it can be assumed that they are actively involved in educational activities and environmental management. In terms of final education, the majority of respondents were bachelor's degree graduates (58.8%), followed by master's degree graduates (22.1%), while high school/vocational school graduates (8.8%) and diploma graduates (10.3%) were only a small portion. This indicates that the majority of respondents have a fairly adequate formal educational background.

In addition, the respondents' experience in participating in environmental education programmes was dominated by those who had been involved for more than two years (58.8%). This finding indicates that most respondents had been exposed to environmental issues for a long time, enabling them to provide relevant and credible assessments of the research instruments. Thus, the characteristics of the respondents in this study describe a heterogeneous profile but are still in line with the needs of the analysis regarding the role of sustainable education in supporting the effectiveness of environmental education management.

Data Analysis

Assessing *the Outer Model* or *Measurement Model*

In analysing data using SmartPLS, the outer model is assessed based on three important criteria, namely convergent validity, discriminant validity, and composite reliability. Convergent validity ensures that the indicators are able to explain the construct well. Discriminant validity shows the differences between constructs so that they do not overlap. Meanwhile, composite reliability measures the consistency of indicators in representing latent variables. These three criteria are very important to ensure that the research model has good validity and reliability before testing the hypothesis.

Convergent Validity

Convergent validity in measurement models that use reflective indicators is measured based on the correlation level between item scores or component scores calculated by PLS software and the construct being measured. A reflective indicator is considered to have good convergent validity if the correlation value obtained is greater than 0.70. This value indicates that the indicator is able to explain the construct quite well because its contribution to the construct is quite strong and consistent in representing latent variables.

Table 2. *Outer Loadings (Measurement Model)*

	Continuing Education	Environmental Education Management
CE1	0.889	
CE2	0.829	
CE3	0.833	
CE4	0.857	
CE5	0.889	
CE6	0.937	
EEM1		0.767
EEM2		0.856
EEM3		0.769
EEM4		0.797
EEM5		0.765
EEM6		0.819
EEM7		0.799

The results of the analysis using SmartPLS shown in Table 2 indicate that the external model values, namely the correlation between the constructs and their indicators, have met the convergent validity requirements. This is evident because all indicators have factor loading values above 0.70. Therefore, the model used in this study is considered convergent valid because each indicator is able to represent the measured construct consistently and adequately.

Discriminant Validity

Discriminant validity is used to ensure that each construct of the latent variables is truly different and does not overlap with other variables. A model is said to have good discriminant validity if each indicator shows the highest loading value on the measured latent variable, compared to the loading value on other latent variables. This means that the indicator must better reflect its own construct than other constructs. The results of the discriminant validity test in this study are shown as follows:

Table 3. Discriminant Validity Values (*Fornell-Larcker*)

	Continuing Education	Environmental Education Management
Continuing Education	0.873	
Environmental Education Management	0.860	0.797

Composite Reliability.

The validity and reliability of the construct can be seen from the construct reliability value and the Average Variance Extracted (AVE) value for each latent variable. A construct is considered reliable if its reliability value is at least 0.70, while an AVE of more than 0.50 indicates that the indicator is able to explain most of the variance of the measured construct. In this way, the combination of these two values ensures that the construct has good internal consistency and strong validity.

Table 4. *Composite Reliability* Values

	Cronbach's alpha	Composite reliability (rho_c)	Composite reliability (rho_c)	Average Variance Extracted (AVE)
Continuing Education	0.937	0.941	0.951	0.762
Environmental Education Management	0.904	0.906	0.924	0.635

Based on Table 4, it can be concluded that all constructs in this study meet the reliability quality requirements. This can be seen from the composite reliability value that is greater than 0.70 and the AVE value that is higher than 0.50, in accordance with the recommended standards. Therefore, the measuring instruments used in this study are considered consistent and capable of representing latent variables well.

Structural Model Testing (*Inner Model*)

The inner model or structural model testing aims to check the relationship between concepts in the study, including the significance level and R-square value. The evaluation is carried out by looking at the R-square value of the measured concept, the t-test value, and the significance level of the relationship coefficient that appears. In this way, we can determine how well the research model explains the measured variables, while also assessing the strength of the relationship between the variables in the model.

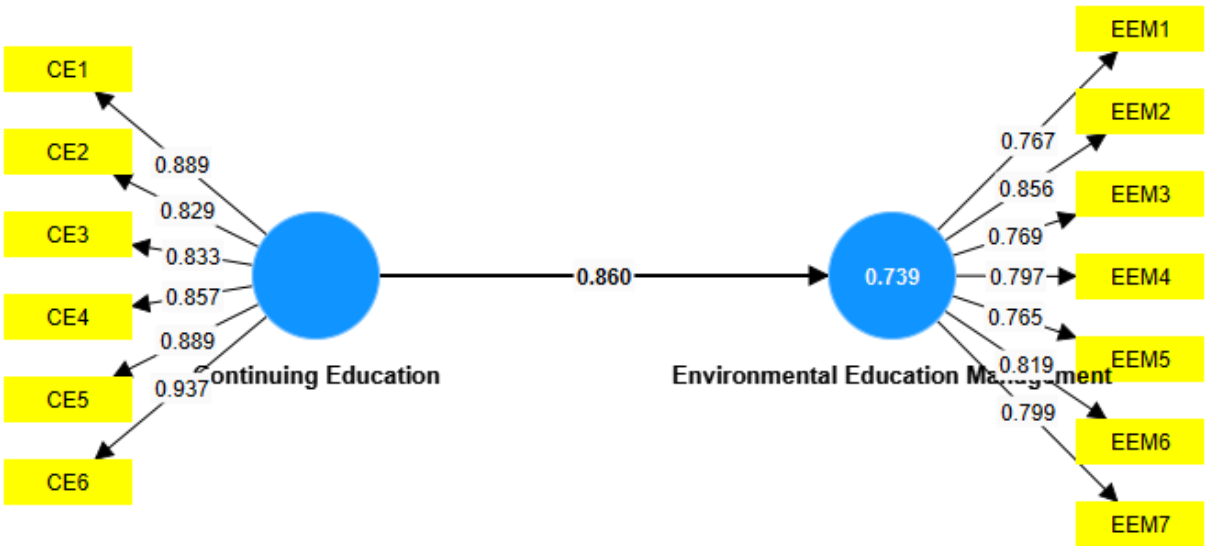

Figure 1. Tested structural model

In evaluating models using the PLS approach, the first step is to assess the R-square value for each dependent latent variable. The R-square value is used to show the extent to which the independent variables are able to explain the variation of the dependent variables in the research model. The higher the R-square value, the greater the model's ability to represent the relationships between the variables analysed. The following table presents the results of the R-square value estimation obtained from data processing using SmartPLS software, which can be used as a basis for assessing the predictive power of the constructed model.

Table 5. *R-Square Values*

	R-square	Adjusted R-square
Environmental Education Management	0.739	0.736

Table 5 shows that the R-Square value for the Environmental Education Management variable is 0.739. This means that 73.9% of the variation in Environmental Education Management can be explained by the Continuing Education variable, while the remaining 26.1% is influenced by other factors not included in this research model. This value indicates that the contribution of Continuing Education to Environmental Education Management is strong, so it can be concluded that the model has sufficient predictive power in explaining the relationship between variables, although there are still other external factors that have the potential to influence it.

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Hypothesis Test Results

Direct (Partial) Effect

Direct (partial) influence in SmartPLS analysis is the relationship formed between independent variables and dependent variables without involving the role of mediating variables. This relationship is assessed through path coefficients, t-statistics, and p-values as the basis for significance testing. An effect can be said to be significant if it meets the criteria of a t-statistic greater than 1.997 and a p-value less than 0.05. Thus, the direct effect analysis provides an overview of how much each independent variable contributes to influencing the dependent variable individually in the research model.

Table 6. Results of Direct (Partial) Influence Hypothesis Testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T-statistic (|O/STDEV|)	P-values	Alpha	Conclusion
Continuing Education - Environmental Education Management	0.860	0.863	0.022	39.052	0.000	0.05	Influential Positive Significant

The table above shows that all variables tested partially meet the significance criteria, namely having a t-value greater than 1.997 and a p-value less than 0.05. More specifically, the Continuing Education variable has been proven to have a positive and significant effect on Environmental Education Management. This is indicated by a path coefficient value of 0.860, a t-value of 39.052, which far exceeds the critical limit of 1.997, and a p-value of 0.000, which is less than 0.05. These results confirm that an increase in Continuing Education will significantly contribute to an increase in Environmental Education Management in this research model.

Effect Size (f square)

Effect size (f^2) is a measure used to assess the extent to which independent variables contribute to the predictive power of dependent variables in a research model. The f^2 calculation is performed by comparing the change in R Square when an independent variable is removed from the model. The f^2

value is then interpreted based on certain criteria, namely $f^2 < 0.02$ means the effect is very small or insignificant, $0.02 \leq f^2 < 0.15$ indicates a small effect, $0.15 \leq f^2 < 0.35$ indicates a moderate effect, and $f^2 \geq 0.35$ indicates a large effect. Based on the analysis results obtained, the effect size can be used as a basis for assessing how strong the specific influence of each independent variable is in explaining the variation in the dependent variable, thereby strengthening the understanding of the contribution of each variable in the research model being tested.

Table 7. Effect Size (f-square)

	f-square
Continuing Education → Environmental Education Management	2.838

Based on the table results, the f^2 value in the Continuing Education pathway to Environmental Education Management is 3.678, which is classified as a large effect. This confirms that Continuing Education makes a very strong contribution in explaining the variation in Environmental Education Management. In other words, the better the implementation of Continuing Education, the more effective Environmental Education Management will be. This finding shows that continuing education programmes can strengthen understanding, skills, and awareness related to environmental education management, thereby encouraging the creation of more optimal, targeted, and sustainable management practices.

Discussion

The Influence of Continuing Education on Environmental Education Management

The study results reveal that continuing education positively and significantly influences environmental education management. This finding confirms that continuing education plays a strategic role in improving the capacity of individuals and institutions to manage environmental education programmes effectively and sustainably. Continuing education is not only oriented towards knowledge transfer, but also functions in shaping attitudes, skills, and critical awareness that favour sustainability principles. Thus, the more optimal the implementation of continuing education, the better the practice of environmental education management.

This study is consistent with the results of Ramos et al. (2021), which show that community-based continuing education can expand community involvement in various environmental management activities, particularly in decision-making, waste management, and resource conservation. In line with this, Barth and Rieckmann (2022) found that individual participation in continuing education encourages educational institutions to develop more adaptive and contextual policies and management practices. Similarly, Manni et al. (2022) found that a participatory approach to sustainable education has been proven to increase the effectiveness of environmental education programme implementation at various institutional levels.

However, there are also studies whose results do not fully support this. Huckle (2021), for example, assessed that continuing education often fails to impact environmental education management due to limited resources, weak policy implementation, and a lack of long-term support. Jickling and Sterling (2017) also highlighted that most environmental education programmes are still symbolic or ceremonial, so their contribution to environmental management is not very profound.

The differences between the findings of this study and previous studies can be understood in the context of implementation. Most of the respondents in this study had more than two years of experience participating in environmental education programmes. This high level of involvement strengthened their understanding and awareness of sustainability issues, proving that continuing education contributes significantly to the effectiveness of environmental education management. Conversely,

studies that did not support this generally took place in a context of minimal policy support, limited curriculum quality, or inadequate supporting facilities, preventing the maximum impact of continuing education from being achieved.

Thus, this study provides novelty by showing that consistent continuing education supported by participants' long experience can be a major determinant in improving the effectiveness of environmental education management. These findings enrich the literature by emphasising that the success of continuing education is largely determined by the quality of implementation and the active involvement of participants, not merely by the existence of the programme.

Furthermore, an important difference between this study and previous studies lies in the analytical approach used and the characteristics of the respondents. This study applies the Partial Least Squares–Structural Equation Modelling (PLS-SEM) method to comprehensively test the relationship between variables, whereas some previous studies still use descriptive or qualitative analysis. Furthermore, the respondents in this study have a relatively high educational background and extensive experience in environmental education programmes. Hence, the study results place more emphasis on the aspect of consistent implementation.

These findings also present a new perspective that the effectiveness of environmental education management is not only determined by policy or curriculum design, but is greatly influenced by the duration and quality of participants' involvement in continuing education. This is an added value of this study compared to previous studies.

5 Conclusion

This study confirms that continuing education plays a significant role in improving the effectiveness of environmental education management. Continuing education has been proven to strengthen the understanding, skills, and critical awareness of individuals and institutions in managing environmental issues more consistently, focused, and sustainably. The more optimal the implementation of continuing education, the greater its contribution to the success of environmental education management. Thus, the main objective of the study, to examine the influence of continuing education on environmental education management, can be achieved.

From a theoretical perspective, the results of this study enrich the literature on the relationship between continuing education and environmental education management. These findings provide empirical evidence that the concept of lifelong learning is relevant to individual capacity building and contributes significantly to the effectiveness of environmental education management. This adds a new perspective to the study of education management, particularly in the context of integrating sustainability values. In practical terms, this research can be used as a basis for educational institutions, governments, and civil society organisations to strengthen continuing education programmes. Developing an applicable curriculum, continuous training, and cross-sector collaboration needs to be improved so that environmental education management is more effective and has a real impact.

This study has several limitations. First, the number of respondents was only 68, so the findings must be cautiously generalized. Second, the use of purposive sampling has the potential to cause bias because respondents were selected based on specific criteria. Third, the study only focused on two main variables, namely continuing education and environmental education management, so other external factors such as policy support, organisational culture, and availability of facilities were not analysed. Fourth, the data collection technique using questionnaires has weaknesses because the subjectivity of respondents can influence it, so the interpretation of the results needs to be supplemented with a qualitative approach.

Based on these limitations, future research should involve a larger number of respondents using a more representative sampling technique, such as stratified random sampling, so that the results can be more generalised. Researchers can also add other variables, such as policy support, the role of technology, or the level of community participation, to enrich the research model. In addition, using mixed methods that combine quantitative and qualitative approaches will help explain the relationship between variables and the dynamics of sustainable education implementation in greater depth. Thus, further research is expected to provide a more comprehensive and applicable picture for developing environmental education management in various contexts.

Based on the research results and limitations that have been presented, several suggestions can be given as further development efforts. For educational institutions, it is necessary to strengthen continuing education programmes by developing an applicable curriculum that integrates current environmental issues, while implementing participatory learning strategies that allow participants to be directly involved in real projects such as waste management, energy conservation, and climate change mitigation.

For the government and policymakers, it is important to provide regulatory support and sustainable funding for continuing education programmes in the environmental field, accompanied by cross-sector collaboration between the government, the private sector, and civil society to expand the reach and impact of the programmes. Furthermore, for environmental education programme organisers, it is recommended to strengthen the monitoring and evaluation aspects so that the effectiveness of the programmes can be measured continuously.

The use of digital technology, such as e-learning platforms or interactive applications, can also help expand access and increase community participation. Meanwhile, programme participants, both individuals and communities, need to be encouraged to actively apply the knowledge and skills they have acquired in their daily lives and become agents of change in their environment. The formation of community-based study groups or green communities can be a strategic step in strengthening the sustainability of the programme.

As for future researchers, it is hoped that research will involve a larger number of respondents with more representative sampling methods, integrate additional variables such as policy support, the role of digital technology, or organisational culture, and use a mixed methods approach (quantitative and qualitative) so that the dynamics of programme implementation can be explored in greater depth. Further research is also recommended to conduct comparative studies across regions or countries in order to obtain a broader picture of best practices in sustainable education in environmental education management.

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