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Co-created environmental messaging for climate action: Insights from coastal communities in the Global South

Isabell Richter[1,2] | **Elizabeth Gabe-Thomas**[3] | **Arlene Avillanosa**[4] | **Lota Creencia**[4] | **Joel Sumeldan**[4] | **Sabine Pahl**[2,5]

[1]Citizens, Environment and Safety Group, Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway

[2]School of Psychology, University of Plymouth, Plymouth, UK

[3]Sea & Society, Plymouth Marine Laboratory, Plymouth, UK

[4]College of Fisheries and Aquatic Sciences, Western Philippines University, Puerto Princesa, Palawan, Philippines

[5]Environmental Psychology Group, Institute for the Psychology of Cognition, Emotion & Methods, Faculty of Psychology, University of Vienna, Vienna, Austria

Correspondence
Isabell Richter, Citizens, Environment and Safety Group, Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway.
Email: isabel.richter@ntnu.no

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Abstract

Effective environmental communication is essential for building capacity for sustainable decision-making and fostering climate action, particularly in diverse community settings. Our study, conducted in Palawan, Philippines, implements a co-created communication strategy developed in collaboration with local fisherfolk, students and environmental practitioners. Using cluster analysis, we examined how 29 action prompts (APs) combining behavioural guidance with emotional engagement influenced learning, content sharing and behavioural change. APs evoking hope were the most effective in strengthening capacity building in terms of behavioural intention, motivation for learning and empowerment, while fear-based messages heightened awareness but required clear solutions to drive action. Notably, audience-specific responses varied: students responded more positively to emotionally engaging APs, whereas fisherfolk were more motivated by solution-oriented messages relevant to their livelihoods. The participatory approach served as a model for sustainable partnerships, reinforcing bottom-up engagement and strengthening community agency and knowledge-sharing networks. These findings highlight the importance of integrating emotional engagement, especially hope-based content with explicit behavioural recommendations tailored to audience knowledge and lived experiences. By bridging research and practice, this study offers a scalable method for developing culturally relevant communication strategies in Global South contexts. It underscores the significance of co-creation, ongoing evaluation and tailored messaging in promoting sustainable behaviours.

KEYWORDS

cluster analysis, coastal communities, emotions, environmental communication, sustainable action

1 | INTRODUCTION

The path to achieving the Sustainable Development Goals (SDGs) requires transforming global ambitions into locally relevant actions. Environmental communication plays a crucial role in building capacity for climate action (SDG 13) and improving community health by addressing environmental risks (SDG 3). However, simply providing information about environmental issues has proven insufficient in fostering sustainable behaviours. Instead, effective communication strategies must be developed to be audience-specific, tailored to local

Isabell Richter and Elizabeth Gabe-Thomas shared first authorship.

needs and considerate of the limitations of cognitive processing and potential biases (McKenzie Mohr, 2013; Richter et al., 2023).

Environmental messages are more effective when they engage emotions, provide actionable solutions and align with audience values (Devine Wright, 2013; Feitelson, 1991). Communication Accommodation Theory (CAT) suggests that message tailoring—adapting content to the audience's linguistic, cultural and contextual preferences—enhances understanding and acceptance (Giles & Ogay, 2007). Calls for environmental action vary widely, from text-based information and infographics to visual storytelling, animations and participatory media. While images are often more impactful than text alone (Altinay & Williams, 2019; Tuscher, 2022), it remains unclear which types of visual communication are most effective and for whom.

This study investigates the effectiveness of visual environmental messages in coastal communities in the Global South, specifically Palawan, Philippines. By analysing responses from students and fisherfolk, we assess how different features such as emotional content, message clarity and behavioural guidance influence environmental action. We also explore how audience-specific factors affect message reception, providing insights into optimising communication strategies in culturally diverse settings.

1.1 | Limitations of existing environmental communication strategies

Despite growing interest in environmental communication, experimental studies comparing multiple message strategies remain limited (Boykoff, 2019; Brick et al., 2018). Most studies have focused on single variables, such as comparing text vs. visuals (Nyhan & Reifler, 2019), different visual formats (Fischer et al., 2020), or positive vs. negative emotional appeals (Altinay & Williams, 2019; O'Neill & Nicholson Cole, 2009). However, real-world communication strategies combine multiple factors, making it essential to study how different elements interact to influence behavioural outcomes.

Much of the existing research is Global North centric, often failing to account for the unique socio-economic, cultural and infrastructural realities of the Global South (Tam & Milfont, 2020). Environmental messages that are effective in well-resourced, high-literacy societies may not translate to communities with different educational backgrounds, livelihoods and policy frameworks (Nguyen et al., 2023; Queirós et al., 2021). Therefore, studying environmental communication in the Global South is critical for developing more context-specific and impactful strategies.

Palawan, often referred to as the 'Last Frontier' of the Philippines, is a region rich in biodiversity but increasingly vulnerable to environmental degradation. Coastal communities here rely heavily on marine ecosystems for their livelihoods and food security, yet they face mounting challenges such as habitat destruction (e.g., mangrove deforestation, coral bleaching due to climate change), overfishing and illegal fishing practices (e.g., cyanide and dynamite fishing). These pressures are compounded by limited access to resources, extreme weather events and socio-economic constraints, making climate adaptation a pressing concern. Understanding these challenges is essential for crafting effective environmental communication strategies that resonate with local communities and foster action toward sustainability. This study addresses these research gaps by (1) co-creating environmental messages with local communities, (2) analysing how different communication features influence engagement and (3) comparing responses across audience groups (students vs. fisherfolk). By identifying what works best for whom, this research contributes to developing scalable, culturally relevant environmental messaging strategies for climate-vulnerable communities in the Global South.

1.2 | The current research

This study investigates how visual environmental messages influence climate action in Palawan, Philippines, by examining the role of emotions, message content and audience-specific responses. In collaboration with local fisherfolk and students, we co-created 29 action prompts (APs) reflecting key sustainability issues. Using cluster analysis, we categorised these APs based on perceived characteristics and evaluated their impact on fostering sustainable behaviours.

Our exploratory research questions were:

RQ1: Which characteristics of the APs enabled the categorization into distinct, data driven clusters?
RQ2: How did these clusters and their characteristics relate to environmental action?
RQ3: Did suggested cluster solutions and respective effects differ between groups?

By addressing these questions, we aim to inform more effective, audience tailored environmental communication strategies for coastal communities in the Global South.

2 | METHODS

2.1 | Co-development of action prompts

In partnership with local community members and the Blue Communities research team, 29 pictorial images (APs) were developed through a structured co-creation

process. Local fisherfolk and students participated voluntarily, engaging in workshops and focus group discussions rather than through a competition or contest. These sessions, held in multiple municipalities (Roxas and Aborlan for fisherfolk, Puerto Princesa for students), ensured that the APs reflected the lived experiences and environmental concerns of the communities. The evaluators, students and fisherfolk, belonged to the same communities that informed the AP development, making the content personally relevant. Furthermore, the APs were designed to reflect pressing environmental issues that were familiar to both groups, including sustainable fisheries and agriculture, conservation of natural ecosystems (coral reefs and mangroves), tourism, health and well-being and littering, reinforcing their applicability in the local setting. They were presented in diverse formats, such as infographics, photo stories, videos and animations, adhering to best practices in environmental communication (Devine Wright, 2013); Mycoo (2015).

While the core messaging and themes originated from community input, researchers and environmental communication experts assisted in refining the final visual outputs to enhance clarity and coherence without altering the original intent. The process was highly interactive, incorporating feedback loops where early prototypes were shared with participants for review. Some APs underwent multiple rounds of revision to ensure message clarity through an external group of local stakeholders, including community leaders, environmental organizations and educators, visual impact and cultural relevance. While this study focused on a bottom-up co-creation process, it did not include a comparative top-down condition.

2.2 | Samples

Two samples were recruited for this study. Sample 1 included a total of 115 participants, with 47.8% being male and 52.2% being female. The average age of the participants was 20.71 years, ranging from 15 to 29 years old. This sample was composed of secondary school and university students from Palawan. Participants were recruited through voluntary online registration, promoted via social media and university networks, and were invited to participate through social media announcements and personal invitations. To encourage participation, students were incentivised with food/snacks and certificates of participation. The data collection took place at the Western Philippines University in Puerto Princesa, Palawan.

Sample 2 consisted of 45 participants, with 24.4% being male and 75.6% being female, due to women in Palawan playing a key role in post-harvest activities (processing, marketing and selling the fish). The mean age of the participants was 43.91 years, with a range of 18–68 years old. The participants were fisherfolk from various municipalities in Palawan who already collaborated with the research group through an ongoing extension programme affiliated with the Western Philippines University. They were recruited through established partnerships with fisherfolk associations and participated voluntarily. Many of the fisherfolk were active members and officers of local fisherfolk organisations and had prior engagement with national government agencies (NGAs) for technical consultation. As a form of logistical support and appreciation for their participation, they were provided with transportation assistance and given t-shirts. The data collection was integrated into a Fisherfolk Forum, where participants engaged in discussions on sustainable fisheries, making it a relevant setting for evaluating environmental communication materials.

2.3 | Data collection

Data collection with Sample 1 took place in a lecture hall of the Western Philippines University, Puerto Princesa, Palawan. Data collection with Sample 2 took place as part of a 2-day Fisherfolk Forum, which is the culminating activity of the Commission of Higher Education-funded extension programme implemented by the Western Philippines University. The data collection process began in both cases by obtaining informed consent from all participants, who then provided sociodemographic information.

Participants in Sample 1 sat in front of an overhead projector on which each AP was presented one at a time, for one minute. Following exposure to each AP, participants completed a short evaluation questionnaire concerning the characteristics and impact of the AP they had just viewed. Participants viewed a trial AP to calibrate responses and ensure task understanding before exposure to the 29 APs. The measures are displayed in Figure 1 and were categorised as (1) the characteristics of the AP (e.g., how understandable and professional an AP is) and (2) the effects the AP had on the receiver (e.g., the extent that the AP evoked motivations to learn more or feelings of empowerment in participants). The evaluation focused on participants' perceptions and intentions rather than direct measures of behavioural or attitudinal change. Both characteristics and effects variables were statements to which agreement was measured via a 5-point Likert scale with verbal anchors on each point (from strongly disagree to strongly agree).

For Sample 2 we condensed this process, incorporating only 10 APs and reducing the number of measures. This was done to adapt the study design to the circumstances as the fisherfolk were seeking to generate income and network during the forum.

Detailed questionnaires, the full list of APs and item wordings for both data collections can be found in the

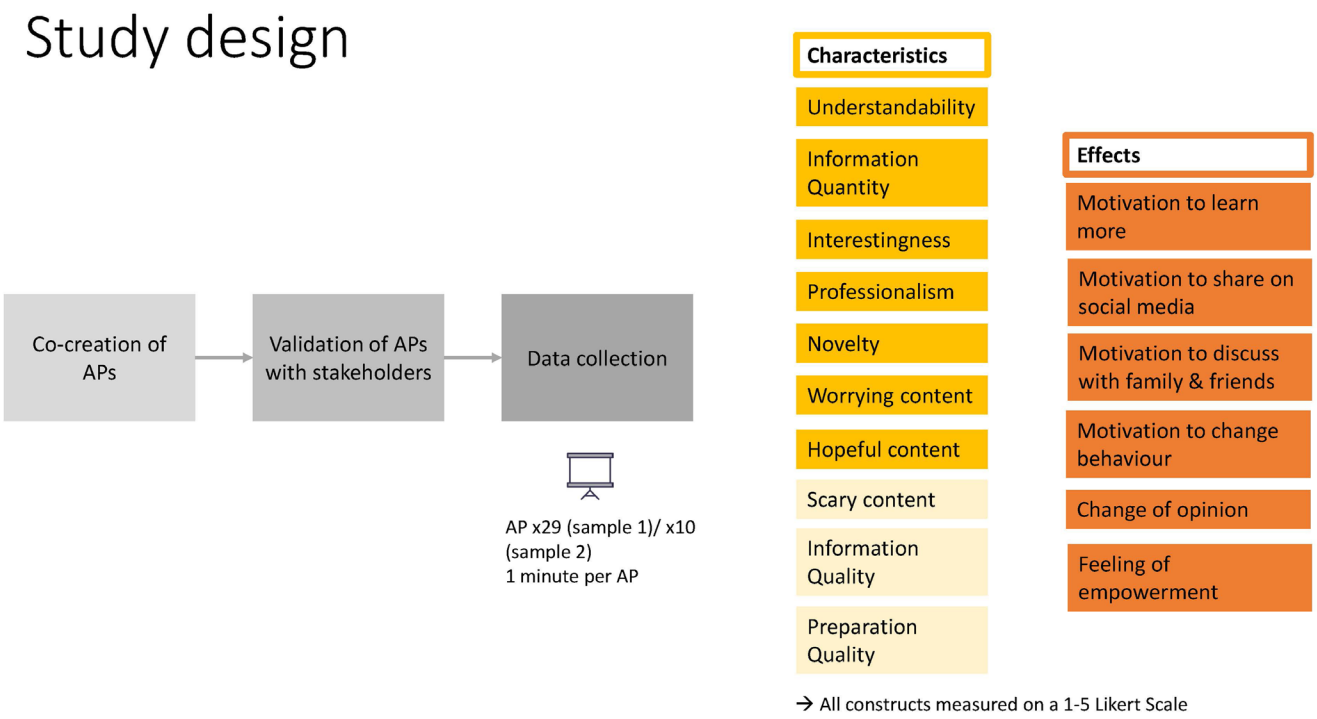

FIGURE 1 Visualization of study design and measures in the first and second data collection. Characteristics marked in lighter colour boxes were excluded for the second data collection due to high covariance.

Supporting Information (Figure S1a,b for sample 1 and Figure S2 for sample 2). Please note that any items omitted in the second phase of the study are denoted with an (excl) annotation.

2.4 | Analysis plan

2.4.1 | Cluster analysis

To find perceived similarities between the 29 APs in sample 1 and the respective 10 APs in sample 2, a hierarchical cluster analysis was performed on the characteristics (not effects, see Figure 1) using R Version 4.0.1 (R Core Team, 2022). Squared Euclidean distances were used as the similarity measure, and the distances were evaluated using Ward's method (Ward, 1963), which was selected for its efficiency (Burns, 2008). We determined cluster membership by a combination of inspection of the resultant dendrogram and by plotting the height of each agglomeration against the number of clusters. The demarcation point (the point at which there is a large change in the agglomeration height) was identified by finding an 'elbow' in the data, as is done with a scree plot in factor analysis (Sarstedt & Mooi, 2014). The validity of the clustering was assessed by completing the analysis using a different clustering technique (complete linkages method) and comparing the output. The second analysis produced identical cluster membership to the first, thus demonstrating the stability of the clusters revealed in the original analysis.

Nine characteristics (see Table 1) were used to cluster the APs: understandability, information quantity, information quality, interestingness, professionality, preparation quality, novelty, hopeful content and fear-inducing content. Worrying and scary content were highly correlated ($r(df) = 98$, $p < 0.001$, Cronbach's $\alpha = 0.99$) and were therefore averaged to produce one variable representing fear-inducing content. The mean of each of these variables across all participants was calculated for each AP individually, meaning that the unit of analysis was the AP and not the individual participant's score. This approach allows comparison of APs, not people, allowing for the identification of APs that show similar profiles in terms of the overall sample's perceptions of them.

2.4.2 | Analysis of variance

To describe the clusters and to explore differences between the resultant clusters on the variables that were used to create them, a series of one-way ANOVAs were conducted with each clustering variable as the outcome variable and the cluster membership as the independent variable. These analyses can demonstrate that each cluster is distinct in terms of the perceived characteristics of the APs.

A second set of one-way ANOVAs was conducted with the effect measures (indicated in orange colour in Figure 1) to understand the effect the distinct clusters of APs have on the participants' motivation to change behaviour. Pairwise comparisons were conducted using

TABLE 1 Characteristics of the clusters (ANOVA results for each clustering variable) for Sample 1.

	Estimated marginal means (SD)							
	Clust 1	Clust 2	Clust 3	Clust 4	Clust 5	*F* value	ETA square	Post hoc comparisons
Understandability	4.56 (0.05)	4.44 (0.08)	4.24 (0.07)	4.44 (0.07)	4.44 (0.06)	16.28***	0.73	C1>C3***, C1>C4*, C2>C3***, C3<C4*** C3<C5***, C1>C5^{ms} C1>C2^{ms}
Information Quality	4.45 (0.07)	4.39 (0.04)	4.14 (0.08)	4.37 (0.06)	4.26 (0.06)	21.14***	0.78	C1>C3***, C1>C5*** C2>C3***, C2>C5* C3<C4***, C3<C5* C4>C5*
Information Quantity	4.49 (0.07)	4.41 (0.05)	4.20 (0.08)	4.42 (0.07)	4.33 (0.05)	15.51***	0.72	C1>C3***, C1>C5** C2>C3***, C3>C4*** C3>C5*
Interestingness	4.30 (0.04)	4.24 (0.08)	4.18 (0.05)	4.28 (0.02)	4.24 (0.04)	5.22**	0.47	C1>C3**, C3<C4**
Professionalism	4.13 (0.09)	4.13 (0.10)	3.88 (0.09)	3.90 (0.12)	3.98 (0.09)	7.92***	0.57	C1>C3**, C1>C4**, C2>C3**, C2>C4**
Preparation quality	4.13 (0.03)	4.1 (0.04)	4.05 (0.03)	4.07 (0.03)	4.08 (0.06)	3.37*	0.34	C1>C3**
Novelty	3.83 (0.08)	3.99 (0.11)	3.81 (0.06)	3.92 (0.09)	3.65 (0.04)	14.52***	0.71	C1>C5*, C2>C1* C2>C3** C2>C5***, C3>C5* C4>C5***
Hopeful content	4.14 (0.08)	4.02 (0.04)	3.85 (0.09)	3.86 (0.04)	3.89 (0.08)	19.07***	0.76	C1>C3***, C1>C4*** C1>C5***, C2>C3** C2>C4**, C2>C5*
Negative content	3.78 (0.14)	3.31 (0.16)	3.49 (0.12)	3.95 (0.08)	3.20 (0.12)	39.17***	0.87	C1>C2***, C1>C3** C1>C5***, C2<C4*** C3<C4***, C4>C5***, C1>C2^{ms}

Note: ***$p<0.001$, **$p<0.01$, *$p<0.05$, ^{ms}marginally significant with $p<0.10$.

Tukey's Honest Significant Difference (HSD) test. Diagnostic tests were performed for all ANOVAs to ensure assumptions were met (Levene's test & inspection of plotted residuals). MANOVAs were not conducted as the number of APs in each cluster group was often exceeded by the number of outcome variables, meaning that the analysis thus violated the assumption of adequate sample size. Pairwise comparisons were conducted using Wilcoxon tests. Where the results of the non-parametric tests were comparable, the parametric version is reported for consistency and ease of interpretation. Where diagnostic tests showed the ANOVA models did not meet the assumption of homogeneity of variances, Welch's *F* test is reported with the Games Howell post hoc test for pairwise comparisons.

To reveal any potential gender differences in the ratings of the APs, a series of MANOVAs were conducted on all clustering variables and effect variables. Participant gender was the independent variable in each analysis, and the outcome variables were the participants' mean response to the APs within each of the clusters.

3 | RESULTS

3.1 | Cluster solution for sample 1

The demarcation point on the plotted agglomeration heights (Figure S3) indicated a five-cluster solution best fit the data; this was confirmed by inspection of the dendrogram (Figure 2).

3.2 | Differences between the clusters for sample 1

A series of ANOVAs revealed that there was a significant main effect of cluster membership on each of the

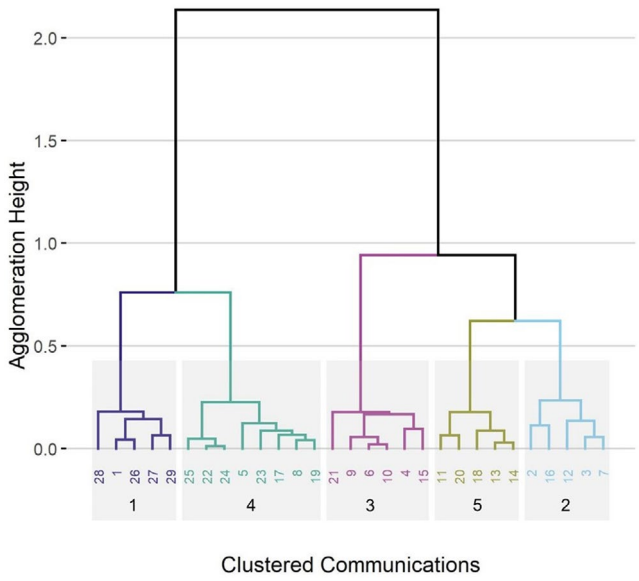

FIGURE 2 Dendrogram displaying five distinct clusters of APs revealed using Ward's method with squared Euclidean distances (sample 1).

clustering variables. Table 1 provides details on the main effects and significant differences between pairwise cluster comparisons for each analysis. While all analyses revealed a significant main effect, the effect sizes were particularly large for fear-inducing content, information quality, hopeful content, understandability and information quality. This shows that there were larger differences between clusters on these measures. The APs within each cluster were then inspected alongside the mean differences in scores for the variables that went into their creation (post hoc tests). The clusters were given names to reflect their content.

3.2.1 | Cluster 1 'The Engaging'

This cluster contained the APs that were rated as the most understandable. The APs in "The Engaging" were also rated significantly higher on information quality than most other clusters, except cluster 2. The Engaging APs were perceived to contain the highest amount of information and were the most interesting. The APs were perceived as looking the most professional (along with those in cluster 2) and as highly novel. The APs in cluster 1 were also rated as most inspiring with the highest levels of hopeful content, as well as inducing the highest levels of fear-inducing content.

3.2.2 | Cluster 2 'The Intriguing'

This cluster contained APs that were rated as understandable and perceived as professional looking. Cluster 2 was rated the most novel and educational, with high levels of information quality. The APs in "The Intriguing" cluster were perceived to be more hopeful than clusters 3, 4 and 5. Overall, APs in cluster 2 could be considered as 'ecosystem explainers' and were perceived as novel, educational and not particularly fear-inducing.

3.2.3 | Cluster 3 'The Confusing'

The confusing cluster was named due to the perceived low quality of information and lack of clear message in the APs. It had the lowest mean score for understandability and a comparably low mean information quality score as well as a low mean professional score. The mean interestingness score and the novelty score were the lowest of all clusters. In terms of emotional content, the perceived hopefulness but also the perceived fear was lower than other clusters.

3.2.4 | Cluster 4 'The Disturbing'

This cluster contained messages that lacked a behavioural message and were dominated by negative topics. The APs in this cluster were perceived as understandable but not very professionally looking. The information quality as well as the level of interestingness were moderately high. Cluster 4 contained significantly more fear inducing content than most other clusters.

3.2.5 | Cluster 5 'The Pleasant'

This cluster had good quality and understandable messages. The information quality in cluster 5 was moderately high and the APs were rated as the least novel. In terms of emotional content (i.e. hope, worry and fear) cluster 5 was lower than most other clusters. Overall, APs in cluster 5 contained good quality information and lacked emotional content but were not perceived as novel or impactful compared to other clusters.

Details on the cluster characteristics and significant differences between single clusters can be retrieved in Table 1 as well as in the Appendix S1 under "1.2 Cluster Solution Details". Example APs for each cluster can be seen in Figure 3.

3.3 | Assessing the effectiveness of clusters for sample 1

A series of ANOVAs revealed that there was a significant main effect of cluster membership on each of the outcome variables (Table 2).

APs categorized within the engaging, intriguing and disturbing clusters demonstrated greater efficacy in stimulating participants' interest to learn about

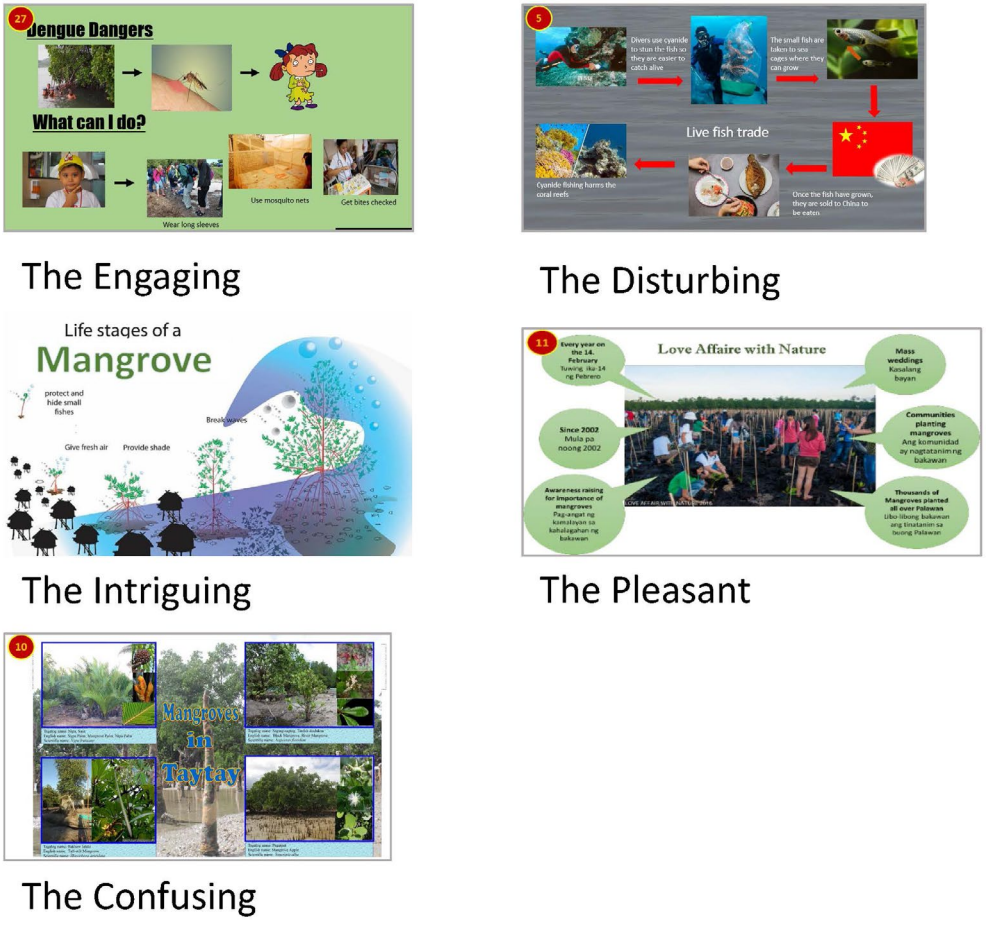

FIGURE 3 AP examples per cluster in study 1.

environmental topics, as opposed to those classified under the confusing and pleasant clusters. The engaging cluster evoked a higher likelihood of repeated viewing on social media during participants' leisure time, compared to the confusing and pleasant clusters; it was more frequently chosen for sharing with friends and family, thereby outperforming APs in the confusing, disturbing and pleasant categories; and it was the most influential in prompting behaviour and perspective changes, with the disturbing cluster closely following suit. APs deemed engaging or disturbing were more successful in empowering participants, surpassing the impact of the intriguing, confusing and pleasant clusters.

3.4 | Gender differences in clustering for sample 1

To reveal potential gender differences in responses, MANOVAs were conducted as described above on each clustering variable and each effect variable. The analyses revealed no significant difference in mean participant responses to the APs within each cluster for any of the clustering and effect variables (all $p > 0.05$).

3.5 | Cluster solution for sample 2

Using a reduced set of visuals (10 out of 29), inspection of the demarcation point on the plotted agglomeration heights (Figure S4) indicated a three-cluster solution, which was confirmed by inspection of the dendrogram (Figure 4).

3.6 | Differences between the clusters for sample 2

A series of ANOVAs were conducted on the data (Table 3). The analysis indicated that there was a significant main effect of cluster membership on each of the clustering variables based on all variables that went into their creation. The main effects for each analysis can be found in Table 4, along with the significant differences between pairwise cluster comparisons.

Again, the APs within the clusters were inspected, and the clusters received names to reflect their content as well as their perceived characteristics according to our second group of participants, the local fisherfolk. Cluster 1 was named The Pessimistic, as the APs within were perceived to be professional and understandable but in a negatively framed way. They had a clear layout

TABLE 2 Differences between the clusters on the outcome variables (ANOVA results) for sample 1.

	Estimated marginal means (SD)							
	Clust 1	Clust 2	Clust 3	Clust 4	Clust 5	*F* value	ETA square	Post hoc comparisons
Intention to learn more	4.42	4.33	4.16	4.32	4.18	17.23***	0.74	C1>C3***, C1>C5**, C2>C3***, C>C5***, C4>C3***, C4>C5**
	0.08	0.07	0.06	0.04	0.06			
Intention to watch again	4.08	3.97	3.88	3.97	3.89	3.43*	0.36	C1>C3***, C1>C5*
	0.15	0.1	0.09	0.07	0.09			
Change of behaviour	4.07	3.79	3.74	3.96	3.76	10.93***	0.65	C1>C2*, C1>C3***, C1>C5*** C4>C3*, C4>C5*
	0.12	0.08	0.05	0.12	0.1			
Intention to show to friends & family	4.21	4.09	3.96	4.07	4.01	7.47***	0.55	C1>C3***, C1>C4*, C1>C5**
	0.1	0.1	0.07	0.04	0.09			
Change of opinion	4.06	3.89	3.81	3.98	3.82	8.85***	0.6	C1>C2**, C1>C3***, C1>C5***, C4>C3**, C4>C5*
	0.1	0.03	0.08	0.08	0.1			
Feeling of empowerment	4.17	4.02	3.91	4.06	3.93	13.72***	0.7	C1>C2**, C1>C3***, C1>C4*C1>C5***, C4>C3**, C4>C5*
	0.09	0.05	0.06	0.05	0.07			

Note: ***$p<0.001$, **$p<0.01$, *$p<0.05$.

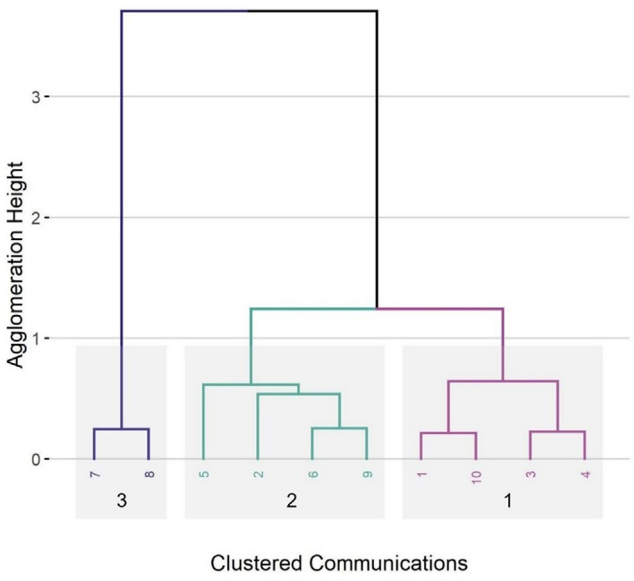

FIGURE 4 Dendrogram displaying three distinct clusters of APs revealed using Ward's method with squared Euclidean distances (Sample 2). Please note, the AP numbers represent different APs than in sample 1 (see Figure S1a,b and S2).

but did not feature a behavioural message. Cluster 2 was named 'The Uplifting' and included APs that featured a behavioural message. The APs were perceived to be professional and novel and to communicate in a positive way. Cluster 3 was named 'The Frustrating' as the APs within it were perceived to be low on quality, not very understandable or informative and had no clear behavioural message. The messages were not perceived as very emotional, neither hopeful nor fear-inducing.

3.7 | Assessing the effectiveness of clusters on DVs

The results show no significant difference among these clusters in terms of increasing participants' intention to learn more about the topic or feeling empowered to take action. However, significant differences were observed in other responses. APs in the Frustrating cluster were significantly less likely to be watched again on social media compared to those in the Pessimistic and Uplifting clusters. In terms of sharing with friends and family, participants showed a higher likelihood of sharing APs from the Uplifting cluster, followed by the Pessimistic cluster, and least likely with the Frustrating cluster. Regarding changing participants' views, APs in the Frustrating cluster were also rated as less effective compared to those in the Pessimistic and Uplifting clusters. Finally, when it came to changing behaviour, the Uplifting cluster's APs were significantly more likely to induce behaviour change than those in the Pessimistic and Frustrating clusters. Example APs for each cluster can be seen in Figure 5.

The gender comparison analysis was not conducted for sample 2 due to little difference between the results

TABLE 3 Characteristics of the clusters (ANOVA results for each clustering variable) for sample 2.

	Estimated marginal means (SD)					
	Cluster 1	**Cluster 2**	**Cluster 3**	***F* value/χ^2**	**ETA square**	**Post hoc comparisons**
Understandability	3.95	4.22	3.43	124.86***	0.97	C2>C3**
	0.08	0.03	0.02	χ^2=7.90*	0.84	
Information Quantity	3.76	3.87	3.24	7.82*	0.69	C1>C3*, C2>C3*
	0.18	0.23	0.02			
Interestingness	3.83	3.81	3.88	0.13	0.04	–
	0.23	0.03	0.09	χ^2=2.26	0.04	
Professionalism	3.42	3.84	2.87	20.81***	0.86	C1<C2*, C2>C3***, C1>C3*
	0.10	0.21	0.22			
Novelty	3.44	3.67	3.16	4.21***	0.67	C2>C3*
	0.22	0.09	0.01			
Induced hope	3.97	4.19	3.73	5.16*	0.60	C2>C3*
	0.17	0.16	0.18			
Induced negative emotion	3.69	3.52	3.58	0.54	0.13	–
	0.11	0.31	0.17			

Note: ***p<0.001, **p<0.01, *p<0.05. Different statistical tests were applied based on the specific assumptions being met for each analysis (see Section 3.8).

TABLE 4 Differences between the clusters on the outcome variables (ANOVA results) for sample 2.

	Estimated marginal means (SD)							
	Clust 1	**Clust 2**	**Clust 3**	***F* value/χ^2**	**ETA square**	**CI l**	**CI U**	**Post hoc comparisons**
Intention to learn more	3.81	3.98	3.32	2.29	0.87	0.6	0.94	–
	0.05	0.07	0.26					
Intention to watch again	3.5	3.76	3.1	14.43**	0.8	0.42	0.9	C1>C3**, C2>C3***
	0.09	0.18	0.14					
Intention to show friends & family	3.65	3.93	3.26	25.41**	0.88	0.62	0.94	C2>C1*, C2>C3***, C2>C3***
	0.13	0.1	0.05					
Change of opinion	3.69	3.78	3.46	22.93**	0.87	0.59	0.93	C1>C3**, C2>C3***
	0.06	0.06	0.01					
Change of behaviour	3.55	3.71	3.35	13.87**	0.8	0.4	0.9	C2>C3***, C1>C2^{ms} C1>C3^{ms}
	0.09	0.07	0.08					
Empowerment	3.84	3.76	3.75	2.1	0.37	0	0.66	–
	0.06	0.07	0.04	χ^2=3.05	0.15			

Note: ***p<0.001, **p<0.01, *p<0.05, ^{ms}marginally significant with p<0.10. Different statistical tests were applied based on the specific assumptions being met for each analysis (see Section 3.8).

of the cluster analysis for male and female participants in sample 1; sample 2 consisted of an unequal number of males and females.

3.8 | Comparison of clusters across samples

Table 5 displays a comparison of cluster membership to the APs that were presented to participants in both samples. Whilst the analyses differed in terms of the number of characteristic variables used in the clustering process and the number of AP clusters, there are some similarities in the way that the APs were clustered across samples. Notably, AP(S1) numbers 5 and 8 were consistently grouped according to their fear-inducing content. AP(S1) number 15 was clustered with poor-quality APs that were not rated as very understandable. AP(S1) 26 was consistently grouped by its positive emotional

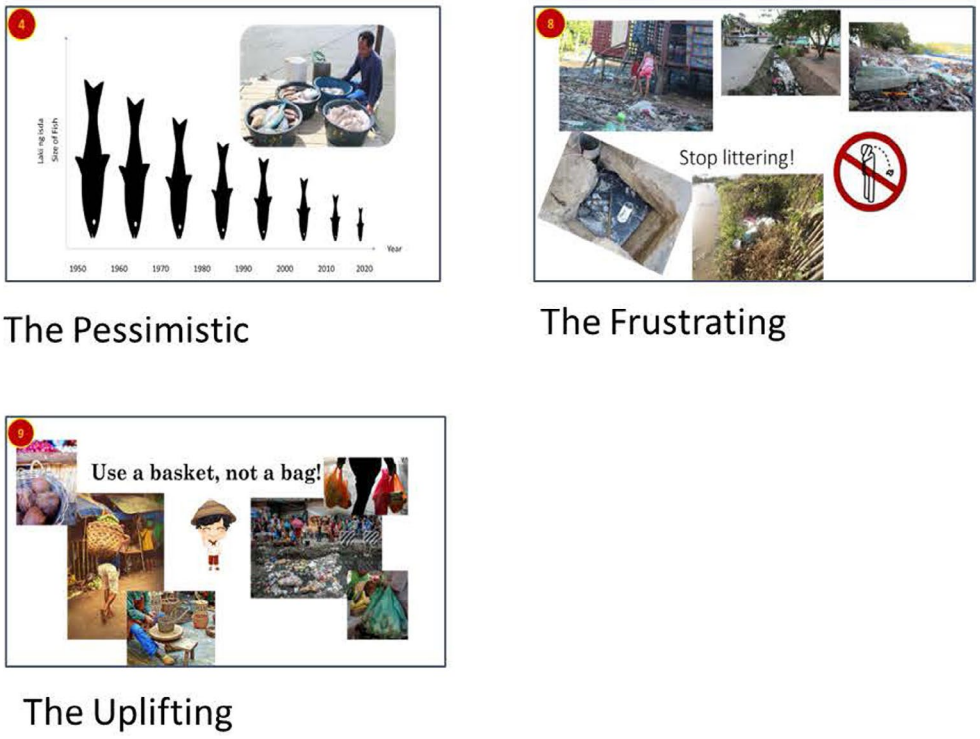

FIGURE 5 AP examples per cluster in study 2.

TABLE 5 Comparison of AP cluster membership across samples.

AP no S1	AP no S2	S1 cluster	S2 cluster
1	1	1 Engaging	1 Pessimistic
4	2	3 Confusing	2 Uplifting
5	3	4 Disturbing	1 Pessimistic
8	4	4 Disturbing	1 Pessimistic
9	5	3 Confusing	2 Uplifting
12	6	2 Intriguing	2 Uplifting
15	7	3 Confusing	3 Frustrating
25	8	4 Disturbing	3 Frustrating
26	9	1 Engaging	2 Uplifting
27	10	1 Engaging	1 Pessimistic

Note: S1 = Sample 1, S2 = Sample 2. AP S1 numbers correspond to the numbers within Figures S1a,b and S2.

content. Clear differences lie across samples in the grouping of AP(S1) numbers 5 and 9. For sample one, they were clustered with APs that were rated confusing, whereas they were grouped with uplifting APs in sample two. AP(S1) numbers 1 and 27 both featured in the engaging cluster for sample one and the pessimistic cluster for sample two. This is not necessarily inconsistent as the engaging cluster featured APs rated high on both positive and negative emotional content, and both the engaging cluster and the pessimistic cluster were rated as more effective than the frustrating cluster.

4 | DISCUSSION

To address our research questions, we synthesised the findings from both samples to provide recommendations for effective environmental communication that supports capacity building for climate action, particularly in the Global South.

In response to RQ1 (*Which characteristics of APs enable categorization into distinct, data driven clusters?*), our analysis revealed that understandability, information quality, professionalism, novelty and emotional content were key attributes that shaped the perception and effectiveness of environmental messages. APs that successfully combined strong emotional appeal with clear behavioural guidance were the most impactful, while those lacking clarity, professional presentation, or relevance to the audience were less effective. Emotional content, particularly hopeful framing, played a critical role in enhancing engagement and fostering action.

For RQ2 (*How do these clusters and their characteristics relate to environmental action?*), the most effective APs were those that combined emotional engagement with actionable recommendations, leading to increased intentions to act, motivation for learning and willingness to share content with others. Messages that evoked hope, empowerment and concrete solutions were more successful in prompting pro-environmental behaviours. Conversely, APs that relied on fear-based messaging without offering clear steps for action heightened concern but were less effective in driving tangible change.

However, it is important to note that the current study assessed participants' responses based on perceived impact and self-reported intentions, rather than observed behavioural outcomes. Future research should track actual behaviour change over time to validate these findings. These findings align with behavioural science research, which suggests that while fear can increase awareness, it must be paired with solution-oriented content to translate concern into action.

Regarding RQ3 (*Did the effectiveness of AP clusters differ between groups?*), our results highlight the importance of audience-specific customisation in environmental communication. Students responded more positively to emotionally engaging content, whereas fisherfolk preferred practical, solution-oriented messages relevant to their livelihoods. Some APs that students found confusing or ineffective were well received by fisherfolk, likely due to differences in lived experience and environmental knowledge. These results underscore the need for tailored messaging that aligns with the specific knowledge base, cultural context and priorities of the target audience.

Across both groups, three key principles emerged for designing effective environmental messages: (1) Emotional engagement, particularly through hope-based content, enhances message retention and motivation; (2) clear, behavioural guidance ensures that messages translate into action rather than passive concern; and (3) audience-specific customization is essential for maximizing relevance and impact, as different groups process environmental messages differently.

While our cluster analysis was sample specific, the underlying communication principles align with established environmental psychology theories. Future research should explore how these findings translate across diverse socio-economic and cultural contexts, particularly comparing Global South and Global North communities.

4.1 | The role of emotions for environmental action

The cluster analysis based on Sample 1 identified five stable categories of APs: The Engaging, The Intriguing, The Confusing, The Disturbing and The Pleasant (see Figure 3). The Engaging and Intriguing clusters emerged as the most effective in motivating environmental action, primarily due to their emotional impact and clear behavioural guidance. Emotions are known to play a significant role in environmental communication, as they can enhance engagement, improve message retention and encourage action (Bailey et al., 2014; Van Kleef et al., 2015). However, the type of emotion elicited and whether it was paired with actionable guidance determined the effectiveness of an AP.

The Engaging cluster, which recorded the highest scores across all characteristics, stood out for its hope-inducing content, reinforcing findings in environmental psychology that highlight the role of hope in fostering self-efficacy and long-term engagement (Leiserowitz, 2006; Ojala, 2012). According to the affect heuristic (Finucane et al., 2000; Slovic et al., 2002), individuals rely on emotions to guide decision-making, particularly in complex issues like environmental sustainability. This explains why APs that portrayed recovery and positive change, such as AP1, which depicted a thriving coral reef, and AP29, a video showcasing community-driven sustainable initiatives, were consistently rated as inspiring and actionable. Similarly, AP19, which provided dengue prevention tips through playful and colourful icons, successfully transformed a health-related environmental issue into an engaging and approachable message. These APs effectively communicated that change is possible and that individuals have the power to take meaningful action.

The Disturbing cluster heightened concern but was less effective in prompting behaviour change. Fear-inducing messages, such as AP22, which illustrated polluted coastal waters and their link to food poisoning in children, and AP5, which depicted live fish trade benefiting foreign markets rather than local communities, heightened awareness of environmental degradation. While these APs were effective in raising concern, they often lacked clear behavioural guidance, which may explain why they were less effective in prompting action. Research suggests that fear alone can lead to defensive avoidance, where individuals disengage due to feelings of helplessness (Markowitz & Guckian, 2018). This aligns with previous studies warning that excessive exposure to overwhelming problems without tangible solutions can result in apathy rather than engagement (O'Neill & Nicholson Cole, 2009).

The cluster analysis based on the data collected from Sample 2 identified three distinct clusters: the Uplifting, the Pessimistic and the Frustrating (see Figure 5). Similar to the findings from Sample 1, APs in the Uplifting cluster—those that combined positive emotional content with clear behavioural guidance—were the most effective in driving environmental engagement. These messages not only sparked curiosity but also increased participants' willingness to take action. For example, AP4, a video showcasing a thriving coral reef, and AP9, which illustrated alternative livelihood opportunities in seaweed farming, were particularly well received. These APs reinforced self-efficacy by demonstrating that conservation efforts and sustainable practices can lead to tangible environmental and economic benefits, aligning with prior research emphasising the role of hope in fostering long-term engagement with environmental issues (Brosch, 2021; Ojala, 2012).

While the Pessimistic cluster contained APs focused entirely on negative environmental trends, it still

performed significantly better than the Frustrating cluster. These APs, such as AP1, which depicted a coral reef in a state of severe degradation, and AP8 and visualised declining fish sizes over time due to overfishing, effectively raised awareness and concern. Despite the lack of explicit behavioural recommendations, these APs stimulated discussions and increased the likelihood of social media sharing, demonstrating that emotionally powerful messages—even those based on environmental loss—can drive engagement (Altinay & Williams, 2019; Markowitz & Guckian, 2018).

In contrast, APs in the Frustrating cluster, which lacked strong emotional or action-based components, were the least effective. These included AP25, which depicted littered beaches, and AP15, which illustrated unfair trade practices where middlemen profited while local fisherfolk struggled to earn fair wages. These messages failed to capture attention or inspire change, reinforcing that environmental communication must incorporate emotional engagement whether through hope or concern to be effective (Bailey et al., 2014; Devine Wright, 2013). The absence of a compelling emotional hook or actionable steps likely contributed to the limited impact of these APs, as prior research has shown that neutral or overly complex messages risk being ignored (Fischer et al., 2020; Richter et al., 2021). These findings emphasize that to drive meaningful behavioural change, environmental messages should balance emotional appeal with practical solutions, ensuring that audiences not only feel motivated to act but also know how to do so.

4.2 | The role of clear behavioural advice for environmental action

Our findings indicate that APs with specific behavioural guidance were significantly more effective in motivating action compared to those that relied solely on emotional engagement. APs in the Engaging and Uplifting clusters, which combined emotional appeal with clear, actionable recommendations, consistently outperformed those in the Confusing and Frustrating clusters. This aligns with research on implementation intentions, which emphasises that concrete behavioural advice enhances follow-through on environmental actions (Bamberg, 2002; Gollwitzer, 1999). For both students and fisherfolk, APs that outlined practical steps such as sustainable fishing techniques or waste reduction practices were rated as more impactful in shaping behaviour. These results support the Theory of Planned Behaviour (Ajzen, 1991), which highlights the importance of procedural knowledge and perceived behavioural control in decision-making. Participants were more likely to share and act upon APs that provided explicit recommendations rather than those that simply evoked concern.

The effectiveness of behavioural instructions was particularly evident among fisherfolk, who responded more positively to APs with clear solutions relevant to their livelihoods. This finding is in line with studies suggesting that message clarity and accessibility improve self-efficacy and increase the likelihood of pro-environmental behaviour (Richter et al., 2023). Additionally, APs featuring actionable steps were more likely to be revisited on social media, reinforcing their role in sustained engagement and long-term capacity building. These findings highlight that while emotional engagement is crucial in capturing attention, it must be paired with practical guidance to drive action. Without clear behavioural advice, even fear-inducing messages (e.g., illustrating marine degradation) risk disengagement rather than motivation. Our study underscores the need for environmental communication strategies that integrate emotional resonance with actionable steps, ensuring that individuals not only feel compelled to act but also know exactly how to do so (Webb et al., 2009; Webb & Sheeran, 2007).

4.3 | The role of message tailoring for environmental action

Our findings highlight the importance of audience-specific customization in environmental messaging, particularly in communities with distinct knowledge systems and lived experiences. While previous research has emphasized the need for culturally and contextually relevant communication (Bailey et al., 2014; Devine Wright, 2013; Nursey Bray, 2023), our study provides empirical evidence on how different groups students and fisherfolk respond to environmental messages differently.

For fisherfolk, APs with clear, practical guidance were most impactful (e.g., AP27 on dengue fever prevention), reinforcing the idea that hands-on experience enhances intuitive understanding of environmental messages (Fischer et al., 2020). Some APs that students found confusing, such as a video on seaweed farming (AP9), were perceived as relevant and actionable by fisherfolk, suggesting that direct engagement with marine ecosystems influences message clarity and perceived usefulness (Green & Appel, 2024). In contrast, students responded more positively to emotionally engaging messages, particularly those emphasising hope (e.g., AP 26 on replacing plastic bags). This aligns with research showing that younger audiences are more influenced by positive future scenarios and emotional framing (Ojala & Bengtsson, 2018). However, when APs were emotionally engaging but lacked clear behavioural guidance (e.g., AP8 on littering), student engagement decreased, suggesting that emotion alone might be insufficient to drive action in this group. Interestingly, fear-inducing content was consistently

categorised as a distinct and effective cluster across both groups (e.g., AP4 and AP5 on shifting baseline syndrome in fish size and life fish trade), reinforcing the idea that strong emotional arousal influences message processing (Brosch, 2021). However, while students reacted with curiosity, fisherfolk interpreted these messages as urgent, likely due to their proximity to environmental risks.

These findings suggest that audience knowledge and experience should guide message design, as messages that resonate with one group may not be effective for another. While co-creation ensures messages align with community priorities, ongoing evaluation and adaptation are necessary to refine communication strategies across diverse audiences. Our results show that even in what seems like one community on a small island, universal, one size fits all approaches to environmental messaging are unlikely to be effective (Markowitz & Guckian, 2018) and that tailoring communication based on audience-specific needs, experiences and cognitive processing styles is essential (Kim et al., 2020; Lorenzoni et al., 2007).

4.4 | Advice for practitioners

For those striving to craft compelling narratives, it is also important to know what to avoid. We caution against confusing or ambivalent messages and those lacking a sense of novelty. It is important for APs not to overwhelm with too many complex details or a cluttered layout. The imperative should be clarity and conciseness. An audience confronted with complex language, excessive informational content, ambiguity, or disorganized structure is prone to disengagement, thereby hindering the learning process. Messages that do not have strong emotions might not capture people's attention or feelings, making them easy to forget. This sentiment echoes research by Richter et al. (2021), who found that future scenarios lacking emotional content and merely presenting foreseeable predictions were insufficient in instigating behaviour change, and at times, even caused adverse outcomes. Another piece of advice is for messages to incorporate novel insights or a distinctive perspective. Such innovative content enhances the likelihood of dissemination within academic and social circles (Vosoughi et al., 2018). A testament to this was the COVID 19 pandemic, during which the novelty of information predominantly dictated the virality of Tweets (Photiou et al., 2021).

5 | LIMITATIONS

To reach a sufficient sample size, we conducted the first data collection with students from the local university in Puerto Princesa. Engaging students, rather than a more representative sample of the Palawan population, is one potential limitation of this research and could imply that the results are unique to a student population. Nonetheless, the purpose of this data collection was to identify potential patterns in the data. With the second sample, we aimed to counteract the potential sampling bias by recruiting local fisherfolks to test a selection of the APs. The main limitation of the second data collection is the smaller sample size, which is due to the difficulty of recruiting fisherfolk for a voluntary research purpose.

Additionally, the narrowed set of APs and variables used in the second study could have inherently influenced the resulting cluster solution. We thus advocate for replicating this design across multiple samples, with the amendment that subsequent studies maintain a consistent number of APs and variables across samples. This consistency ensures that discerned clusters and potent communication traits are attributed solely to audience resonance, eliminating potential methodological artefacts.

Another limitation is that while participants evaluated each AP's perceived clarity, emotional impact and motivational potential, we did not measure actual behavioural or attitudinal change. The outcome measures relied on self-reported intentions and perceptions, which may not translate into real world action.

Furthermore, although the APs were developed through a participatory co-creation process, the study design did not include a comparison group using non-co-created materials. As such, we cannot isolate the specific added value of co-creation itself in driving environmental engagement. Because the creators and evaluators came from overlapping networks, social desirability, community pride, or affinity with the programme may have inflated ratings. A future step is to test the same APs with audiences who were not involved in their development, or to include a control set of top-down messages to isolate the incremental impact of co-creation and relational context. Future research could also directly compare co-created and externally designed messages to quantify the specific benefits of participatory communication.

6 | CONCLUSION

Our study highlights key principles for effective environmental communication: (1) emotional engagement, particularly through hope, (2) clear, actionable behavioural guidance and (3) audience-tailored messaging that resonates with local knowledge and experiences. By categorising co-created environmental messages into distinct clusters, we identified which strategies best drive climate action in diverse communities. The co-creation approach proved essential in increasing message relevance, strengthening community agency and fostering

engagement. Our findings emphasise that bottom-up, participatory methods enhance communication effectiveness, especially in regions where traditional top-down strategies may not translate effectively. For policymakers and practitioners, this research provides actionable insights into designing communication campaigns that motivate real behavioural change. Future studies should test these principles across diverse cultural and socioeconomic settings to further refine environmental messaging strategies.

AUTHOR CONTRIBUTIONS

Isabell Richter: Conceptualization; formal analysis; investigation; methodology; project administration; resources; visualization; writing – original draft. **Elisabeth Gabe-Thomas:** Conceptualization; data curation; formal analysis; methodology; visualization; writing – review and editing. **Arlene Avillanosa:** Investigation; methodology; writing – review and editing. **Joel Sumeldan:** Investigation; writing – review and editing. **Lota Creencia:** Funding acquisition; methodology; supervision; writing – review and editing. **Sabine Pahl:** Funding acquisition; methodology; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data and materials supporting the findings of this study are openly available in Zenodo at https://zenodo.org/doi/10.5281/zenodo.10402550. This dataset includes all relevant data and materials used in the analysis, ensuring transparency and reproducibility of the results presented in this manuscript.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the National Ethics Committee of the Department of Science and Technology (NEC Code: 2019-002-Creencia-Blue) and University of Exeter Medical School Research Ethics Committee (approval reference: May19/B/185). The participants provided their written informed consent to participate in this study.

RESEARCH MATERIALS AVAILABILITY STATEMENT

The data and materials supporting the findings of this study are openly available in Zenodo at https://doi.org/10.5281/zenodo.10402550. This dataset includes all relevant data and materials used in the analysis, ensuring transparency and reproducibility of the results presented in this manuscript.

PRE-REGISTRATION STATEMENT

This study was not pre-registered.

ORCID

Isabell Richter https://orcid.org/0000-0003-1196-2769

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AUTHOR BIOGRAPHIES

Isabell Richter, PhD, Associate Professor at the Norwegian University of Science and Technology, specializes in environmental psychology. Her research in the Citizens, Environment and Safety Group focuses on the interaction between individuals and (marine) environments, emphasizing the use of creative communication to enhance environmental awareness and engagement.

Elizabeth Gabe-Thomas, PhD, a researcher in the Sea & Society section at Plymouth Marine Laboratory, UK, has expertise in examining the complex relationship between marine environments and societal well-being. She is specialised in quantitative methods and collaborates interdisciplinary in projects working on improving benefits for both, ecosystems and communities.

Arlene Avillanosa, PhD, Associate Professor at the College of Fisheries and Aquatic Sciences, Western Philippines University, conducts research in aquaculture and fisheries genetics. With a background in biotechnology, fish genetics and resource management, she contributes to the field through her work on marine biodiversity and the health management of species with aquaculture potential.

Lota Creencia, with her PhD in Fisheries Science from Kagoshima University, Japan, brings knowledge and experience to her role as professor at the College of Fisheries and Aquatic Sciences, Western Philippines University. Her specialization in abalone biology, marine ecology and community-based aquaculture management advances fisheries management and conservation practices.

Mr. **Joel Sumeldan**, serving as a Research Assistant at the College of Fisheries and Aquatic Sciences, Western Philippines University, focuses on monitoring and analysing water and soil quality, particularly in relation to harmful algal blooms.

Sabine Pahl, PhD, Professor of Social Psychology, is leading the Urban and Environmental Psychology Group in Vienna. Her research addresses the human dimensions of environmental issues, particularly in marine environment protection and energy efficiency. Through her applied work, she aims to influence behavioural changes and policy, making significant contributions to both academic research and practical environmental solutions.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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