

VISUAL POSTER DESIGN ABOUT MARINE MICROPLASTIC POLLUTION

Siyu Zhou¹, Supawadee Juysukha²

^{1,2}*Faculty of Visual Arts and Design, Graduate School,*

Suan Sunandha Rajabhat University, Bangkok, Thailand

E-Mail: s67563832001@ssru.ac.th¹, Supawadee.ju@ssru.ac.th²

ABSTRACT

This paper analyzes the current state of marine microplastic pollution and clarifies the crucial role of information visualization in environmental communication. Based on a review of research progress and public awareness regarding marine microplastic pollution, it finds that current science communication relies primarily on academic papers and reports, which suffer from abstract information expression, difficulty in comprehension, and a lack of emotional resonance. This limits the public's effective understanding of the concept, sources, and hazards of microplastics. Therefore, this paper uses information visualization posters as the research object, combining relevant theories of environmental communication and visual design to explore how to transform complex scientific data into visually understandable and perceptible information through visual structure, information hierarchy, and emotional expression. The research aims to explore the potential role of information visualization posters in enhancing public environmental awareness and participation, providing theoretical reference and practical direction for interdisciplinary research in environmental communication and visual design.

Keywords: Microplastic pollution, Information visualization, Environmental communication, Visual design

INTRODUCTION

The invention and widespread use of plastics were once hailed as an achievement of modern industry. However, its environmental residues, especially marine microplastics with a diameter of less than 5 millimeters, are gradually evolving into a global ecological crisis. These fragments, originating from cosmetic microparticles, textile fibers, or the degradation of large plastic items, are now found in oceans worldwide, from nearshore to open ocean, from the surface to deep-sea sediments, and even invading polar glaciers. They not only directly threaten the survival of marine life but also enter organisms through the food chain, potentially carrying pollutants and ultimately impacting human health (Brahney et al., 2020; Galloway et al., 2017). Unlike relatively "visible" environmental problems such as climate change and air pollution, marine microplastics, due to their extremely small size, long-term cumulative effects, and uncertainties, are not easily perceived by the public, thus failing to evoke a sense of urgency and a willingness to act, posing a unique challenge in public communication.

Currently, research on marine microplastics is mainly concentrated in environmental science and ecology, with findings presented primarily in highly specialized academic papers and technical reports (Andrady, 2011; Thompson et al., 2004). While this research is crucial, the abundance of technical terminology, complex data, and abstract models increases the difficulty for the public to understand. Studies show that the public has basic knowledge of "plastic waste," but their understanding of the specific

concept of "microplastics," its multiple sources, migration pathways, and long-term harms remains quite limited and vague (Hossain, 2024). This cognitive gap reflects the inadequacy of traditional science communication models in translating professional knowledge into information acceptable to the public, particularly in visual presentation, emotional connection, and storytelling.

In the field of environmental policy and planning, visualization is also seen as an important bridge connecting science, policy, and the public (Metze, 2020). Furthermore, posters, as a readily disseminated and widely accessible print medium, have a significant impact on information reception and emotional engagement through their visual structure and design strategies. Research indicates that visual hierarchy, color schemes, and typography not only affect readability and dissemination efficiency but also influence audience understanding and emotional engagement with the subject matter (Puenpong, 2024). This suggests that when addressing complex environmental issues, poster visual design not only serves to "convey information" but can also become a crucial medium for constructing narratives, shaping risk perception, and evoking public resonance. However, existing research largely focuses on macro-level environmental issues or general visualization methods, lacking systematic, evidence-based visual communication design studies specifically addressing "invisible pollution" such as marine microplastics. Specifically, how to design information visualization works that, while ensuring scientific rigor, effectively evoke public emotional resonance, guide cognitive understanding, and even promote behavioral change, requires further in-depth exploration regarding specific strategies, pathways, and effectiveness evaluation.

Therefore, this study directly addresses the "public communication dilemma of marine microplastic pollution," focusing on information visualization posters as its core research object. It aims to respond to the following key questions: Given the highly abstract and specialized nature of microplastic information dissemination, how can visual design transform scientific data into an informational form that is easily understood, perceived, and evokes emotional resonance in the public, thereby effectively enhancing public awareness and willingness to participate? This research will explore visual structure, information hierarchy, and emotional expression mechanisms, combined with specific design practices and effect evaluations, aiming to provide a solution with both theoretical insights and practical value for the interdisciplinary field of environmental communication and visual design. Therefore, utilizing information visualization design to transform scientific data into a visual form that is easily understood and evokes emotional resonance is of great significance for enhancing public environmental awareness and willingness to participate. It can fill the knowledge gap in the interdisciplinary field of science communication and visual design, providing an operable design path for environmental communication practice, and possesses certain academic value and social significance.

OBJECTIVE

This study aims to develop effective visual solutions for the scientific communication of marine microplastic pollution through design research and analysis. Specific objectives are as follows:

1. Analyze representative information visualization poster cases in domestic and international environmental communication, summarizing their main characteristics and shortcomings in design structure, visual narrative, and scientific expression.
2. To assess the differences in the impact of different information visualization design elements (such as color schemes, graphic symbol types, and data chart formats) on the efficiency of information comprehension and emotional response of non-professional audiences.

3. Develop a set of principles and design guidelines for the visual transformation of information visualization on the theme of "marine microplastic pollution," improving communication effectiveness while ensuring scientific accuracy.

4. Construct a framework applicable in design practice, providing methodological support for cultivating scientific communication design and sustainable design capabilities in the environmental field.

METHODOLOGY

This study focuses on the design of information visualization posters on the theme of marine microplastic pollution, aiming to explore the communication effects of information visualization in enhancing public awareness and emotional resonance.

1. Literature Analysis: This study systematically reviews and summarizes relevant domestic and international literature on marine microplastic pollution, information visualization, and environmental communication. The aim is to construct a theoretical framework for the research, clarify the mechanism of information visualization in environmental communication, and summarize the visual strategies and shortcomings in existing design practices, providing a theoretical basis for subsequent design interventions.

2. Case Study: This study selects representative information visualization posters and visual projects in the field of environmental communication as cases. Based on design theory, it conducts in-depth analysis of their visual structure, information hierarchy, and emotional expression mechanisms. Through comparison, it extracts effective design principles and visual frameworks applicable to the theme of marine microplastics.

RESULTS

Based on a literature review and comparative analysis of multiple cases, this study summarizes a series of key patterns and phased findings regarding the visual communication of marine microplastic pollution. The research results are mainly presented in three levels: (1) the main problems in current environmental visual communication practices, (2) the common characteristics of effective visualization design, and (3) the significance of constructing and applying an integrated conceptual framework for design schemes.

1. Major Shortcomings in Current Visual Communication Practices

Existing visual communication works on the topic of marine microplastic pollution generally struggle to strike a balance between scientific accuracy and public comprehensibility. Their core shortcomings are mainly reflected in the following three aspects:

First, some environmental posters rely excessively on emotional symbolic expressions (such as dead marine life, polluted beaches, and abstract crisis symbols). While these designs have a strong visual impact, they often lack explanations of the scientific mechanisms involved, failing to clearly explain how microplastics form, spread, and accumulate in the food chain. Therefore, while audiences may experience a brief emotional shock, they are unlikely to develop a stable understanding of "what microplastics are" and "how they affect ecology and humanity."

Second, another type of work tends to directly present statistical data and charts from scientific reports. While maintaining scientific accuracy, the dense text, complex indicators, and numerous labels

can easily lead to information overload. These posters often assume the audience has a high level of scientific literacy, which is mismatched with the actual cognitive level of the general public, resulting in decreased communication efficiency and affecting their persuasiveness and effectiveness.

Third, case studies show that many existing works lack a coherent narrative structure. Information is often presented in a fragmented manner, lacking an organized causal relationship. This makes it difficult for viewers to connect the sources, transmission routes, ecological consequences, and human health risks of microplastics into a complete logical system, resulting in a "fragmentation of understanding" in communication.

Overall, current visual communication regarding marine microplastics exhibits a clear polarization: one type is "emotionally strong but lacking mechanistic explanations," while the other is "scientifically rigorous but lacking narrative appeal." This makes it difficult for communication works to simultaneously achieve cognitive understanding and emotional resonance.

2.Common Characteristics of Successful Cases

Through case comparison, this study found that successful environmental visualization posters share highly consistent structural characteristics. Their success in dissemination does not solely rely on aesthetic expression, but rather on their ability to transform complex scientific knowledge into visually understandable logic.

(1) Narrative-Driven Approach: Integrating data points into a "storyline" with temporal, spatial, or causal logic transforms data paths into easily understood cognitive paths, lowering the public's comprehension threshold and helping them understand dynamic processes and their relevance to themselves.

(2) Clear Scientific Logic: All visual expressions are based on reliable data, using complete data labels and clear source attributions to ensure the credibility and traceability of information.

(3) Clear Visual Concepts: Employing strong visual metaphors, clear information hierarchy and grouping mechanisms (such as differentiating primary and secondary information through color, size, and position), and guiding compositions (such as arrows and numbered sequences), actively guides the viewer's gaze and cognitive sequence, helping them gradually acquire information along a set path, thereby reducing cognitive burden and making complex content more readily accepted.

(4) Emotion and reason work together: Emotional elements (such as impactful images and emotionally charged colors) are closely integrated with the scientific mechanisms being explained, making emotion a catalyst for deeper understanding rather than a tool to replace facts.

3.Core Design Principles for Addressing Marine Microplastics

Based on the above analysis and considering the characteristics of marine microplastic pollution, such as its "small size" and "hidden nature," this study further refines four key information visualization design principles to guide future design practices:

(1) Narrative-driven visualization: Emphasizing the construction of contextualized and mechanistic visual narratives, rather than simply listing charts (e.g., expressing the migration path of pollutants from the pollution source to their final ecological impact and potential risks to human health).

- (2) Adhering to rigorous scientific visual expression: Visual transformation must be faithful to the data, avoiding oversimplification that could lead to misunderstandings, and clearly indicating the data sources.
- (3) Maintaining a clear visual hierarchy and cognitive guidance: Proactively managing the audience's attention through design methods to reduce their cognitive burden and ensure that key information is prioritized.
- (4) Combining emotional resonance with rational education: On the basis of accurately conveying scientific facts, strategically using visual techniques to evoke emotional resonance and promote changes in attitudes and behavioral intentions.

4. Construction of an Integrated Conceptual Framework for Design

To further translate the above principles into actionable design methods, this study proposes an integrated conceptual framework for the topic of marine microplastics, to guide the design practice of information visualization posters.

This framework consists of two core driving forces:

- (1) Scientifically Precise Visual Transformation: Ensuring that environmental data is accurately transformed into visual elements, including symbol systems, chart structures, typography systems, and data expression methods.
- (2) Resonance-Oriented Environmental Narrative Construction: Ensuring that information organization is story-driven and perceptible, thereby stimulating public awareness of responsibility, sense of crisis, and behavioral intentions.

Within this framework, the visual transformation process can be divided into three consecutive stages:

- (1) Scientific Data Interpretation Stage: Extract key microplastic indicators, including pollution sources, spatial distribution, particle size, ecological migration pathways, and risk evidence.
- (2) Narrative Mapping Stage: Organize data into causal chains and construct clear reading paths (e.g., timelines, flowcharts, food chain structures, or system grid diagrams).
- (3) Visual Expression Stage: Achieve a balance between scientific clarity and emotional appeal through color schemes, graphic symbols, and hierarchical layout design.

This framework not only provides systematic guidance for the design practice of this study but also aims to offer an adaptable visual transformation method for science communication on similar complex and abstract environmental issues.

CONCLUSION AND FUTURE WORK

This study systematically explores the application potential and design pathways of information visualization in the science communication of marine microplastic pollution. Through literature and case analysis, it clarifies the core problem of the disconnect between scientific content and visual narrative in current communication practices and successfully extracts a set of key design principles for this type of "invisible" pollutant: narrative-driven, scientifically rigorous, clearly hierarchical, and combining reason and emotion. Furthermore, this study constructs an integrated conceptual framework, providing

systematic guidance for transforming complex scientific data into effective public visual communication products.

The theoretical contribution of this study lies in bridging the disciplinary gaps between environmental science, communication studies, and visual design, providing a visual transformation methodology for specific scientific issues in the field of "environmental communication design." Its practical significance lies in the fact that the proposed principles and framework can directly provide designers, environmental educators, and communication organizations with actionable design strategies and tools, enhancing the professionalism and effectiveness of environmental visual communication, thereby contributing to the improvement of public environmental awareness.

Future work will primarily focus on the following areas:

1. Empirical Verification: Based on the methods developed in this study, a comprehensive questionnaire survey and interviews will be conducted to collect quantitative and qualitative data. The effectiveness of the proposed design principles and framework in actual communication will be rigorously tested to validate the research hypothesis.

2. Design Refinement and Testing: Based on the integrated framework, a series of visual information posters on marine microplastics will be designed and produced. Controlled audience experiments will be conducted to evaluate the specific differences in the impact of different design strategies on cognitive enhancement, emotional arousal, and behavioral intention.

3. Framework Expansion and Application: The application of the visual transformation framework constructed in this study to the science communication of other complex and abstract environmental issues (such as global warming and biodiversity) will be explored to test its applicability.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to Suan Sunandha Rajabhat University for invaluable help throughout this research.

REFERENCES

- Brahney, J., Hallerud, M., Heim, E., Hahnenberger, M., & Sukumaran, S. (2020). Plastic rain in protected areas of the United States. *Science*, 368(6496), 1257-1260.
- Galloway, T. S., Cole, M., & Lewis, C. (2017). Interactions of microplastic debris throughout the marine ecosystem. *Nature Ecology & Evolution*, 1(5), 0116.
- Andrady, A. L. (2011). Microplastics in the marine environment. *Marine Pollution Bulletin*, 62(8), 1596-1605.
- Hossain, M. S. (2024). People's attitudes regarding plastics and microplastics pollution: Perceptions, behaviors, and policy implications. *Marine Policy*, 165, 106219.
- Segel, M., & Heer, J. (2010). Narrative visualization: Telling stories with data. *IEEE Transactions on Visualization and Computer Graphics*, 16(6), 1139-1148.
- Puenpong, S. (2024). Visual communication design of Thai movie print media. *FOCUS ON ARTS*, 1(1), 20-27.
- Metze, T. (2020). Visualization in environmental policy and planning: A systematic review and research agenda. *Journal of Environmental Policy and Planning*, 22(5), 745-760.