

Art-Based Education on Climate Change and Sustainability in Museums: Towards a Pedagogy of Interconnectedness

Maria Daskolia, Lydia Exarchou

Department of Educational Studies, National and Kapodistrian University of Athens (NKUA), Athens, Greece
Email: mdaskol@eds.uoa.gr, lexarchou@eds.uoa.gr

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Abstract

Dominant approaches to climate change education have traditionally relied on top-down models emphasizing the transmission of scientific knowledge and behavior change strategies. While valuable, these approaches often overlook the affective, imaginative, and relational dimensions of learning. Emerging scholarship advocates for interdisciplinary and arts-informed approaches that foreground emotional engagement, embodied experience, and narrative meaning-making. Central to this shift is the concept of a pedagogy of interconnectedness, which promotes relational thinking, critical reflection on socio-cultural values, and the co-creation of sustainable futures. Museums are increasingly recognized as key sites of public pedagogy, offering immersive and participatory environments that foster climate literacy and civic engagement. Art-based practices in museum settings translate abstract climate knowledge into experiential and emotionally resonant forms, bridging the gap between understanding and action. This paper presents a structured literature review of art-based approaches to climate change education in museums. The findings highlight the growing role of museums as spaces for transformative learning and demonstrate how art-based education can empower learners and visitors as active participants in climate action and sustainability transitions.

Keywords

Art-Based Education, Climate Change Education, Pedagogy of Interconnectedness, Museum Education, Public Pedagogy

1. Introduction

The concept of climate literacy has gained increasing prominence, referring not merely to the understanding of climate systems, but also to the ability to interpret,

communicate, and act upon climate-related knowledge in contextually relevant ways. Climate literacy encompasses scientific comprehension as well as socio-cultural, ethical, and behavioral dimensions that are essential for informed decision-making and active engagement with climate challenges (Moser & Dilling, 2011; Monroe et al., 2019). It emphasizes the integration of knowledge, skills, and values to empower individuals and communities to critically evaluate climate information, participate in public discourse, and implement context-sensitive mitigation and adaptation strategies (Cutter et al., 2008; Renn et al., 2026). Within educational settings, fostering climate literacy requires pedagogical approaches that combine cognitive understanding with affective engagement and participatory learning, enabling learners to connect climate science with personal and collective action (Jorgenson et al., 2019; Leiserowitz et al., 2021; Reid, 2019).

Despite this growing recognition, prevailing models of climate change education remain predominantly rooted in positivist epistemologies, privileging knowledge acquisition and behavior modification while often neglecting affective, ethical, and relational dimensions of learning (Bentz, 2020; Lehtonen et al., 2018). Recent scholarship has increasingly critiqued this narrow framing, advocating for more holistic and transformative educational paradigms that foreground emotion, creativity, and critical reflection (Cameron, 2012; Hannigan et al., 2025). In particular, art-based approaches have emerged as powerful mediating tools that bridge scientific knowledge with lived experience. Through visual representation, metaphor, storytelling, and sensory engagement, art enables learners to encounter climate change not merely as an abstract global phenomenon but as an emotionally and culturally embedded reality (Raaijmakers et al., 2021; Bentz, 2020). Such approaches expand the epistemological boundaries of climate education by incorporating imagination, empathy, and the capacity to envision alternative, sustainable futures (Hannigan et al., 2025; Lehtonen et al., 2018).

Building on this expanded understanding of learning, there is a growing need for pedagogical models that move beyond fragmented and disciplinary responses to climate change toward more relational and systemic forms of education. One such model is a *pedagogy of interconnectedness*, understood here, drawing on Lehtonen et al. (2018), as an educational approach that emphasizes the relational and interdependent character of learning by highlighting the connections among human communities, ecological systems, and cultural practices. In the context of climate change education, it seeks to cultivate critical understanding, affective engagement, ethical reflection, and a sense of shared responsibility and agency toward more just and sustainable futures. This understanding also resonates with UNESCO's (2021) call for education to rebuild our relationships with one another, with the planet, and with technology.

Despite this potential, climate change remains marginal within humanities and arts education, reflecting a persistent disciplinary divide (Bentz, 2020). Addressing this gap is critical, as the complexity of climate change demands interdisciplinary engagement that integrates scientific, cultural, ethical, and artistic perspectives.

Within this context, museums offer a particularly fertile ground for rethinking climate change education. As hybrid spaces situated between formal and informal learning, museums enable experiential, dialogic, and socially situated encounters with complex sustainability issues (McGhie, 2020; Rees & Leal Filho, 2018). In this study, museums are understood as both sites of museum education and spaces of public pedagogy, where informal and socially situated learning takes place, reflecting their hybrid role at the intersection of structured educational programming and broader processes of meaning-making in the public sphere (Hooper-Greenhill, 1999; Sandlin et al., 2010; Falk & Dierking, 2013). In particular, they provide conditions for art-based practices into climate communication, thereby fostering deeper forms of engagement, in which visitors can connect cognitively, emotionally, and ethically with climate-related themes. Such approaches support reflection, imagination, and the capacity to envision and orient toward more sustainable futures (Cameron et al., 2012; Sutton, 2020).

Building on this perspective, this paper contributes to the emerging field of art-based climate education in museum contexts by exploring how such practices can operationalize a pedagogy of interconnectedness, fostering transformative forms of climate learning, futures literacy, and climate agency among children and young people.

2. “Pedagogy of Interconnectedness” through Art-Based Education

The notion of a pedagogy of interconnectedness arises from the recognition that climate change is a “wicked problem” characterized by complexity, uncertainty, and deep entanglements between ecological, social, cultural, and political systems (Rittel & Webber, 1973; Lehtonen et al., 2018). Such problems cannot be effectively addressed through fragmented, discipline-bound knowledge; instead, they require integrative modes of thinking that foreground relationality, interdependence, and systems awareness (Sterling, 2011). Interconnected pedagogical approaches thus emphasize holistic understanding, encouraging learners to perceive the relationships among human, non-human, and environmental dimensions.

Art, as both a cultural and communicative practice, is uniquely positioned to support such integrative learning. Historically, art has responded to and catalyzed social transformations, evolving from purely aesthetic representation toward participatory, socially engaged, and interdisciplinary forms (Bamford, 2006; Bentz, 2020). Its mediating capacity lies in rendering the invisible visible, evoking emotional responses, and opening spaces for alternative imaginaries and futures (Hannigan et al., 2025; Raaijmakers et al., 2021). By engaging multiple senses and forms of representation, art fosters embodied understanding, enabling learners to connect affectively and cognitively with climate issues (Cameron et al., 2012).

Within this framework, art-based education supports a shift from transmissive to transformative learning. Learners encounter climate change through visual, performative, and narrative modalities, integrating knowledge, emotion, and eth-

ical reflection. This aligns with the principles of interconnectedness, emphasizing that cognition, emotion, and action are inseparable and that humans are embedded within ecological and social systems (Lehtonen et al., 2018; Hannigan et al., 2025).

A pedagogy of interconnectedness also entails a critical dimension. It invites learners to interrogate dominant cultural narratives, socio-political values, and power structures that underpin environmental degradation, while simultaneously fostering imagination and co-creation of alternative, sustainable futures (Sterling, 2011; Bentz, 2020). In this sense, art-based approaches do not merely convey information about climate change—they reframe it as a lived, relational, and ethically charged phenomenon.

Museums, understood here as both sites of museum education and spaces of public pedagogy (as introduced above), are particularly well-suited to operationalize this pedagogy. Contemporary museology increasingly positions museums as socially responsive institutions that engage with pressing global challenges (McGhie, 2020; Rees & Leal Filho, 2018). Through exhibitions, participatory programs, interdisciplinary collaborations, and community engagement, museums create environments that foster dialogue, reflection, and collective meaning-making (Sutton, 2020; Hannigan et al., 2025). By integrating art-based methodologies—such as immersive installations, storytelling, and co-creative activities—museum education can move beyond knowledge transmission toward transformative engagement, cultivating not only climate literacy but also empathy, agency, and a sense of interconnectedness among visitors (Cameron, 2012; Raaijmakers et al., 2021).

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3. Methodology

This study adopts a structured literature review to critically explore the role of art-based education in museum-based climate change learning. Structured reviews offer a transparent and methodical approach to synthesizing literature while accommodating the conceptual and methodological diversity typical of interdisciplinary research (Grant & Booth, 2009; Boland, Cherry, & Dickson, 2017; Petticrew & Roberts, 2006). This approach balances the systematic identification and evaluation of studies with flexibility in dealing with heterogeneous sources, making it particularly suitable for integrating insights from climate change education, museum studies, and arts-based pedagogy.

The literature search was conducted across multiple academic databases and research platforms, including Google Scholar, Scopus, ProQuest, ERIC, Education Source, and Academia.edu. Key search terms included “art-based education”, “cli-

mate change education”, “museum education”, and “pedagogy of interconnectedness”, and “public pedagogy”, combined using Boolean operators. While no strict temporal limitations were applied, studies published within the last two decades were prioritized to capture contemporary trends in climate communication and museum engagement.

A set of inclusion and exclusion criteria was applied to ensure relevance and scholarly rigor. Studies were included if they addressed climate change education in museum or informal learning contexts, employed art-based, interdisciplinary, or participatory approaches, and provided empirical data, theoretical frameworks, or well-documented case studies. Studies were excluded if they focused solely on formal education, lacked methodological clarity, or addressed environmental education without explicit engagement with climate change. A two-stage screening process—title/abstract review followed by full-text evaluation—resulted in a final sample of fifteen studies.

Thematic analysis was used to examine the selected studies, allowing for identification of recurring patterns, concepts, and analytical categories (Braun & Clarke, 2006). Coding was iterative, combining inductive and deductive strategies to capture both emergent themes and pre-defined conceptual dimensions. Four main analytical dimensions were identified: a) institutional roles of museums, b) educational objectives, c) pedagogical approaches and methods, and d) emerging trends. This structure facilitated a systematic synthesis and supported interpretation of findings in relation to the concept of a pedagogy of interconnectedness.

While the structured review provides a rigorous and transparent framework, limitations include the small number of selected studies, potential database bias, and heterogeneity of methodologies and contexts, which constrain direct comparability. Nonetheless, the approach offers a coherent, analytically grounded overview of research trends and lays the foundation for further empirical and theoretical investigation in museum-based climate change education.

4. Findings

4.1. Data Description

Table 1 presents a structured synthesis of the reviewed studies, highlighting their methodological approaches, art-based pedagogical strategies, and contributions to the development of a pedagogy of interconnectedness in museum-based climate change education.

The reviewed studies collectively illustrate a significant transformation in how museums conceptualize and operationalize their role in climate change education. Rather than functioning as neutral repositories of knowledge, museums are increasingly positioned as active agents of environmental communication, public engagement, and social transformation (Cameron, 2012; McGhie, 2020; Newell, 2020). This shift reflects broader developments in museum studies, where institutions are reconceptualized as spaces of *public pedagogy* that mediate complex socio-environmental issues and facilitate civic participation (Salazar, 2015; Biesta, 2012).

Table 1. Overview and thematic synthesis of studies on museum-based climate change education and pedagogy of interconnectedness.

Study Author(s)	Year	Country/ Context	Participants/ Audience	Methodology	Art-Based Approach	Key Findings/ Outcomes	Notes/Relevance to Pedagogy of Interconnectedness
Hebda	2007	Canada/Natural history museums and environmental education context	Public visitors	Qualitative (case study and conceptual analysis)	Visual and interpretive strategies (e.g., imagery, exhibitions, environmental representations, future scenario visualizations)	Demonstrates how interpretive exhibition strategies enhance environmental awareness and support informed decision-making and pro-environmental attitudes; museums can act as spaces for meaningful public engagement with climate change	Integrates environmental, cultural and historical dimensions, fostering temporal and systemic understanding of human-nature relationships
Cameron	2012	Australia-USA/ Natural history museums, science museums and science centres	Public visitors	Qualitative and quantitative	Performative, dialogic practices	Reframes climate change as a socio-cultural issue, emphasizing public dialogue and interpretive engagement	Advances relational epistemologies by challenging nature-culture dichotomies and fostering reflective and meaning-making
Cameron, Hodge & Salazar	2012	Australia-USA/ Natural history museums, science museums and science centres	Public visitors	Qualitative/ interdisciplinary research (case-based and conceptual synthesis)	Immersive exhibitions, multimedia environments, narrative co-creation, participatory and dialogic practices	Enhances cognitive, affective and participatory engagement; positions museums as trusted spaces for dialogue and co-creation of climate narratives	Supports relational, participatory and multi-sensory learning; integration of science, culture and experience; and co-construction of knowledge across scientific and cultural domains
Swim & Fraser	2013	USA/Informal science education and museum education context	Informal science educators, museum educators	Quantitative/ program evaluation (survey-based)	Emotion-based engagement strategies (e.g., fostering hope and affective responses)	Strengthens educators' sense of hope, self-efficacy, emotional resilience, and willingness to engage in climate communication; underlines the importance of affect in climate education	Highlights the integration of affect, cognition, and action in fostering agency and engagement
Salazar	2015	Global/Museum and media studies context	Public visitors, citizens, museum audiences	Theoretical/ conceptual analysis	Participatory and media-based practices, dialogic and collaborative processes	Positions museums as mediating platforms for civic engagement and public pedagogy on climate change	Emphasizes networked, participatory knowledge production and relational learning across social, cultural and environmental systems

Continued

Lackner, Mohankumar, Damert, Petz, Meyer, Klug & Reiter	2018	Austria/Museum setting (science and environmental communication context)	Public visitors	Qualitative (case study)	Interactive exhibitions, games, multimedia, standalone exhibits, posters and hands-on activities	Demonstrates that interactive and experiential exhibits enhance engagement and comprehension of complex climate concepts	Promotes active, experiential and participatory learning, integrating cognitive and sensory dimensions
McGhie, Mander & Underhill	2018	UK/Museums and climate communication context	Public visitors	Qualitative (applied and conceptual analysis)	Participatory and engagement-based practices, exhibitions, interpretive and communication strategies	Shows that emotionally engaging exhibitions can motivate behavioral reflection and meaningful public participation in climate action	Links emotional engagement with social action, emphasizing value-based and participatory learning
Rees & Leal Filho	2018	Global/Museums and climate communication	Public visitors	Conceptual/applied analysis	Storytelling, exhibitions, communication and engagement strategies	Identifies storytelling as a key mechanism for activating public awareness and informed action and engagement with climate change	Connects knowledge dissemination with action-oriented engagement at a global and societal scale
Collins	2020	United Kingdom/Archaeological museums and heritage settings	Public visitors	Qualitative (doctoral research; case studies, interviews, interpretive analysis)	Collaborative and participatory practices, interpretive storytelling, exhibition-based engagement	Demonstrates how cultural narratives foster emotional engagement, critical reflection and personal connection to climate change	Emphasizes emotional engagement, cultural interpretation and relational understanding of climate change through heritage and identity
Hamilton & Ronning	2020	USA/Informal learning environments	Public visitors, community groups	Qualitative (case-based, practice-oriented framework; public engagement model)	Dialogic and participatory practices, public forums, demonstration projects, community engagement activities	Promotes scientific literacy, collective climate action and public dialogue; shifts focus from individual to collective responsibility	Highlights collective agency, community-based learning and the role of museums as conveners connecting diverse social, scientific and cultural perspectives
McGhie	2020	UK/Museum policy and sustainability context	Museum sector, institutions, public (indirectly)	Conceptual/policy analysis	Not explicitly art-based; strategic and participatory approaches embedded in museum practice	Emphasizes the role of museums in aligning with global sustainability frameworks (e.g., SDGs) to support climate action; fosters institutional change and collective responsibility	Supports systemic thinking, global interconnections and the integration of social, environmental and institutional dimensions

Continued

Newell	2020	Global/Climate museums and museum practice	Public visitors	Conceptual/ practice-based analysis (drawing on case examples)	Interactive exhibitions, participatory and experiential practices, community collaborations	Shows how climate museums can foster climate-oriented engagement and empower visitors as active agents	Connects individual experience with broader societal change by promoting systems thinking, integration of knowledge and action
Sutton	2020	Global/Museum practice and sustainability context	Public visitors, museum professionals, wider society	Conceptual/ practice-based analysis	Oral history, artistic and narrative practices, collection-based engagement	Highlights museums' ethical responsibility to address climate change and promote sustainability through cultural engagement, learning and action	Integrates cultural heritage with environmental awareness and social responsibility, supporting holistic and relational learning
Nieroba & Geisler	2025	Global/Museum case studies (climate change discourse)	Institutional documents (museum strategies, policy texts and discourse)	Qualitative (case study analysis; critical discourse analysis)	Exhibition narratives, interpretive and curatorial strategies (setting examples, providing tools and resources)	Demonstrates how museums construct and frame climate change discourse through institutional narratives, shaping meanings and priorities	Emphasizes systemic and discursive interconnectedness between knowledge, policy, and cultural representation
Hannigan, Hradsky, Bellingham, Raphael & White	2025	Global/Educational programs (formal and informal learning contexts, including museums)	Students, learners, educators, public participants	Literature review (qualitative synthesis of arts-based education programs)	Theatre and drama, visual arts, storytelling, creative writing, film and digital media, embodied and participatory practices, artefacts, dance	Enhances futures literacy, imagination, and critical thinking; supports affective engagement and the ability to envision alternative sustainable futures	Promotes holistic, interdisciplinary and arts-based approaches that integrate cognitive, affective and imaginative dimensions of learning and promote relational and futures-oriented thinking

A recurring theme across the literature is the increasing reliance on interpretive and affective strategies to communicate climate change. For example, [Hebda \(2007\)](#) demonstrates how museums employ interactive maps, visualizations of future scenarios, and historically grounded narratives to make climate change more tangible and relatable. Similarly, [Lackner et al. \(2018\)](#) emphasize the role of interactive exhibitions and visually informed displays in translating complex scientific knowledge into accessible and engaging forms. These approaches reflect a broader movement away from linear, information-based communication toward experiential and multi-sensory learning environments ([Cameron et al., 2012](#)).

Another key dimension concerns the mediating and dialogic role of museums. [Cameron \(2012\)](#) and [McGhie et al. \(2018\)](#) highlight how museums function as trusted spaces where individuals can engage in reflection, dialogue, and meaning-

making. This mediating function is particularly important in the context of climate change, which is often characterized by uncertainty, controversy, and emotional complexity. By fostering open-ended engagement rather than prescriptive messaging, museums enable visitors to construct their own understandings and positions (Cameron, 2012).

Importantly, the literature underscores the growing significance of art-based approaches in enhancing climate communication. Cameron et al. (2012) document a wide range of artistic initiatives, including multimedia installations, participatory performances, and collaborative projects between artists and scientists. These practices leverage the affective and imaginative dimensions of art to evoke emotional responses, stimulate creativity, and facilitate deeper engagement with climate issues. Similarly, Hannigan et al. (2025) argue that arts-based education supports *futures literacy*—understood as the capacity to imagine, anticipate, and critically engage with possible futures, enabling individuals to better understand the present and act upon it (UNESCO, 2021)—by fostering imagination, reflection, and a sense of agency that links present experiences with future possibilities. Within museum-based, art-oriented educational contexts, futures literacy is further cultivated through practices such as storytelling, visual expression, and participatory activities that invite learners to reflect on and envision more sustainable and just futures.

The participatory turn in museum practice is also strongly evident. Studies highlight the increasing use of co-creation, community engagement, and collaborative knowledge production as key strategies for fostering active involvement (Salazar, 2015; Newell, 2020; McGhie, 2020). Such approaches reposition visitors from passive recipients of information to active participants in meaning-making processes, thereby aligning with contemporary theories of transformative learning.

At the same time, some critical perspectives point to ongoing limitations and tensions. Nieroba and Geisler (2025) note that, despite the progressive rhetoric, certain museum practices may still reproduce anthropocentric assumptions or remain at the level of symbolic engagement without leading to substantive behavioral change. This highlights the need for more critically reflexive and structurally informed approaches to climate communication within museum contexts.

Overall, the reviewed studies converge in identifying museums as hybrid spaces that integrate communication, education, and cultural mediation, increasingly employing interdisciplinary and art-based strategies to address the multifaceted nature of climate change.

4.2. Data Analysis and Interpretation

The thematic analysis reveals a multi-layered reconceptualization of museum-based climate change education, closely aligned with the principles of a pedagogy of interconnectedness. Across the four analytical dimensions, museums emerge as institutions that are progressively integrating cognitive, affective, and partici-

patory forms of learning in order to address the complexity of climate change.

a) Institutional Roles of Museums

The findings indicate that museums operate simultaneously across multiple, overlapping roles. While their traditional function as knowledge communicators remains central (Rees & Leal Filho, 2018; Lackner et al., 2018), this role is increasingly complemented by a mediating function, through which museums facilitate interpretation, dialogue, and critical engagement (Cameron et al., 2012; Sutton, 2020).

Furthermore, the concept of public pedagogy provides a useful framework for understanding museums as informal learning environments that shape public understanding and civic discourse beyond formal education systems (Salazar, 2015; Biesta, 2012). In this capacity, museums act as *cultural intermediaries* that translate scientific knowledge into socially meaningful narratives.

Importantly, several studies conceptualize museums as deliberative and performative spaces, where climate change is not only communicated but also negotiated through dialogue, participation, and collective reflection (Cameron, 2012; Newell, 2020). This expanded institutional role reflects a shift toward more democratic and socially engaged forms of knowledge production.

b) Educational Objectives

The analysis demonstrates that museum-based climate education is characterized by a holistic set of learning objectives, extending beyond cognitive understanding.

- Cognitive objectives focus on developing an understanding of climate change as a complex, interdisciplinary phenomenon (Cameron et al., 2012; Sutton, 2020).
- Affective objectives emphasize emotional engagement, empathy, and reflective awareness, which are increasingly recognized as essential for meaningful learning (McGhie et al., 2018; Collins, 2020).
- Behavioral and transformative objectives aim to foster agency, encourage pro-environmental action, and support civic participation (Rees & Leal Filho, 2018; Hebda, 2007).

In addition, the literature highlights the growing importance of futures-oriented learning, particularly the development of *futures literacy*, which enables individuals to anticipate, imagine, and critically evaluate alternative scenarios (Hannigan et al., 2025).

Taken together, these objectives reflect a shift toward transformative learning frameworks, where education is understood as a process of changing not only knowledge but also values, perspectives, and practices.

c) Pedagogical Approaches and Methods

The reviewed studies reveal a diverse and evolving repertoire of pedagogical strategies that prioritize experiential, participatory, and interdisciplinary learning.

Narrative-based approaches, including storytelling and oral history, are widely used to connect climate change to personal and cultural experiences, thereby en-

hancing relevance and engagement (Rees & Leal Filho, 2018; Sutton, 2020).

Participatory and collaborative methods—such as co-creation, community-based projects, and networking—support shared knowledge production and foster a sense of ownership and agency (Salazar, 2015; McGhie, 2020).

Interactive and immersive techniques, including multimedia exhibitions, simulations, and games, provide sensory-rich environments that facilitate embodied learning and deeper engagement (Lackner et al., 2018; Cameron et al., 2012).

Crucially, arts-based practices emerge as a cross-cutting pedagogical approach. Through visual arts, performance, and digital media, these practices enable learners to engage with climate change in affective, symbolic, and imaginative ways (Hannigan et al., 2025). They also support the integration of scientific and cultural knowledge, thereby operationalizing the principles of interconnectedness.

Finally, capacity-building initiatives targeting educators and practitioners highlight the importance of institutional support in sustaining innovative educational practices (Swim & Fraser, 2013; Hamilton & Ronning, 2020).

d) Emerging Trends and Key Insights

Several cross-cutting trends point to a broader paradigm shift in museum-based climate education.

First, there is a clear transition from transmission to dialogue, with increasing emphasis on interaction, participation, and co-creation (Cameron, 2012; Lackner et al., 2018).

Second, the integration of art and science emerges as a defining feature of contemporary practice, enabling more holistic and multidimensional understandings of climate change (Cameron et al., 2012; Collins, 2020).

Third, the literature foregrounds the centrality of affect and emotion in learning processes, challenging the traditional privileging of rational and cognitive approaches (McGhie et al., 2018).

Fourth, museums are increasingly oriented toward fostering agency and action, positioning visitors as active participants in sustainability transitions rather than passive recipients of information (Rees & Leal Filho, 2018; Hebda, 2007).

Finally, the growing emphasis on futures thinking highlights the importance of imagination and anticipatory learning in addressing climate uncertainty (Hannigan et al., 2025).

Across these trends, art-based approaches function as a key integrative mechanism, linking knowledge, emotion, and action. In doing so, they concretely enact a pedagogy of interconnectedness by fostering relational understanding, critical reflection, and creative engagement with climate change.

5. Conclusion

This review demonstrates that museum-based climate change education is undergoing a substantial epistemological and pedagogical transformation, moving away from transmission-oriented models toward more participatory, affective, and transformative approaches. Central to this shift is the integration of art-based

practices, which expand the scope of climate education by engaging learners not only cognitively but also emotionally, ethically, and imaginatively.

By situating these developments within the framework of a pedagogy of interconnectedness, the study highlights how museums can foster relational ways of knowing that emphasize the interdependence between humans, culture, and the natural environment (Lehtonen et al., 2018). In this sense, museums are not merely sites for communicating climate science, but spaces where meanings are negotiated, values are questioned, and alternative futures are envisioned (Cameron, 2012; Newell, 2020).

The findings further indicate that effective climate education in museums requires the integration of cognitive, affective, and behavioral dimensions, aligning with broader theories of transformative learning. Art-based approaches play a pivotal role in this integration, as they enable the translation of abstract knowledge into embodied and emotionally resonant experiences, thereby strengthening the connection between understanding and action (Cameron et al., 2012; Hannigan et al., 2025).

At the same time, the review points to ongoing challenges, including the risk of superficial engagement and the persistence of anthropocentric narratives (Nieroba & Geisler, 2025). In this context, superficial engagement may be understood as forms of interaction that remain at the level of aesthetic appreciation or immediate emotional response, without fostering deeper critical reflection, relational understanding, or sustained action. While such experiences may generate initial interest, they do not necessarily lead to meaningful or transformative learning. Addressing these challenges requires more critically reflexive practices, as well as stronger links between museum initiatives and broader social and structural dimensions of climate action.

6. Implications

This paper contributes to the literature by synthesizing interdisciplinary research and demonstrating how art-based museum education can operationalize a pedagogy of interconnectedness. It provides a conceptual framework that connects museum studies, climate education, and arts-based pedagogy, offering new insights into the role of informal learning environments in sustainability transitions.

For practitioners, the findings suggest the need to a) design participatory and co-creative learning environments; b) integrate affective and experiential dimensions into climate communication; and c) foster cross-sector collaborations between artists, scientists, and educators. These recommendations are reflected in existing practice. For example, Bentz (2020) describes a participatory art-based project in a high school in Portugal in which participatory students engaged with climate change through creative, reflective and collaborative processes, supporting both emotional engagement and critical awareness. At the institutional level, Sutton (2020) discusses the redevelopment of the Hall of Planet Earth at the American Museum of Natural History, where interactive digital installations enable vis-

itors to explore climate scenarios and examine the consequences of human decisions through real-time feedback. Similarly, Lackner et al. (2018) present a bilingual climate change exhibition that enhances accessibility and engagement by combining multilingual communication with interactive elements, thereby supporting more inclusive meaning-making processes.

While these approaches offer considerable pedagogical potential, their implementation is accompanied by a range of challenges. Practical constraints include limited institutional funding, the need for specialized staff training in participatory and arts-based methods, and the complexity of designing inclusive experiences accessible to diverse audiences. In addition, institutional structures and established exhibition conventions may limit the extent to which more experimental, dialogic, and co-creative practices can be adopted. These challenges are also reflected in the literature, which points to structural and organizational barriers in the implementation of innovative climate education practices. Addressing these barriers is essential for the sustainable and meaningful integration of art-based climate education within museum contexts.

For researchers, further work is needed to 1) empirically assess the long-term impact of art-based interventions; 2) examine visitor engagement and behavioral change; and 3) explore issues of inclusion, equity, and cultural diversity in museum-based climate education.

In conclusion, museums hold significant potential as catalysts for transformative climate learning, with art-based education serving as a critical vehicle for fostering interconnected, reflective, and action-oriented forms of engagement. By embracing this role, museums can contribute meaningfully to the development of more sustainable and socially just futures.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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