JDPBE Journal of Design Practice in the Built Environment
eISSN 3140-4847

Critical review
J. Des. Pract. Built Environ. 2026;1(1):127-145
https://doi.org/10.67639/jdpbe.260011

A paradigm shift in spatial experience design through the integration of 4D Art and landscape architecture in the AI era

Jiyoung Park, Jihee Hwang

Korean Institute of Built Environment, Seoul, Korea

Received: Apr 20, 2026
Revised: Jun 1, 2026
Accepted: Jun 3, 2026
Published: Jun 30, 2026

Corresponding author
Jihee Hwang
E-mail: jihee5654@naver.com

Copyright © 2026 Korean Institute of Built Environment.
This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0/) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID
Jiyoung Park
https://orcid.org/0009-0004-0594-936X
Jihee Hwang
https://orcid.org/0009-0002-5064-4077

Conflict of interests
No potential conflict of interest relevant to this article was reported.

Funding sources
Not applicable.

Acknowledgements
Not applicable.

Availability of data and material
Upon reasonable request, the datasets of this study can be available from the corresponding author.

Author contributions
Conceptualization: Park J, Hwang J.
Formal analysis: Park J, Hwang J.
Methodology: Park J, Hwang J.
Investigation: Park J, Hwang J.
Writing - original draft: Park J, Hwang J.
Writing - review & editing: All authors.

Ethics approval
Not applicable.

Abstract

This study critically examines how the integration of 4D Art and landscape architecture in the AI era is transforming the paradigm of spatial experience design, and discusses its transitional patterns and future directions for landscape design. It first reviews the evolving trajectory of landscape spatial experience in the AI era, then derives the concept of 4D Art and identifies the characteristics of spatial experience design that emerge from the integration of 4D Art and landscape architecture. Based on this framework, the study analyzes teamLab Botanical Garden Osaka and Studio Roosegaarde's WATERLICHT, to interpret the experiential structures that emerge as landscape spaces are integrated with media, environmental conditions, and users' actions. The case analysis reveals that, in these integrated spaces, observational spatial experience shifts toward participatory and immersive spatial experience, form-centered spatial formation expands into generative and responsive spatial formation, and representation-centered space is transformed into co-evolutionary place. Finally, the study proposes that future landscape design should move beyond the mere adoption of technology and instead integrate human sensory experience, natural change, artistic imagination, and the meaning of place in a coordinated manner. Through synesthetic experience design, generative and responsive design, and the cultivation of relational sense of place, landscape design should evolve toward co-evolutionary spatial experience design.

Keywords: 4D Art, spatial experience design, sense of place, landscape design

Introduction: a walk toward a new place

1. Research background and problem statement

We now inhabit an era in which artificial intelligence (AI) technology has become integrated into everyday life, enabling the generation of diverse cultural content—including images, music, artworks, and videos—through simple text-based prompts (Jeon & Lee, 2025, p. 35). AI and digital media are moving beyond a merely instrumental dimension and fundamentally reorganizing the ways art is produced and received, as well as the ways humans perceive and relate to the world (Shim, 2006, pp. 6, 19). Phrases such as "the age of digital media," "the age

Declaration of generative AI
During the preparation of this work, ChatGPT was used for language refinement and editorial assistance. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

of AI," and "the information revolution" have become defining discourses through which contemporary society understands itself.

Within this context of broader societal transformation, the ways in which we perceive and experience environments are also being fundamentally reconfigured. In general, landscape spaces have been organized through the arrangement and combination of physical components, such as landform, planting, circulation, and facilities. Recently, however, certain landscape spaces have been generating new place meanings and experiential structures through the integration of digital technologies and spatial elements. Through interactive and immersive media art and environmentally responsive media installations, landscape spaces are expanding into environments that are experienced anew through user participation and interaction and through changes in environmental conditions (Koh & Kang, 2013, p. 207).

In particular, the 4D Art on which this study focuses can be understood as a spatial artistic practice in which temporal, responsive, and multisensory experiential dimensions are combined with three-dimensional physical space. It reconceives space not as a static object of contemplation, but as a responsive and immersive environment that changes according to user participation and environmental conditions. Landscape architecture is well positioned to engage with developments at the intersection of art and technology as questions of spatial experience, given that it is an inherently integrative discipline that bridges artistic and scientific inquiry across multiple fields (Kim et al., 2020, p. 35). Accordingly, the integration of 4D Art and landscape architecture holds the potential to expand landscape space into a place that is continuously transformed through the interaction of users and environment.

Against this backdrop, a key question arises: as the integration of 4D Art and landscape architecture gives rise to new places and spatial experiences in the AI era, what should landscape design practice consider? Beyond form-centered design, landscape architecture must explore how to design new spatial experiences within changing environments. This requires careful examination and interpretation of the specific dimensions of this emerging paradigm: what changes it has brought about in modes of experience, how it has transformed modes of spatial formation, and what implications it carries for place-based context.

These questions must be addressed not merely as descriptions of phenomena, but in order to establish an interpretive framework for future landscape discourse and directions for design practice. Accordingly, this study takes as its starting point an examination of how the integration of 4D Art and landscape architecture in the AI era is transforming the paradigm of spatial experience design.

2. Research purpose and methods

The purpose of this study is to interpretively examine the transitional patterns that the integration of 4D Art and landscape architecture produces in spatial experience design in the AI era. To this end, this study operationally defines 4D Art as a spatial artistic practice characterized by interactivity, immersion, multisensory experience, responsiveness, and temporality/narrativity, and identifies the characteristics of spatial experience design that emerge from its

integration with landscape architecture, establishing these as the interpretive framework for case analysis. In addition, by analyzing cases of integrated spaces in which the spatial experience of landscape architecture is expanded and the landscape is reconfigured, this study discusses the transitional patterns of the spatial experience design paradigm in terms of spatial experience, spatial formation, and place-based context, and aims to elucidate the significance of this transition and the future development directions of landscape design. Here, the "AI era" in this study does not mean that AI technology is directly applied to the analyzed cases; rather, it refers to the conditions of the present moment in which AI and digital technologies are permeating and transforming the practices of art, design, and spatial experience. In particular, the emergence of generative AI is transforming methods of image generation, design thinking, and spatial visualization, thereby expanding the possibilities of technology-based expression and experience construction in landscape design. Therefore, this study does not analyze teamLab Botanical Garden Osaka and WATERLICHT as instances of the direct application of AI technology, but interprets them as cases that demonstrate how landscape spatial experience is reconfigured in responsive, immersive, and multisensory ways within the broader context of digital transformation in the AI era.

To this end, this study employs a qualitative research method that combines systematic literature review and case study analysis. First, through a literature review, it establishes the theoretical background concerning the expansion of spatial experience through the integration of 4D Art and landscape architecture in the AI era, and constructs an analytical framework for case analysis. Subsequently, in accordance with the derived analytical framework, it selects cases of integrated spaces involving 4D Art and landscape architecture and interpretively examines the experiential structures that each case produces within a landscape architectural context. In this process, the study focuses less on the technological features of the cases themselves and more on the changes they produce in modes of spatial experience, modes of spatial formation, and place-based context, thereby examining the transitional patterns of the spatial experience design paradigm.

3. Review of previous studies

1) Landscape architecture research in the AI era

Research on landscape architecture in the AI era can be broadly classified into three categories: landscape design and visualization research utilizing AI, landscape analysis and management research utilizing AI, and landscape education and criticism research related to AI.

First, landscape design and visualization research utilizing AI has developed in directions that explore the possibilities of design support and the generation and evaluation of design proposals, such as analyzing AI-based garden planting layout optimization systems (Woo & Kim, 2025) and generating and evaluating design proposals for small parks based on abstract art (Lee, 2025). In addition, studies by Jang & Kim (2025), Lee (2024), and Yoon & Kim (2024) demonstrate more specifically the applicability of generative AI to the visualization of landscape spaces and design processes.

Second, landscape analysis and management research using AI has developed through studies that examine the applicability of convolutional neural network (CNN)-based landscape image analysis (Sung & Lee, 2023), analyze park use characteristics using social media image data (Lee et al., 2023), and suggest the possibility of analyzing and monitoring user activities in urban parks through deep learning-based image classification (Lee & Son, 2022). In addition, Kwon (2023) and Lee et al. (2019) focus on the implementation of smart parks and user perceptions, showing that smart technologies such as AI and the internet of things (IoT) are expanding into the analysis, operation, and management of landscape spaces.

Third, AI-related landscape education and criticism research has proposed directions for improving landscape curricula in response to digital transformation (Na, 2021) and has analyzed the applicability and effects of generative AI in design studios (Han, 2025; Park & Han, 2024). Meanwhile, a discourse has also formed that analyzes the aesthetic characteristics of AI landscape drawings and discusses critical issues such as creativity, copyright ownership, and the lack of contextual elements (Jeon & Lee, 2025).

In summary, research on landscape architecture in the AI era is rapidly expanding across the domains of design, analysis and management, education, and criticism. However, relative to the considerable attention given to the efficiency and possibilities of technological application, studies that engage in depth with the experiential structures of landscape spaces and with the sensory and place-based meanings that such spaces afford remain comparatively limited.

2) Studies on 4D Art (interactive and immersive media art)

The research landscape related to 4D Art was surveyed with particular attention to interactive and immersive media art, given their close associations with the temporal unfolding and real-time responsiveness of 4D Art, the expansion of sensory experience, and changes in spatial experience. The findings indicate that related studies have developed primarily within three categories: studies on concepts and characteristics, studies on viewing experience and immersion, and studies on application to actual spaces.

First, studies on the concepts and characteristics of interactive and immersive media art have examined the historical development of interactive art (Kim & Lee, 2008), and have considered and typologically analyzed the structure and aesthetic characteristics of interactive media art with a focus on interactivity in art (Kim, 2008). Other studies have reviewed the conceptual structure and aesthetic characteristics of interactive art (Lee, 2026a), interpreted the artistic significance of audience participation based on John Dewey's theory of experience (Kim, 2020), and analyzed the expressive characteristics of new media art arising from the convergence of technology and art (Jang, 2022). In addition, research has structured the immersion of immersive media art in terms of psychological and perceptual immersion, spatial staging, sensory experience, interaction, and narrative (Jung, 2025).

Second, studies on viewing experience and immersion have analyzed the experiential structure of immersive media art exhibitions (Lee, 2026b) and have examined how sensory experience, participation, and affordance affect viewing experience (Kim, 2010; Kim, 2025a; Yang, 2016). Research has also explored bodily perception and the infinity of boundaries in team-

Lab's immersive media art based on perceptual phenomenology (Na, 2025), and has analyzed visitors' experiences of immersive media art exhibitions through the case of Arte Museum (Jang, 2024).

Third, studies on application to actual spaces have suggested the possibility of expanding spatial experience through augmented reality technology and interactive art (Lee, 2023), and have examined the possibility of combining digital art and spatial design (Kim & Kim, 2009). In addition, studies have analyzed the applicability of new media art and interactive media art from the perspectives of urban regeneration and public design (Kim, 2007; Tian, 2025), while analyses of immersive media art exhibition staging and cases of visual interactive experience in digital art spaces have continued to examine the spatial reception of media art (Kim, 2025b; Yoo, 2025).

In summary, studies related to 4D Art richly address aspects such as spatial interactivity, immersion, sensory expansion, viewing experience, and spatial application. However, relatively few studies have interpreted these aspects from the perspective of place-based context and spatial experience design within landscape settings.

3) Limitations of previous studies and need for this study

Taken together, the existing literature demonstrates that research on landscape architecture in the AI era has developed primarily in the directions of design support, visualization, analysis and management, educational application, and criticism, with a general emphasis on the potential and efficiency of AI technology. Meanwhile, studies related to 4D Art have richly discussed characteristics such as interactivity, immersion, sensory expansion, viewing experience, and spatial application. However, in landscape architecture research within the AI era, discussions of how the experiential structures of landscape spaces and their sensory and place-based meanings are transformed have been comparatively underdeveloped relative to discussions of the introduction and use of technology. Similarly, in scholarship on 4D Art, relatively few studies have interpreted these artistic and experiential characteristics from the perspective of place-based context and spatial experience design in landscape settings.

Therefore, it is necessary to move beyond understanding landscape architecture in the AI era solely in terms of technological application, and to analyze how spatial experience is reorganized in participatory, immersive, and responsive ways through its integration with 4D Art. Accordingly, this study seeks to articulate a new paradigm for future landscape design by interpreting the patterns of spatial experience design transformed through the integration of 4D Art and landscape architecture.

Theoretical background: spatial experience expanded by 4D Art and landscape architecture in the AI era

1. Concept and characteristics of 4D Art in the AI era

In the AI era, art and spatial environments are being rapidly reorganized amid the prolifer-

ation of digital media and generative AI. The emergence of digital media has brought about fundamental changes in the nature and characteristics of artworks and in their modes of production and reception (Shim, 2006, p. 19), while the emergence of generative AI is transforming design methodologies and conceptual frameworks (Han & Park, 2025, p. 91; Jeon & Lee, 2025, p. 35). Contemporary spaces are expanding into complex environments in which user participation and interaction unfold as digital media and information technologies become integrated (Koh & Kang, 2013, pp. 205-207), and landscape architecture is similarly evolving toward convergent design as the scope of collaboration extends to encompass culture, art, information technology, and related fields (Kim et al., 2020, pp. 228-232).

Against this background, this study focuses on the changing ways art and spatial experience operate in the AI era, and establishes the concept of "4D Art" by synthesizing characteristics drawn from interactive art and immersive media art. In this study, 4D Art is not a concept that refers to a specific independent artistic genre; rather, it is an operationally defined concept for interpreting the emergent patterns of spatial experience design that arise as art is combined with landscape space in the AI era. To this end, the study reviews prior discussions of interactive media art and immersive media art and reconstructs the concept of 4D Art deployed here by synthesizing existing accounts of space and place experience.

According to previous studies, interactive media art is characterized by relational participation, sensory immersion, relational responsiveness, networking, and open artistry (Lee, 2026a, pp. 40-52). Immersive media art elicits viewers' emotional and perceptual responses via multisensory stimuli, and its defining characteristics encompass interaction between audience and artwork, time and narrativity, artistic staging, immersive experience, and audience participation (Kim, 2025b, pp. 13, 17, 26, 29; Lee, 2026b, pp. 23, 25).

Synthesizing these prior discussions, the "4D" in 4D Art as used in this study does not simply refer to adding a temporal axis to three-dimensional space. Rather, it signifies a processual dimension in which spatial experience changes and is generated through temporal unfolding, real-time response, sensory expansion, and viewer participation. Whereas 3D is characterized by form, depth, and physical spatiality, the fourth dimension in 4D Art denotes the processual dimension through which space transforms, responds, and unfolds as lived experience over time. Therefore, in this study, 4D Art can be understood as a concept in which temporal, responsive, and multisensory experiential dimensions are combined with physical three-dimensional space, constituting a spatial artistic practice characterized by interactivity, immersion, multisensory experience, responsiveness, and temporality/narrativity.

In this study, 4D Art resembles interactive media art and immersive media art in that it encompasses user participation, sensory immersion, and real-time response, but it is distinguished by not being confined to a specific exhibition genre or media form. Rather, 4D Art is an interpretive concept for explaining the processual generation of spatial experience through the combination of physical space, temporal change, environmental conditions, and user actions. Accordingly, in this study, 4D Art is employed not as a genre classification of media art per se, but as a conceptual framework for interpreting the changes in responsive, multisensory, and temporally unfolding spatial experience design that emerge when art is integrated with landscape space.

2. Characteristics of landscape spatial experience

In this study, landscape spatial experience is understood not simply as the perception of physical space, but as a holistic experiential process in which users perceive, traverse, dwell in, and ascribe meaning to landscape space. Accordingly, this study examines the key characteristics that constitute landscape spatial experience based on prior literature, and uses these to establish the theoretical basis for spatial experience design.

First, "spatial experience" is understood as a holistic process of perception and cognition in which human users perceive spatial environments through their sensory organs, construct affective responses, and attribute symbolic meaning—an experience that is constituted through the interaction between humans and environments. In this context, space acquires meaning through "experience," which activates emotional dimensions through processes of human perception and cognition (Lee, 2009, pp. 7, 8). Furthermore, space and place are experienced by humans, and space becomes place through the process by which humans come to know it and invest it with value (Tuan, 2020, pp. 8, 19).

From this perspective, landscape space can be understood as an experiential field composed of physical elements such as landform, facilities, and paving; climatic conditions such as temperature, rainfall, and wind; and natural elements such as vegetation, while simultaneously being invested with meaning and developing sense of place through users' experiences and behaviors (Im et al., 2011, pp. 47, 48; as cited in Jung, 2021, p. 1).

In particular, sense of place is a crucial perspective for understanding landscape spatial experience. Sense of place refers to the meaning of space formed through accumulated experience in a particular place; physical space becomes place through the process by which human experiences and activities are repeated and meaning is progressively attached. This perspective suggests that landscape space should be understood not merely as a physical environment or visual object, but as a site in which place-based meaning is constituted through users' experiences and activities (Hong et al., 2011, p. 22; Im et al., 2011, pp. 47, 48).

3. Characteristics of spatial experience design resulting from the integration of 4D Art and landscape architecture

The integration of 4D Art and landscape architecture can be understood not as a simple combination of the two fields, but as a new experiential structure in which the characteristics of 4D Art—interactivity, immersion, multisensory experience, responsiveness, and temporality/narrativity—are woven into landscape spatial experience, through which place-based meaning is constituted. If, on the basis of the preceding discussion, landscape architecture is understood as a spatial practice oriented toward the process through which place-based meaning is formed through users' experiences and activities, rather than merely toward the creation of physical environments (Im et al., 2011, pp. 47, 48), then 4D Art expands space into an environment that changes over time, responds to user actions and environmental conditions, and is experienced multisensorially. Therefore, the integration of 4D Art and landscape architecture can be seen as

expanding landscape space beyond a static backdrop or mere visual scenery into a complex form of spatial experience design in which user participation, environmental responsiveness, multisensory experience, and temporal and narrative dimensions intersect.

Synthesizing these discussions, spatial experience design that integrates 4D Art and landscape architecture can be organized around four key characteristics: sense of place, responsiveness, temporality/narrativity, and sensory expandability. First, "sense of place" can be understood as a characteristic through which the physical conditions of a place, human behavior, and meaning converge within spatial and temporal contexts to constitute place identity and meaning (Im et al., 2011, p. 48). Second, "responsiveness" refers to the characteristic by which the state and experience of space change in real time in response to user participation and actions and environmental conditions. Third, "temporality/narrativity" refers to the characteristic by which spatial experience unfolds sequentially as scenes and events over time, through which meaning is formed. Fourth, "sensory expandability" (i.e., the capacity for cross-sensory and multisensory extension) refers to the characteristic of eliciting multisensory participation and immersion beyond visually centered appreciation. These four characteristics form the theoretical basis for understanding how the integration of 4D Art and landscape architecture transforms landscape spatial experience design.

Case analysis of integrated spaces of 4D Art and landscape architecture

1. Analytical framework and perspective

Based on the characteristics of spatial experience design integrating 4D Art and landscape architecture discussed above, this study establishes sense of place, responsiveness, temporality/narrativity, and sensory expandability as four interpretive criteria for case analysis. Through these criteria, this study examines how the integration of 4D Art and landscape architecture structures and transforms spatial experience. The case analysis criteria are elaborated as follows.

First, "sense of place" is a concept in which the physical conditions of a place, human behavior, and meaning converge within spatial and temporal contexts to constitute place identity. In this study, it is understood both as experience within a specific micro-environment and as an interactional concept that encompasses the emotions, perceptions, and actions related to space as patterned human responses to environmental stimuli (Im et al., 2011, p. 48). Drawing on this concept of sense of place, this study seeks to interpret the processes by which physical space is transformed into "place"—a site where events and experiences occur—through its integration with media.

Second, "responsiveness" corresponds to the concept of "relational responsiveness" discussed in interactive art scholarship, and this study extends it to the dimension of landscape spatial experience. Specifically, responsiveness refers to the characteristic by which the state and experience of space change in real time according to users' participation and actions, as well as environmental conditions such as wind and rain. It designates the nature of an interac-

tive space whose condition varies in response to human movement or environmental change, as distinct from static space (Lee, 2026a, p. 44).

Third, "temporality/narrativity" draws on the characteristics of temporality and narrative immersion discussed in immersive media art scholarship, and refers to the characteristic by which spatial experience does not remain confined to a single fixed moment, but unfolds sequentially as scenes and events over time, through which meaning is formed (Lee, 2026b, pp. 8, 18).

Fourth, "sensory expandability" draws on the concept of sensory immersion discussed in interactive art scholarship and refers to the characteristic of eliciting multisensory participation and immersion—encompassing hearing, touch, and proprioception—beyond visually centered appreciation (Lee, 2026a, pp. 42-44). This study interprets it as a shift away from the traditionally vision-dominant modes of landscape appreciation toward an experience of space mediated through the full body and its senses.

These four criteria are not discrete elements; rather, they overlap and intersect within actual cases and are applied as an integrated interpretive framework that reveals the structure of spatial experience. Accordingly, in the following case analysis, this study focuses not on simply cataloguing individual components, but on examining how the four characteristics collectively transform the structure and meaning of spatial experience within landscape settings.

2. Expansion of landscape spatial experience through immersive media: teamLab Botanical Garden Osaka

The first case examined in this study is teamLab Botanical Garden Osaka, a nocturnal outdoor media art exhibition installed at Nagai Botanical Garden in Osaka, Japan. This project exemplifies how the integration of immersive media with an actual landscape space can transform that space from a fixed backdrop into a dynamic field of sensory and participatory experience.

Nagai Botanical Garden, established in Osaka in 1974, is an outdoor botanical garden of approximately 240,000 square meters in which more than 1,200 species of plants grow. During the day it functions as a botanical garden; at night, the same site is transformed into an art space that changes interactively under the influence of birds' and people's behavior, wind, and rain (Osaka Convention & Tourism Bureau, n.d.; teamLab, n.d.c). In this way, the same place reveals different experiential structures according to the time of day and the actions of nature and humans, thereby expanding the temporal layers of landscape space.

The most prominent characteristic of this case is sense of place: the existing landscape space of the botanical garden is integrated with media and reconstituted as a place to which new value and meaning are attributed through users' experiences, rather than remaining a simple backdrop. Sensory expandability is also prominent, as the space elicits participation and immersion through multiple senses—including hearing and touch—beyond visually centered appreciation. teamLab articulates this work under the concept of "Digitized Nature" as an attempt to transform nature into art through immaterial digital technology without damaging nature. This framing posits the existence of the artwork as established in relation to the surrounding environment rather than as an object fixed within a physical boundary (teamLab,

n.d.c). In this context, the botanical garden is not merely a backdrop serving as an exhibition venue; rather, it is reconstituted as a place where artworks, human actions, trees and forests, lakes, ecosystems, and the surrounding environment are seamlessly continuous, and where new value and meaning are formed (teamLab, n.d.c). Moreover, ovoid installations distributed throughout the botanical garden and resonating lamps on the lake move beyond visual appreciation by responding to human actions and environmental conditions such as wind and rain, generating light and sound whose responses propagate sequentially to surrounding objects, thereby eliciting multisensory immersion (teamLab, n.d.a, n.d.b). When the familiar botanical garden is newly encountered in darkness—through luminous ovoid objects, resonating lamps on the water's surface, and light and sound that shift in response to human actions and environmental conditions—visually centered landscape appreciation expands into an embodied experience in which hearing, touch, and kinesthetic senses are intertwined (teamLab, n.d.c; Zeng, 2026, pp. 9, 11, 12).

Meanwhile, "responsiveness" and "temporality/narrativity," which function as supplementary criteria, serve as the key mechanisms through which this space is rendered experientially dynamic. Visitors' contact and actions, as well as environmental conditions such as wind and rain, generate changes in light and sound, and these real-time responses produce an experience in which humans and environment actively interact (teamLab, n.d.c; Zeng, 2026, p. 12). "Temporality/narrativity" is manifest in the process by which the botanical garden is transformed into an art space at night and visitors traverse a boundaryless garden, interacting with artworks and generating distinct personal experiences (teamLab, n.d.c; Zeng, 2026, p. 11). As a result, teamLab Botanical Garden Osaka transforms landscape space from a fixed scenic form into a place that is newly experienced at each moment through the interaction of natural environment, digital technology, and human actions, expanding the mode of landscape experience by repositioning visitors from passive observers into sensing and participating subjects (teamLab, n.d.c; Zeng, 2026, pp. 9, 12).

3. Reconfiguration of landscape through environmentally responsive media installation: WATERLICHT (Studio Roosegaarde)

Studio Roosegaarde's WATERLICHT is a representative example of an environmentally responsive media installation that enables a visceral experience of the threats posed by sea-level rise and the climate crisis by creating a virtual flood landscape that responds dynamically to wind and rain within public open spaces (Lee, 2021, p. 7; Studio Roosegaarde, 2022).

First presented in the Netherlands in 2015 and subsequently exhibited at major venues around the world—including Amsterdam's Museumplein, New York, Paris, Rotterdam, Dubai, and Australia—this project uses LEDs, lenses, and software to create a "virtual flood" and visually render the height that water levels could reach through waves of light (Media Architecture Awards, n.d.; Studio Roosegaarde, n.d.). This work extends well beyond a lighting spectacle; rather, it reveals the educational and social roles that public space can perform by translating environmental awareness of crisis into an artistic experience (Art Jameel, 2018, p. 1; Lee, 2021, p. 14).

The most prominent characteristics of this case are environmentally responsive "responsiveness," in that a virtual flood scene is formed in real time in response to environmental elements such as wind and rain, and "sense of place," in that existing public open spaces such as plazas are reconstituted as sites where sensory experience and social awareness of the climate crisis are generated. WATERLICHT comprises LEDs, software, lenses, humidity sensors, and site-specific design elements, and operates as an environmentally responsive installation in which the layers and atmosphere of light shift according to natural elements such as wind and rain (Studio Roosegaarde, n.d.). While physically standing on solid ground, visitors perceive the sensation of being submerged beneath water (Art Jameel, 2018, p. 1), as an ordinary public space such as a plaza is transformed from a neutral backdrop into an experiential field that generates sensory and emotional awareness of the climate crisis. As Lee (2021) argues, WATERLICHT fosters participation, sense of place, and social identity within the social space it occupies (Lee, 2021, pp. 12, 14), thereby disclosing new dimensions of public space. "Temporality/narrativity," which operates as a supplementary characteristic, is apparent in that the possibility of future sea-level rise is projected into the present and experienced as a sensory scene. The blue horizontal plane of light in this work superimposes upon public space the possibility of a flood not yet arrived, staging future sea-level rise as a scene that is experienced through the senses (Roosen et al., 2017, p. 14; Studio Roosegaarde, n.d.). It thereby offers a spatial experience that elicits sensory immersion and synesthetic perception that transcends the boundaries of actual time and space.

As a result, WATERLICHT is a case that reconfigures environmental crisis and the contextual meaning of place within the landscape through technology, demonstrating that landscape architecture is expanding beyond the design of fixed forms toward dynamic and generative place formation.

Interpretation of the paradigm shift in spatial experience design

The case analysis reveals that, although the two cases differ in their methods and principles of spatial staging, they share a common transition in which landscape-based outdoor spaces no longer remain as fixed backdrops or objects of contemplation, but are reconstituted as new fields of spatial experience in which participation and response, temporal unfolding, and the formation of meaning are simultaneously operative. Accordingly, this study interprets these shared changes not as characteristics confined to the specificity of individual cases, but as patterns indicative of a paradigm shift in spatial experience design. To this end, it examines the patterns of change by focusing on three dimensions: first, changes in modes of spatial experience—that is, how users perceive and engage with space; second, changes in modes of spatial formation—that is, how space is constituted and transformed; and third, changes in how sense of place is formed in relation to place-based context. The spatial experience, spatial formation, and place discussed here do not refer to general spatial concepts, but specifically to the transformations in landscape-based outdoor spaces that emerge through the integration of 4D Art and landscape architecture. These three dimensions of change serve as the interpretive criteria

for understanding the directions in which spatial experience design in landscape architecture is being reorganized in the AI era.

1. From observational spatial experience to participatory and immersive spatial experience

From the perspective of environment-behavior studies, landscape design has been understood as a practice that shapes outdoor spaces by comprehending users' behaviors and patterns of spatial use grounded in the interrelationship between humans and environment, and incorporating these into the design process (Im, 1994, pp. 149-152). However, in spaces where 4D Art and landscape architecture are integrated, user actions intensify beyond the conventional dimension of "spatial use," advancing into stages of "active participation" and "multisensory immersion" that alter the sensory state of space in real time. In other words, spatial experience is expanding beyond visual-centric modes of engagement into a mode that encompasses bodily movement, sensation, immersion, and interaction.

These patterns are clearly evident in the two cases analyzed in Section 3. In teamLab Botanical Garden Osaka, the ovoid objects in the garden glow and produce sounds when pushed by people, shaken by wind, or struck by rain, and their responses propagate sequentially to surrounding objects. Similarly, the lamps on Oike Lake illuminate and emit sounds when people stop nearby or when the wind blows, with light and tone spreading in sequence to surrounding lamps (teamLab, n.d.c). This indicates that users' behavior no longer remains simply a matter of spatial use, but functions as an active force that shapes the atmosphere and narrative of space. Meanwhile, WATERLICHT generates a virtual flood scene in public space through LEDs, software, lenses, humidity, and site-specific design, and through its constantly shifting layers of light, makes visitors experience the sensation of being submerged beneath water (Art Jameel, 2018, p. 1; Studio Roosegaarde, n.d.). Through this, users move beyond the role of external observers of space and become immersed in the event as constituents of environmental change.

This shift in the mode of experience carries significant implications, as the field of landscape design is expanding beyond the creation of physical environments toward the organization of "structures of real-time responsiveness." Whereas conventional landscape design understood users' behaviors and incorporated them into the process of spatial creation, in spaces integrating 4D Art and landscape architecture, users' sensory interventions themselves function as conditions that shape the state and character of space. In other words, landscape architecture is evolving beyond the provision of finished spaces into a flexible experiential platform that generates new experiences moment by moment through users' participation and immersion and through the responsive capacity of space. If observational spatial experience was one of viewing and interpreting a completed landscape, participatory and immersive spatial experience is one in which users' bodily interventions actively generate and sustain the scenes of space. In sum, integration with 4D Art transforms landscape space into an interface through which body and environment communicate more intimately, positioning users not as external observers of spatial experience, but as subjects who co-constitute that experience.

2. From fixed spatial formation to generative and responsive spatial formation

Whereas conventional landscape spaces have tended toward organizing relatively stable spatial experience around designed forms and scenes, in spaces where 4D Art and landscape architecture are integrated, the tendency for space to be generated and transformed in real time according to human actions, environmental conditions, and the responses of technological devices becomes prominent. Space no longer exists merely as the outcome of a completed form; rather, it is understood as a processual field that continuously alters its state through relationships and responses. teamLab Botanical Garden Osaka operates as a botanical garden during the day, but at night is transformed into an outdoor media environment of light and sound that incorporates plants, lakes, ecosystems, and the surrounding environment. In particular, the ovoid objects and lamps on Oike Lake modify the state of light and sound according to human actions and environmental conditions such as wind and rain, producing different scenes and atmospheres from moment to moment within the same place (teamLab, n.d.c). This demonstrates that space is no longer given as a fixed form, but is a condition continuously generated through response and interaction. Meanwhile, WATERLICHT comprises LEDs, software, lenses, humidity sensors, and site-specific design elements, and operates as an environmentally responsive installation whose scenes change dynamically under the influence of wind and rain (Studio Roosegaarde, n.d.). Accordingly, existing public spaces such as plazas can be understood not as fixed backdrops, but as generative and responsive spaces that are temporarily and newly constituted through the interaction of technology, climatic conditions, and place context.

What merits particular attention here is that spatial experience design is shifting beyond the arrangement of forms and the fixing of scenes toward the organization of the conditions and structures of response through which change can occur. In fixed spatial formation, the character of space was sustained through designed forms and arrangements with relative stability. In generative and responsive spatial formation, by contrast, users' interventions, environmental changes, and technological operations continuously alter the state of space. In other words, space can be understood not as the outcome of a completed form, but as a process continuously constituted within time and relational exchange. This implies that future landscape architecture must attend not only to the composition of form, but also to how to organize the conditions under which response, transformation, and experience can unfold. Accordingly, spatial experience design in landscape architecture needs to develop beyond the presentation of scenery as a finished product, toward designing the very process in which humans and environments, art and technology converge and the state of space is newly generated.

3. From representation-centered space to co-evolutionary place

In scholarship on landscape and urban space, sense of place has been understood as a multilayered concept formed through the interrelationship between physical space and human experience, with its constitution involving a complex combination of physical, social, cultural, and experiential factors (Kwon, 2013, pp. 5, 26). However, in certain cases of contemporary

landscape and urban planning practice, conditions of placelessness have also emerged where the formation of sense of place becomes over-concentrated on physical form and programs, or where concept-setting and meaning-attribution become excessive (Kwon, 2013, p. ii; Lee, 2014, pp. 52, 94, 105). By contrast, in spaces where 4D Art and landscape architecture are integrated, the meaning of place is not anchored to particular forms or programs, but exhibits a prominent "co-evolutionary" tendency in which it is continuously generated through interactions among humans, nature, art, and technology. In other words, place is understood as a relational field in which sensory experience and action, environmental change, and technological response are mutually implicated. At teamLab Botanical Garden Osaka, the concept of "Digitized Nature" enables nature to be experienced as art through immaterial digital technology without damaging nature. The existence of the artwork is established within a continuity with the surrounding environment rather than being circumscribed within a fixed physical boundary. Furthermore, within this space, human actions and environmental conditions such as wind and rain alter the light, sound, and sensory state of the artwork (teamLab, n.d.c). Visitors' interactions also intervene in the experience of the work and in the formation of personal narratives. In this respect, the botanical garden can be interpreted as transcending a simple space of representation toward a relationally constituted place, and further, as a co-evolutionary place where nature and technology coexist and generate new value (Zeng, 2026, pp. 11, 12). Meanwhile, WATERLICHT reconstitutes urban public spaces such as plazas as sites where the possibility of sea-level rise and climate crisis can be sensorially apprehended (Lee, 2021, pp. 7, 10, 12). Here, technology does not simply reproduce an image of water, but transforms place into a relational field in which environmental awareness of crisis and collective experience are produced. In this respect, WATERLICHT exemplifies a transition in which space moves beyond a simple representational backdrop and becomes a place where meaning is formed through interactions among humans, environments, art, and technology.

This transition indicates that spatial experience design in landscape architecture is moving beyond the representation of place meaning through form or symbol, toward designing the relationships and processes through which sense of place is constituted. Sense of place in landscape space has never been determined solely by physical environmental factors; rather, it has been formed through a process in which users' behaviors and meaning-making in relation to place operate in conjunction (Hwang, 2013, p. 20). However, whereas existing place meanings tended to be articulated through relatively stable forms, symbols, and place images in a representation-centered manner, in spaces integrating 4D Art and landscape architecture, place meaning continues to accumulate and transform through a process in which experience, action, response, and temporality overlap and interact. In other words, sense of place expands into a relational form of meaning constituted through the mutual influence of humans, nature, and technology. This suggests that landscape architecture must attend not only to the design of form and symbol, but also to what kinds of interactions occur within space, what kinds of experiences are accumulated, and what kinds of sense of place are thereby produced. Accordingly, future landscape architecture needs to move beyond the representation of spatial meaning and toward organizing the processes through which human experience, environ-

mental change, and technological response become intertwined and co-produce the meaning of place.

As discussed above, the integration of 4D Art and landscape architecture reorganizes landscape spatial experience design across three dimensions. Users shift from observers to participants and immersive experiencers; space is understood not as a completed form but as a process of real-time response and generation; and sense of place expands from a fixed symbol into a relational meaning continuously formed through interactions among humans, environments, art, and technology. This transition suggests that landscape design in the AI era must move beyond the creation of physical space and toward designing the conditions of responsiveness and change, the structures of relationship, and the processes of meaning formation.

Conclusion: designing co-evolutionary spatial experiences and relationships

1. Summary and academic significance

This study set out to examine the transitional patterns that the integration of 4D Art and landscape architecture produces in spatial experience design in the AI era. It analyzed the transformations that occur when the characteristics of 4D Art—interactivity, immersion, multisensory experience, responsiveness, and temporality/narrativity—engage with actual landscape spaces, through the cases of teamLab Botanical Garden Osaka and WATERLICHT. The transitional patterns of the spatial experience design paradigm that emerge from this analysis may be summarized as follows. First, the mode of spatial experience shifted from visually centered observational experience to participatory and immersive experience involving bodily intervention and multisensory engagement. Second, the mode of spatial formation changed from the maintenance of a fixed form to a generative and responsive mode that responds in real time to users' actions and environmental conditions and is continuously transformed. Third, in terms of place-based context, landscape space expanded beyond representation-centered space into a co-evolutionary place where humans and nature, art and technology continuously interact and co-produce meaning.

The academic significance of this study lies in its reinterpretation of the currents of hybridity, interactivity, and indeterminacy explored in contemporary landscape architecture scholarship (Bae, 2007, p. 93; Jang, 2006, p. 96; Suh & Shin, 2009, p. 13) from the perspective of spatial experience design, through cases of integration between 4D Art and landscape architecture. This study examined how, when digital technology and generative AI are combined with physical environments, landscape space can function not merely as a technological spectacle or an extension of visual expression, but as a condition that transforms human modes of perception and the processes through which place meaning is formed. In doing so, it sought to offer one interpretive perspective through which the integration of 4D Art and landscape architecture can be connected to broader discussions of future landscape design.

2. Prospects for future landscape design paradigms

Contemporary landscape design has evolved along the trajectories of participation, technology- and information-based integration, convergence, value-centered design, and open and strategic design (Kim et al., 2020, pp. 227-234). This trajectory is accelerating further amid the proliferation of AI and digital technologies, and design processes in landscape architecture—including survey and analysis, concept development, and visualization—are also changing rapidly. However, technological tools cannot fully substitute for place context or users' embodied, concrete experiences. Research on landscape design utilizing generative AI indicates that while AI proves valuable for generating design concepts, producing images, and rendering alternative design proposals, critical judgment regarding place context, design intent, and user experience continues to demand the designer's interpretive and coordinative expertise (Han & Park, 2025, pp. 91, 96; Jang, 2025, pp. 112-116; Jeon & Lee, 2025, pp. 35, 42, 43). Accordingly, the role of future landscape architects as critical interpreters and integrators—who actively evaluate the possibilities offered by technology while comprehensively attending to human sensory experience, natural change, artistic imagination, and the meaning of place—will become increasingly indispensable.

Against this background, the patterns of integration between 4D Art and landscape architecture analyzed in this study demonstrate that future landscape design must address the dimensions of spatial experience, spatial formation, and place-based context in an integrated manner. On this basis, three directions for future landscape design can be identified. The first is an expansion toward synesthetic experience design, which requires creating conditions that elicit users' active participation and immersion by integrating light, sound, movement, dwelling, and climatic sensation. The second is process-centered generative and responsive design, which conceives of landscape space as a structure in which users' actions, environmental changes, artistic devices, and technological responses interlock, continuously generating new scenes and experiences over time. The third is the cultivation of a relational sense of place, in which place meaning is understood not as something completed through form or symbol, but as something constituted through processes in which human senses and actions, natural change, artistic expression, and technological responses are brought into dynamic relation.

Accordingly, landscape design in the AI era must move beyond the provision of aesthetically pleasing scenery and evolve toward co-evolutionary spatial experience design—in which humans and nature, art and technology operate in concert and continuously co-produce the meaning of place. Ultimately, the challenge facing future landscape architecture lies not in the adoption of more technology, but in designing the "conditions of relation" through which humans and environments can relate more profoundly through technology, and through which new experiences and sense of place can be formed within those relationships.

References

Art Jameel. (2018). *WATERLICHT, the internationally acclaimed art experience by Daan Roose-*

gaarde, makes its regional debut at Dubai's Jaddaf Waterfront Sculpture Park, presented by Dubai Holding. https://artjameel.org/wp-content/uploads/2018/12/Waterlicht-English.pdf

Bae, S. H. (2007). *A study on indeterminate characteristics in contemporary landscape design* [Master's thesis]. University of Seoul.

Han, J. U. (2025). *Exploring generative AI-driven approaches in landscape architecture design education* [Master's thesis]. Cheongju University.

Han, J. U., & Park, J. M. (2025). Applications and implications of generative AI in landscape design education. *Journal of Art & Design Research*, *28*(2), 89-97.

Hong, S. H., Park, J. S., & Im, S. B. (2011). A study on the concept of 'sense of place' for environmental planning and design. *Journal of the Korea Landscape Council*, 3(1), 14–29.

Hwang, J. H. (2013). *An analysis of user satisfaction with factors forming placeness in urban cultural spaces* [Master's thesis]. Kyung Hee University.

Im, S. B. (1994). Environment-behavior studies and landscape design research. *Journal of the Korean Institute of Landscape Architecture*, *21*(4), 149-152.

Im, S. B., Jeong, Y. H., Hue, Y. S., Kwon, Y. K., Byeon, J. S., & Choi, H. S. (2011). A study on the types of experiences related to sense of place in cities. *Journal of the Korean Institute of Landscape Architecture*, *39*(6), 46-56.

Jang, H. W. (2022). *A study on the convergence between technology and art on the expressive characteristics of new media art* [Doctoral dissertation]. Sangmyung University.

Jang, I. Y. (2006). A hybrid tendency of contemporary landscape design. *Journal of the Korean Institute of Landscape Architecture*, *34*(2), 80-98.

Jang, J. M. (2025). *A study on the visualization and applicability of climate crisis-responsive landscape design using generative AI* [Master's thesis]. Hankyong National University.

Jang, Y. J. (2024). *A study on the visitor's experience of immersive media art exhibition with a focus on the Arte Museum* [Master's thesis]. Hongik University.

Jang, Y. J., & Kim, S. W. (2025). AI-based approach to visualization of therapeutic garden design: exploring the availability of stable diffusion models. *Journal of the Korean Institute of Landscape Architecture*, *53*(6), 18-33.

Jeon, Y. J., & Lee, M. J. (2025). Aesthetic characteristics and critical issues of image-generative AI landscape drawings. *Journal of the Korean Institute of Landscape Architecture*, *53*(6), 34-45.

Jung, Y. K. (2025). *A study on immersion in immersive media art exhibition* [Master's thesis]. Yonsei University.

Jung, Y. M. (2021). *A study on the design process and application methods of neighborhood park based on BIM* [Master's thesis]. Seoul National University.

Kim, H. Y., & Lee, W. J. (2008). A consideration on the development of interactive art in 20th century. *Journal of Digital Contents Society*, *9*(2), 177-185.

Kim, J. H., & Kim, C. Y. (2009). A study on expression for indoor design base of interactive using digital art. *Journal of the Korea Institute of Information and Communication Engineering*, *13*(11), 2473-2478.

Kim, A. Y., Kim, Y. M., Kim, Y. G., Kim, H. B., Park, C., So, H. S., Lee, S. S., Lee, J. H., & Han, B. H. (2020). *First encounter with landscape architecture*. Iljogak.

Kim, C. H. (2025a). *The impact of affordance elements in interactive new media art on immersion and visitor experience* [Master's thesis]. Chung-Ang University.

Kim, E. Y. (2010). *A study on interactive art through visual, tactile, and auditory sense experiences* [Master's thesis]. Korea National University of Education.

Kim, J. H. (2008). *Interactive media art: a study on interactivity* [Doctoral dissertation]. Soongsil University.

Kim, K. H. (2025b). *A study on immersive presentation strategies in media art exhibitions: focusing on the case analysis of Arte Museum* [Doctoral dissertation]. Sejong University.

Kim, Y. N. (2020). *A study on artistic significance of audience participation in interactive art: focusing on John Dewey's theory of experience* [Master's thesis]. Chosun University.

Kim, Y. T. (2007). Study of interactive media art application to public design. *Bulletin of Korean Society of Basic Design & Art*, *8*(2), 115-126.

Koh, G. H., & Kang, S. G. (2013). Analysis of the adaptability and methods of public space in media: focused on new-media and HCI theory. *Korean Institute of Interior Design Journal*, *22*(1), 203-210.

Kwon, T. K. (2023). *Smart park implementation through AI modeling and IoT for climate change response: focusing in the case of Seoul Forest Park and Sorae Ecological Park* [Doctoral dissertation]. Seoul National University.

Kwon, Y. K. (2013). *The formation structure and meaning of the sense of place on urban streets: Research on Insa-dong and Daehak-ro within the framework of mixed-methods* [Doctoral dissertation]. Seoul National University.

Lee, A. N. (2026a). *A study on the conceptual structure and aesthetic characteristics of interactive art* [Master's thesis]. Pusan National University.

Lee, C. R. (2023). *A study on augmented reality interactive art for expanding spatial experience: focus on the third place* [Master's thesis]. Ewha Womans University.

Lee, C. R. (2024). *A study on generative AI strategies for transforming landscape sketches into images: targeting the Jamsil Hangang Park Water Playground* [Master's thesis]. Seoul National University.

Lee, D. Y., Park, S. E., & Lee, J. H. (2023). Study of the application of VQA deep learning technology to the operation and management of urban parks: analysis of SNS images. *Journal of the Korean Institute of Landscape Architecture*, *51*(5), 44-56.

Lee, H. N. (2025). Design and evaluation of small parks based on abstract art using AI. *Journal of the Korea Institute of the Spatial Design*, *20*(3), 327-336.

Lee, H. S., Min, B. W., Yang, T. J., Eum, J. H., Kim, K., & Lee, J. Y. (2019). A study on the concept and user perception of smart park: focused on the IoT See Park users in Daegu City. *Journal of the Korean Institute of Landscape Architecture*, *47*(5), 41-48.

Lee, J. H. (2014). *A study on placelessness of new town landscape design in Korea* [Master's thesis]. Seoul National University.

Lee, H. Y. (2009). *A study on brand experience space design based on experience-centered value* [Master's thesis]. Ewha Womans University.

Lee, J. K., & Son, Y. H. (2022). Development of image classification model for urban park user activity using deep learning of social media photo posts. *Journal of the Korean Institute of Landscape Architecture*, *50*(6), 42-57.

Lee, K. (2021). Urban public space as a didactic platform: raising awareness of climate change through experiencing arts. *Sustainability*, *13*(5), 2915.

Lee, S. M. (2026b). *A study on the experience structure of immersive media art exhibitions in Korea: based on 4Es experience theory* [Master's thesis]. Hongik University.

Media Architecture Awards. (n.d.). *Waterlicht 2015, Netherlands, Amsterdam*. https://awards.mediaarchitecture.org/mab/project/185

Na, S. (2021). The need and improvement direction of new computer media classes in landscape architectural education in university. *Journal of the Korean Institute of Landscape Architecture*, *49*(1), 54-69.

Na, S. W. (2025). *A study on the boundless boundary characteristics of immersive media art based on Merleau-Ponty's phenomenology of perception: focusing on the works of teamLab* [Master's

thesis]. Kookmin University.

Osaka Convention & Tourism Bureau. (n.d.). *TeamLab Botanical Garden Osaka*. https://osaka-info.jp/ko/event/teamlab-botanicalgarden/

Park, J. M., & Han, J. U. (2024). Utilizing landscape design education through generative AI. *Journal of Industrial Science Researches*, *41*(2), 49-52.

Roosen, L. J., Klöckner, C. A., & Swim, J. K. (2017). Visual art as a way to communicate climate change: a psychological perspective on climate change–related art. *World Art*, *8*(1), 85-110.

Shim, H. R. (2006). *Aesthetics in the age of cyberspace*. Sallim.

Suh, J. H., & Shin, J. Y. (2009). A study of interactivity in contemporary landscape art work based on strategic experiential modules by Bernd H. Schmitt. *Journal of the Art and Design Research Institute, Kyung Hee University*, *12*(1), 9-14.

Sung, J. H., & Lee, K. J. (2023). Assessment of visual landscape image analysis method using CNN deep learning: focused on healing place. *Journal of the Korean Institute of Landscape Architecture*, *51*(3), 166-178.

Studio Roosegaarde. (n.d.). *WATERLICHT*. https://www.studioroosegaarde.net/project/waterlicht

Studio Roosegaarde. (2022). *Daan Roosegaarde toont WATERLICHT op UNESCO Werelderfgoed locatie Slot Loevestein [Press release]*. https://cdn.prod.website-files.com/6683beecb76948bee8843558/66cbf74897f1a44cf46d4456_persbericht-waterlicht-loevestein.pdf

teamLab. (n.d.a). *Floating resonating lamps on Oike Lake - Fire*. https://www.teamlab.art/ew/floating_resonating_lamps_oike/botanicalgarden/

teamLab. (n.d.b). *Resonating microcosms in the Common Camellia Garden - Liquified light color, dusk to dawn*. https://www.teamlab.art/w/resonating_microcosms_camellia_liquified/botanicalgarden/

teamLab. (n.d.c). *TeamLab botanical garden Osaka - teamLab night open-air museum*. https://www.teamlab.art/e/botanicalgarden/

Tian, H. (2025). *Utilizing new media art for urban regeneration: focused on Busan's Yongdusan Media Park* [Doctoral dissertation]. Pusan National University.

Tuan, Y. F. (2020). *Space and place* (Y. H. Yoon & M. S. Kim, Trans.). Sai.

Woo, K. S., & Kim, J. P. (2025). A study on AI-based garden planting layout optimization systems: focusing on academic research and commercial platforms. *Journal of Art & Design Research*, *28*(3), 1-15.

Yang, J. H. (2016). *Communication for viewer participation and experience in interactive media art* [Doctoral dissertation]. Soongsil University.

Yoo, J. Y. (2025). *Research on the visual interactive design experience in digital art spaces: centered on teamLab's exhibitions in China* [Doctoral dissertation]. Silla University.

Yoon, J. Y., & Kim, Y. S. (2024). Analysis and suggestions on feasibility of using artificial intelligence image generator for design visualization of landscape spaces. *Journal of the Korea Institute of the Spatial Design*, *19*(5), 91-104.

Zeng, G. (2026). A study of the multisensory turn in museums-A case study of teamLab in Japan. *Academic Journal of Humanities & Social Sciences*, *9*(1), 9-17.