

Intersecting Art, Design, and Science Through the Universality of Japanese Aesthetics – The Design of a ‘Garden’ as an Interdisciplinary Collaboration

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ABSTRACT

How can Japanese aesthetics, which touches the essence of the universe and embraces intersecting elements with science – in particular particle physics – cultivate interdisciplinary collaboration? At CERN IdeaSquare, the authors conducted the Garden Project through collaboration with an artistic director, architects, a physicist, and master’s students in architecture and environmental design. By co-creating a new type of garden that reflects the essence of the universe and physics, this research serves as a case study exploring spatial design through integrating the universality of Japanese aesthetics and particle physics. This article outlines the design process in transforming abstract concepts into experienceable forms. The authors explore the possibilities of interdisciplinary collaboration where art, design, and science intersect, creating a novel form of appreciating the universe, while being grounded in genuine aesthetics.

Keywords: Interdisciplinary collaboration; art; design; particle physics; aesthetics; installation.

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INTRODUCTION

The intersection of art, design, and science has long been elusive, yet has been extensively investigated over the countless years during the search for innovative approaches. Throughout history, attempts to integrate these disciplines have long been endeavoured, from the philosophical insights on education by John Dewey (Dewey, 1934), to social practice at the Black Mountain College or the Ulm School of Design, which shows a universal importance of interdisciplinary research and praxis. More recently, the overall needs and impacts of art and design have increasingly demonstrated their respective significance for innovation and creativity (Grigorescu et al., 2025). Proposing breakthrough solutions through a design mindset is one of the main purposes of transdisciplinary collaboration as a practice (Mejía et al., 2023). Despite the fact that interdisciplinary research or case studies on actual art and science collaboration is still limited, a potential theoretical framework for art-science-technology collaborations is proposed by framing such collaborations within antecedent, process, and outcome (Birsel, Marques, and Loots, 2023). In the antecedent, experimental motivations such as new aesthetics in between disciplines play a central role in creating an alternative outcome. On the one hand, Japanese aesthetics have been tacitly transmitted over the centuries, which are deeply rooted in and handed down through oral transmission and cultural practices. They have ambiguous and uncertain

characteristics. Given that transforming tacit knowledge into communicable forms – through an interdisciplinary approach encompassing art, design, science, and engineering – would advance both creative and scientific practices (Polanyi, 1966, and Balint, 2025), further practical explorations could transcend the boundaries within each field.

As a precursor to this approach, the author carried out research on art and science collaboration methodology through in-depth interview among artists, designers, scientists, and engineers from an experimental art program at CERN (Conseil Européen pour la Recherche Nucléaire) founded as Arts@CERN (Koek, 2017, and Tanaka, 2019). This was followed by collaborative practice-based research between a designer and an engineer based at CERN, in which *the universe* functioned as a mutually shared concept (Tanaka, 2019). What resulted was that deeper levels of interdisciplinary collaboration could be realised through an intuitive, uninhibited, and open-ended dialogue among artists and designers, and also scientists and engineers, facilitated by a mediator.

How, then, can a new aesthetic regarding the essence of the universe be materialised experimentally? Assuming that universality and uniqueness both underlie Japanese aesthetics and particle physics, this article aims to explore the possibility of these intersections through interdisciplinary collaboration in creating novel design. The authors discuss the Garden Project as a case study in which aesthetics and abstract concepts are transformed into experienceable form and further developed.



The project originally started in 2018 at IdeaSquare (Figure 1), an innovation platform at CERN, to create a futuristic space indoors. Although this project was suspended several times due to the pandemic between 2020 to 2021, and the sudden loss of a professor, the team members from Kyoto City University of Arts, Nagoya Zokei University, and IdeaSquare continued their collaborative efforts with utmost dedication. Led by the master’s students of environmental design and architecture under the mentorship and professional guidance of an artistic director, architects, and an experimental physicist, this project was finally realised as a permanent artistic installation.

In applying a collaboration framework consisting of a sequence of antecedent, process, and outcome, the following sections outline the background, methods concerning a conceptual framework and design process, project outcomes, and the continued discussions and conclusions.



Fig. 1. A scene from CERN IdeaSquare. Photo: Yuri Tanaka

BACKGROUND

Geijutsu and Aesthetics

Historically, there was no boundary between art and design in Japan until the late 19th century, when objects and ideas related to art and design were imported from the West. *Geijutsu* – a creative way of life or the art of living – encompasses both art and design from a broader perspective, which has developed in parallel with those disciplines in the West. Despite this fact, the notion of *geijutsu* has been largely neglected in the modern Japanese education system over the past century. In recognising these uncertain boundaries, the authors believe that an unexplored fusion of art and design has yet to be cultivated.

Japanese aesthetics have likewise developed in parallel, which have a profound relationship with nature. Regarding what is considered Japanese aesthetics, it is essential to acknowledge the heterogeneous make-up of Japanese culture, which evolved through significant

periodic historical influences from China and Korea. More specifically, Buddhism, Taoism, and Confucianism constitute the fundamental elements of aesthetic sensibilities that have been continually incorporated and uniquely cultivated in Japan (Okakura, 1964, and Davies, 2016). Aesthetics fundamentally shapes art, design, and science alike. From this perspective, the intersection of the universality of Japanese aesthetics and particle physics will now be examined.

Japanese Garden

A garden is regarded as a poetic transformation of the universe – the heart of Japanese garden concepts (Shigemori, 1943). A fundamental concept of Japanese gardens also underlies Buddhist philosophy in general, which understands past, present, and future as inseparable from and integrated within the here and now. Based on this parallel, the meaning of gardens was also explored in the project.

The key concept was that the design should not only maximise the aesthetic qualities of appreciating nature and the universe, but also enhance human experience. These are deeply intertwined. Through such experiences, an enrichment for humans may potentially be realised – unveiling the inherent tendency of the human mind to appreciate beauty – which resides within each individual. This constitutes one of the imperative meanings of creating a garden: to enrich human states of mind. It is not created merely to represent nature nor supersede traditional forms. Accordingly, the garden in this research is conceived as an open area that anyone can access, with or without any specific purpose.

While Japanese culture is often understood as being closely connected to nature, this relationship is not tied to untouched primary nature, but rather it is actively in relation with what is described as *secondary nature* – a reconstructed form of nature that has developed since the early 7th century (Shirane, 2012). Notable examples include *niwa* (gardens) and *satoyama* (landscapes where the wilderness and human activity coexist). Through these practices, nature and natural phenomena have continually been appreciated in an artistic manner. This nature-culture orientation has fostered a fundamental perception that nature and humans are not separate, but rather innately and intricately interconnected. Furthermore, aesthetic sensibilities towards nature have been refined, giving rise to diverse forms of *geijutsu*.

Across the Universe, Nature, and Particle Physics

In Japan, ever since ancient times, humans have been considered a part of nature within the universe itself. For the Japanese, the universe is perceived as embracing interconnections across the earth and through the sky, beyond the conceptions of space and time. This perception extends to particle physics and quantum theory as well, notably within the quantum theory of non-

local fields, which describes the intrinsic interconnections among particles across fields in different locations (Yukawa, 1950a and 1950b), a concept that remains fundamental to contemporary particle physics. In this regard, the Japanese aesthetic notion of the point, or particle in other words, closely resonates – a particle is not merely a static point-like entity, but a dynamic point embedded within continuously interacting fields (Yoshimura, 1967). It can never be isolated. Furthermore, the field theory of the elementary domains is also rooted in the philosophical thought of Chinese poet Li Bai (Yukawa, 1981), in which space and time are described as ceaselessly flowing, like a traveller in a hotel room.

Deep understanding of nature and the universe is essential in the foundations of art, design, and science. Yet, it still remains a question of how the essence of these can be transformed into form via design through aesthetics.

METHODS

This research utilises interdisciplinary collaborative methods consisting of an ideation phase based on the conceptual framework, sequential design and installation processes developed through semi-structured generative dialogues and discussions among members. These phases are interactive in nature and inextricably linked through an iterative feedback loop. The outcome consequently reflects the preceding phases.

Antecedent: Conceptual Framework

In establishing a foundation towards materialisation, the conceptual framework across disciplines was discussed among members. This conceptual framework, preliminarily developed through dialogues between the author and physicists in exploring the aesthetics situated within art, design, and particle physics, is summarised in figures 1–4 of this section. These act as a catalyst for enhancing creativity as well as a guideline for members to follow.

The faculty helped bridge concepts exploring the intersections between particle physics, architecture, art, and design through facilitating interactive discussions with the physicist and students. The facilitation was drawn from the author's practice-based research on art and science collaboration through mediated dialogues mentioned in the introduction (Tanaka, 2019). With this approach, it is essential for collaborators from different disciplines to give birth to ideas collectively from the very beginning. In addition to this, proposing an open-ended broad question would help collaborators come up with creative ideas and design. Thus, in endeavouring to create a new type of garden as a mutually communicable subject, an open-ended question was first posed: "How

can we share the appreciation of life within the universe?"

As an introductory phase, approximately six months were initially set for an in-depth ideation period. As part of a university environmental design course, a series of seminars and discussion sessions were carried out by the author serving as artistic director, together with a professor/architect, an experimental physicist, and master's students. The seminars addressed topics including the conceptions and designs of Japanese gardens, aesthetics, particle physics, and the identity of the site IdeaSquare, as part of the Design Factory Global Network. The scientific aspects included topics on the fundamental concepts of space and time, symmetries, fundamental forces, antimatter, the components of the universe, and the questioning of what we are able to see, or what remains unseeable. The aims were to discuss foundational understandings concerning the universe, enabling students to capture its underlying essence, rather than pre-formulating outcomes related to a specific theme. Through this method of providing the freedom to explore and the space to share ideas, subsequent discussions within the seminars and further dialogue among the members in informal settings were also encouraged and occurred frequently, which strengthened the collaborative relationship.

1. *Art of Concealing Beauty*

Throughout history, the 'art of concealing beauty' has been tacitly embedded in Japanese aesthetics. The principle involves the deliberate partial concealment of beauty in order to enhance imagination and allow humans to appreciate beauty in an artistic and experiential manner (Okakura, 1964). It constitutes a fundamental aesthetic approach in the poetic reconstruction of nature and the nature of reality, fostering a deep appreciation towards hidden beauty, rather than presenting it merely as it is.

2. *Chudo*

With the aim of designing a new type of garden – neither Japanese nor Western, neither artistic nor scientific – the concept of *chudo* (the Middle Way) was introduced. Originating in Buddhism, *chudo* represents a philosophical orientation towards finding the true nature of things by transcending dualistic thinking. Rather than denoting a literal midpoint between opposing elements, it refers to an approach that seeks to maximise harmony among diverse elements, in pursuit of a way beyond extremes (Saigusa, 1984). This idea can support collaborators in integrating different ideas in a unique manner, rather than merely combining separate or opposing components.

3. *Asymmetry*

As discussed in the background, the dynamic nature of particles and fields is reflected in Japanese art and design, through the use of asymmetrical forms, for example. In particle physics, symmetry refers to a state

in which change occurs without altering the underlying structure, revealing patterned behaviour. The theory of spontaneous symmetry breaking, which originated with Nambu (Nambu, 1991), also resonates with the asymmetrical character of Japanese aesthetics (Yoshimura, 1967), namely in its appreciation of the beauty inherent in nature, which is uncertain and ever-changing, and tries to grasp what is perceivable and attempts to unveil what is hidden. Accordingly, this idea also led to a fundamental understanding of the void in particle physics (Asai, 2013).

4. *Ku*

In the discovery of the Higgs field, which is rooted in Nambu’s theory of spontaneous symmetry breaking, the vacuum was revealed not as an empty void, but as a field filled with dynamic potential energy. This understanding of the vacuum resonates with the Buddhist concept of *ku*, which literally means emptiness or void. *Ku* describes the relational nature of the world: nothing is fixed, and everything is relational. This concept is also interconnected with a fundamental element of Japanese aesthetics, *yohaku*, often translated as the beauty of empty space. A deliberately emptied space – such as *karesansui*, which is commonly called a Japanese rock garden in the West – functions as a field of interaction (Yoshimura, 1967), in which audiences can perceive meaning and richness exploratively in what appears to be mere emptiness.

In the ideation phase, the concepts bridging particle physics and Japanese aesthetics broadened members’ perspectives by exploring innovative and creative ideas for designing form through dialogues and collaborative discussions. Extracting the abstract design elements and aligning them with scientific insights reveals an underlying universality, which we believe can be shared across different disciplines and cultures. Accordingly, this conceptual framework outlines a foundation for the actual design process.

Design Process

Phase I

Based on the abovementioned foundational concepts, four master’s students from Kyoto City University of Arts were tasked with the development of design proposals. In the first session, each student developed up to two individual proposals, which were then integrated into two paired proposals (Figures 2 and 3) in the subsequent session. The remote discussion sessions were facilitated again by the faculty, including members of IdeaSquare, alongside in-person discussions in Kyoto. Given the diversity of design approaches, integrating the different ideas presented a challenge for the students. In response, the framework for applying *chudo* consisted of integrating different ideas into a single more harmonised proposal, by reaching mutual understanding through in-depth discussions, rather than selecting a pre-existing proposal or combining different ideas into one proposal.

Although the two original proposals differed considerably in their design, both reflected a concept of enhancing natural and interpersonal interactions, which was physicalised in the use of nets or threads used for suspension.



Fig. 2. A slide from Team I. Image: Zhuoan Dai, and Mao Hasegawa

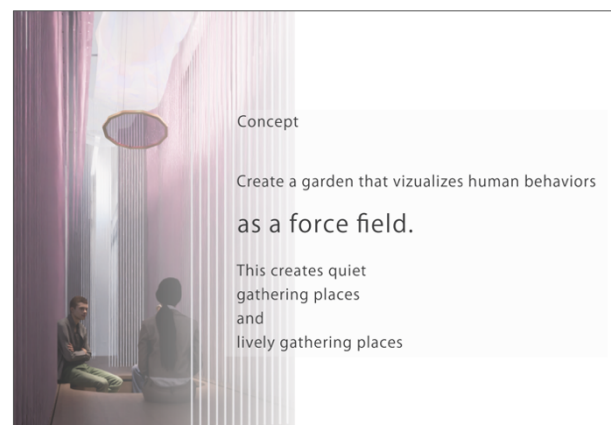


Fig. 3. A slide from Team II. Image: Junyi Guo, and Joh Yamasaki

These proposals were integrated into a simplified design, with the interaction between the environment and humans as a core concept (Figure 4). This design deepens the concept of *ku* by making use of space that is not designed to have a particular function. It maintains a tranquil atmosphere while incorporating lively elements through the use of a net suspended between the first floor and the ground floor, allowing the observer to experience and inhabit the space. The threads function as media of movement and presence, displaying the temporal incidence of light and shadow in the garden. Subtle fluctuations emerge through interactions among the threads, environment, and humans. This invites the participant to realise their interconnectedness with all these elements in the here and now, while also generating an ever-changing dynamic landscape. As a result, this design highlights the ability to appreciate nature's asymmetrical qualities within the concepts of asymmetry

mentioned in the conceptual framework, encouraging the perception of constant change in the environment.



Fig. 4. A rendering of the preliminary garden plan. Image: Joh Yamasaki.

In this process, the concept of *chudo* worked as a method for collaborative decision making. Furthermore, it aided members in integrating and harmonising the spatial design. The concept of *ku* also demonstrated its potential as a design principle for defining spatial layout and scales by maximising seemingly empty space.

Phase II

The challenges faced by the students included the sudden loss of the professor and the graduation of three of the original members, in addition to adhering to technical regulations and security requirements at CERN, which necessitated a redesign of the initial proposal, unexpectedly acting as a catalyst for refining the design.

In collaboration with a professor and two master's students from Nagoya Zokei University, the foundational concepts were redeveloped through further discussions and design studies, especially on asymmetry, for creating an experienceable ever-changing environment for humans directly interacting with the structure, without the actual movement of the threads. However, with the updated approach of installing horizontal structures throughout the corridor, the new design realises materialising asymmetry differently – showing the dynamism of nature through which order and randomness co-exist – by using ten layers consisting of 99 threads per layer, light gauge steel, and acrylic plates (Figures 5, 6, 7, and 10). This complex layout also illustrates *ku* by highlighting the dynamism of the seemingly empty space between layers. Furthermore, these horizontal structures provided increased durability for the whole structure. This design applies the foundational concepts in a different manner, while further enhancing the essence of the design and aesthetics alongside structural integrity and functionality, thereby increasing durability.

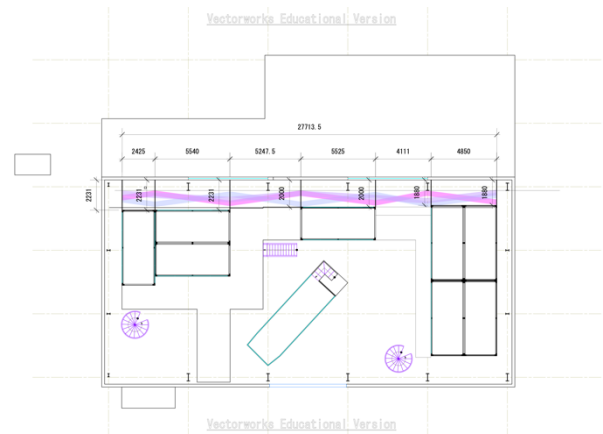


Fig. 5. A top view of the installation in the floor plan. Image: Ryura Kawai, and Rika Oosawa.

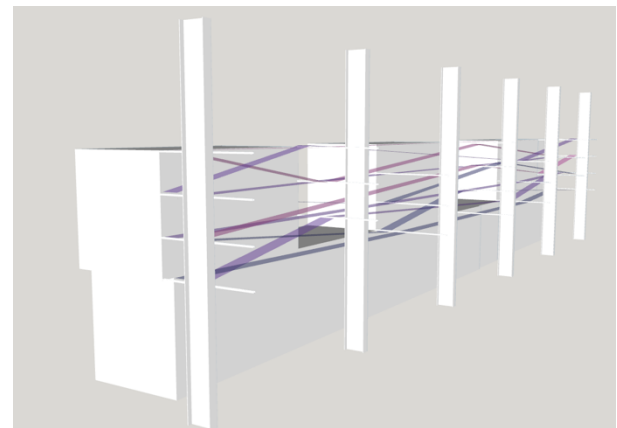


Fig. 6. A rendered horizontal view of the installation design. Image: Ryura Kawai, and Rika Oosawa



Fig. 7. A rendered vertical view of the installation design. Image: Ryura Kawai, and Rika Oosawa

The process of material selection consisted of testing different kinds of materials such as optical fibres, which led to a discovery of natural silk threads as the optimal material, in collaboration with an established dyeing

workshop in Kyoto. Despite the extreme technical challenges inherent in working with silk, its aesthetic qualities – in particular the uneven surface and texture which creates subtle fluctuations in response to environmental factors – were highly valued. The colours were examined based on the colour concept created by the author, as outlined below:

Colours of the Garden

- (i) Ever-changing with the environment and its phenomena
- (ii) Ever-changing the landscape through human behaviour
- (iii) Softly changing space and time
- (iv) Fluctuating with uncertainty through the reflection of light

From this colour concept, lilac, wisteria, and violet colours were chosen to create a gradient landscape within the existing environment. The subtle translucence of the dyed silk threads appearing in these gentle colours can constantly interact and change with the ever-shifting lights. This colour palette, which was selected based on the colour images of actual flowers, enables harmonisation of the installation with the actual environment as well as the whole space – including *ku*, or the empty space. This physicalising approach highlights subtle environmental changes, particularly those emerging through the reflection of natural light.

This phase demonstrates how the foundational concepts could consistently expand the design variations despite changing conditions. This also shows how abstract and ambiguous concepts can generate different interpretations, which in turn lead to creative new design approaches.

Installation Process

Co-creation of the installation was physically carried out through iterative testing of materials and the production of mock-ups and models. It culminated with the on-site installation set-up in the end. The design was implemented according to plan in approximately a two week period, by the authors and students from Nagoya Zokei University, with support from members of CERN and IdeaSquare (Figure 8).

The conceptual framework and the mutual understanding over the years-long project served as guiding principles throughout the process, particularly in the case of several on-site adjustments regarding design and visual aesthetics. Such collaborative engagement in setting up the installation resulted in deepening a sense of shared commitment and unity among members. The actual process of installing the work together not only builds upon the skills of team members, but it also increases intrinsic motivation and improves team cohesion, in addition to fostering interdisciplinary innovation.



Fig. 8. A scene from the set-up period. Photo: Jimmy Poulailon

OUTCOMES

The *Garden* reached its completion and was transitioned into a permanent installation in November of 2024 (Figures 9 and 10). As with the aim of creating a new type of garden, this installation represents a unique design, in which the conceptual framework across disciplines was materialised. As with the concept of *chudo*, this is neither a traditional Japanese garden nor a science-oriented garden, but a harmonised garden that embodies intersecting elements of art, design, and science. It has been tacitly transmitted that the core of what a Japanese garden embodies is not merely contained in form, but in mind, which attributes meaning and makes a garden meaningful (Shigemori, 1943). In exploring experimental design, the fundamental concept of a Japanese garden – as “a poetic transformation of the universe” – was translated and physicalised to exist within an indoor space. Through the transient landscapes that enhance an awareness of the constant and subtle changes of natural lighting via reflections of light and shadow produced by the threads, an experiential appreciation of nature’s constant flux within the here and now – as traditional Japanese gardens realise in different

ways – is created. Rather than directly revealing the beauty of natural phenomena, this installation subtly conceals and enhances it through multi-layered threads, through which this beauty is perceived and experienced by humans in diverse, varied, and unpredictable ways. This method of concealing beauty attempts to cultivate the imagination of the observer.



Fig. 9. A landscape with the *Garden* at the IdeaSquare. Photo: Maria Cavazza



Fig. 10. A view from the corridor at the IdeaSquare. Photo: Maria Cavazza

DISCUSSIONS AND CONCLUSIONS

In summary, this article discusses a case study of how the intersection of Japanese aesthetics and particle physics operated within the design process towards creating a new type of garden through interdisciplinary collaboration. Given the innate universality and uncertainty inherent in both Japanese aesthetics and particle physics, this research demonstrates how spatial design grounded in collaborative discussion through these conceptual frameworks can transform abstract concepts into experienceable forms. This research also suggests that co-creation based on the conceptual foundation alongside mutual understanding throughout the entire process – ideation, design, and installation – supports collaborators in overcoming challenges by moving beyond the mental constraints of their existing knowledge and skillsets. While this article presents a single case study that addresses only a limited aspect of the intersection, further empirical research and practice are necessary to examine how this framework may be applied across diverse interdisciplinary collaboration, of which art and science can become foundational. Expanding on such themes would contribute to exploring the boundaries of art, design, and science in the pursuit of more creative ways of living and interacting with the environment. The authors sincerely hope that exploring the possibilities of interdisciplinary collaboration will inspire more novel forms of *geijutsu*.

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CONFLICT OF INTEREST

None to declare.

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