

Insights in Social Science

Contents

- I The Cross-Media Translation Pathways and Aesthetic Strategies of Literariness in *The Eternal Wave*
Zhao Danmeng
- 14 A Study on the Modes of Narrative Representation and Structural Logic in Artistic Performance Dance in Dance Sport
Sun Weiyi
- 24 Why Singapore's Healthcare Model Cannot Be Directly Replicated in Mainland China: A Comparative Policy Perspective
Wei Mingyang
- 32 Research on Digital Exhibition Design of China Industrial Design Museum
Xu Dan, Rahah bt. Hasan, Tang Zijie
- 56 An Exploration of the Characteristics of Abstract Painting and AI-Generated Abstract Painting in the Age of Artificial Intelligence: A Freudian Perspective
Wen Yanan, Mohd Zahuri bin Khairani
- 66 A Comparative Study on the Effectiveness of ChatGPT and DeepSeek in the English Translation of Characteristic Terms from Classical Chinese Medical Texts—A Case Study of Huangdi Neijing: Jue Lun Chapter 45
Li Yuhan
- 76 Construction and Practice of Smart Wellness Model Integrating Traditional Chinese Medicine Health Preservation Industry Standards and Digital Systems
Chen Yao

Insights in Social Science

Contents

- 87 The Reconstruction of Neighborhood Committees and Urban Grassroots Governance Systems in Early New China: The Case of Beijing
Fang Ning
- 102 Theoretical Analysis on Standardization of Time-Based Moxibustion with Lingui Bafa for Intervention in Mild Cognitive Impairment: From the Perspectives of Time-Based Qi Transformation and Meridian Time Sequence
Huang Rui
- 114 From Heritage to Asset: Pathways for IP Construction of Qilu Transport Cultural Symbols
Shan Yixuan, Liu Yukai

The Cross-Media Translation Pathways and Aesthetic Strategies of Literariness in *The Eternal Wave*

Zhao Danmeng^{1*}

¹ Ph.D., Department of Film and Image, Cheongju University, South Korea

* Correspondence: 759568956@qq.com

<https://doi.org/10.53104/insights.soc.sci.2026.06001>

Abstract: This paper takes the cross-media adaptation of *The Eternal Wave* from literature to the stage as a case study, exploring the translational pathways of literariness within dance drama and opera. Treating literariness as the core aesthetic value, it systematically examines its mechanisms of manifestation in narrative construction, character shaping, lyrical expression, and ideological articulation. Through comparative analysis, it is found that dance drama relies on bodily movement, spatial utilization, and stage choreography to create embodied visual metaphors and narrative structures, whereas opera, through musical development, vocal performance, and its overall structural framework, constructs linear auditory symbolism and emotional flow. The investigation of the transformation of this work between these two artistic forms is not merely a comparison of their artistic characteristics; rather, it seeks to address key issues in cross-media adaptation: how to preserve the intrinsic artistic properties of each medium while achieving effective narrative reception and dissemination, thereby eliciting emotional resonance from the audience. Consequently, this study focuses on how literariness is reorganized within different stage media, rather than extending to broader issues of dissemination or cultural identity.

Keywords: cross-media literariness; translational pathways; aesthetic strategies; red classics; *The Eternal Wave*

Received: 7 April 2026

Revised: 10 April 2026

Accepted: 14 April 2026

Published: 16 April 2026

Citation: Zhao, D. (2026). The Cross-Media Translation Pathways and Aesthetic Strategies of Literariness in *The Eternal Wave*. *Insights in Social Science*, 4(2), 1–13.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The *Eternal Wave* belongs to the category of “red classics.” Its cross-media adaptation from text to dance drama and opera provides a paradigmatic case for exploring the mechanisms of artistic translation. This study takes the transformation and elevation of literariness in this process as its central focus; therefore, it is first necessary to define the

concept. In this paper, literariness does not merely refer to the artistic features of language, but rather to a core aesthetic value that can be transmitted, transformed, and sustained within a cross-media context. Its concrete manifestations are reflected mainly in narrative organization, psychological expression, and symbolic or thematic patterning. The original text, through its espionage narrative, portrays the spirit of self-sacrifice and emotional

contradictions of ordinary individuals while promoting the red ideological theme, thereby establishing a solid literary foundation across these dimensions. Based on this foundation, the present study analyzes how dance drama achieves embodied narration through the body, posture, and rhythm, and how opera accomplishes integrated expression through music, visual elements, and dramatic structure. It further deconstructs and reconstructs literariness, revealing the pathways and aesthetic strategies involved in the process of cross-media translation. The following analysis proceeds by examining how these dimensions are reconfigured in dance drama and opera.

From this theoretical perspective, examining the literariness of *The Eternal Wave* in both dance drama and opera carries significant theoretical value and practical implications. The reason this work serves as a classic case lies primarily in the inherent qualities of its literary original. The source text does not merely remain at the level of verbal representation; rather, through strong narrative tension and dramatic conflict, it constructs an artistic core rich in imagery and highly amenable to translation. This characteristic provides dance drama and opera—two markedly different art forms—with a shared origin while enabling distinct creative environments. The juxtaposition method employed in this study does not aim at isolated or simplistic evaluation; instead, it adopts a comprehensive and systematic perspective to conduct both horizontal analysis and vertical comparison. Within this framework, dance drama, through embodied narration, and opera, through integrated expression, each establish mechanisms of literariness transformation aligned with their respective media characteristics. By comparing the similarities and differences in their translational pathways, this study moves beyond the limitations of analyzing adaptation forms alone and explores the interaction between the stable core of literariness and its high translatability as it traverses media dominated by different sensory modalities.

At present, some audiences exhibit a relatively limited level of acceptance toward *The Eternal Wave*

in its operatic and dance drama forms. An analysis of this phenomenon from the internal logic of cross-media adaptation suggests that it largely stems from structural discrepancies between the characteristics of artistic media and the audience's habitual modes of reception. When dance drama and opera transform literariness into deep-level artistic sign systems, an excessive emphasis on formal exploration by creators may alienate audiences accustomed to traditional narrative modes. In dance drama, where the body functions as a system of signification, overly abstract or insufficiently clear bodily language can easily hinder audience perception and emotional resonance. Opera, for its part, must carefully balance musical lyricism and dramatic progression, avoiding both the weakening of narrative momentum due to musical expansion and the impairment of musical expressivity due to insufficient dramatic structure. During the adaptation process, deviations in the interpretation of the original spirit may lead either to mechanical replication of the plot lacking contemporary interpretation or to excessive subversion that detaches the work from the audience's emotional memory, thereby producing an imbalance between the work and its reception. In terms of stage presentation, the absence of adequate audiovisual guidance—such as ineffective lighting design in dance drama failing to reinforce narrative coherence, or unclear subtitles in opera—can further intensify cognitive difficulties. The diversity of audience responses fundamentally reveals a deep-seated tension between the essential transformation of artistic forms and the outcomes of their dissemination and reception. Therefore, adaptation must establish more strategic channels of dialogue, integrating aesthetic considerations with audience communication. However, in order to maintain analytical clarity, the present discussion focuses primarily on the level of formal transformation across media.

The issues observed at the level of audience reception directly reflect the practical concerns of this study. The aim is not merely to compare the artistic characteristics of dance drama and opera,

but to confront the fundamental challenges of cross-media adaptation—namely, how to achieve a dialectical unity between the intrinsic laws of artistic forms and the effects of mass dissemination and emotional resonance. Existing discussions tend to focus primarily on how such transformations are implemented, while paying comparatively insufficient attention to why they are embraced or resisted. When the information conveyed through bodily language in dance drama becomes overly abstract and difficult to comprehend, or when the musical components in opera compromise the clarity of the narrative, the textual connotations may deviate from the audience's expected psychological horizon.

Taking *The Eternal Wave* as a representative case, this study undertakes a theoretical inquiry that is both diagnostic and constructive, offering a detailed comparison of the two adaptation forms of dance drama and opera. First, it analyzes the limitations in their formal creation and levels of reception, elevating discrepancies in audience feedback into an academic interpretation of the deeper logic linking media characteristics, translational strategies, and reception outcomes. Second, it seeks to move beyond the scope of a single case to summarize translational principles with broader applicability, thereby providing a conceptual framework for the stage adaptation of red classics and other literary works—specifically, how to achieve an organic unity between artistic autonomy and widespread dissemination. In this way, the research value of this paper extends beyond a mere comparison of artistic forms to encompass the contemporary transformation of canonical texts and the construction of cultural identity, both of which hold substantial practical significance.

2. The Translation of Narrative Function: From the Poetics of Body and Space to the Drama of Music and Time

In their representation of narrative, dance drama and opera typically employ media-specific modes of expression, transforming the sequential literary

elements of exposition, foreshadowing, and suspense into stage forms characterized by strong sensory tension. Dance drama narration follows the principle that the body serves as the expressive instrument while space constitutes the structural logic, relying on the visual associations generated by the intensity, rhythm, and staging of movement to convey meaning. A static pose, a shifting gaze, or the aggregation and dispersion of a crowd—these poetic images co-constructed by body and space inherently contain conflict and premonition.

Opera, by contrast, treats the human voice and instruments as its primary media and musical form as its structural framework. It achieves narrative objectives through the insertion and variation of thematic motifs, dramatic transformations of harmonic color, and the auditory rendering of inner states through arias and ensembles. The recurrence of melody evokes associations with trajectories of fate; a timbral shift from firmness to tremor externalizes emotional fluctuation; dissonant intervals in choral writing generate a collective atmosphere of suspense. Dance drama narration thus constitutes a spatialized, embodied practice of meaning production, reconfiguring temporal plots into visually striking instantaneous images. Opera narration, on the other hand, unfolds as a temporally linear, structured sonic process, translating event sequences into an audible logic of emotional progression. Although their pathways differ, both enable audiences to bypass verbal language and apprehend plot development and existential implications through direct visual or auditory perception.

2.1 From Literary Psychological Description to Embodied Narration in Dance Drama

Approximately four minutes into the opening of the dance drama *The Eternal Wave*, a brief subtitle first establishes the covert background of Li Xia and Lan Fen as a “fake couple” operating undercover. This is followed by a pas de deux that presents their everyday tenderness through bodily interaction. Subsequently, the choreographer introduces a rapid and decisive synchronized turning movement. This

design is not merely a matter of stage blocking; rather, it dynamically disrupts the previously constructed atmosphere of softness. At the moment of stillness following the turn, Lan Fen's gaze undergoes a sudden transformation—from the earlier gentleness and apparent dependence to a distinctly alert, perceptive, and composed scrutiny. This nonverbal sign, formed through the integration of bodily movement and facial expression, generates a highly condensed poetic narrative image, fully demonstrating the dance drama's capacity to artistically translate and reconstruct literary connotations.

From a narrative perspective, the design of this turning glance relies on visual and corporeal means to fulfill the dual literary functions of exposition and foreshadowing. First, it immediately reveals the dramatic effect of a relationship that appears tender on the surface yet conceals underlying complexity, while also conveying the true nature of the characters' bond: their intimacy is in fact a performative disguise necessitated by revolutionary duty. Second, the sudden shift in Lan Fen's gaze functions analogously to psychological description in literary narration, rendering the vigilance and professional competence required of an underground operative as an immediately perceptible visual sign. This gaze signifies, on the one hand, acute sensitivity to external risks, and on the other, a momentary withdrawal from the "performed" situation shared with her partner, thereby laying a crucial foundation for the subsequent development of a tense and complex plot.

In terms of character construction as an expression of literariness, this segment significantly enhances the psychological layering and dimensionality of the role. With a single shift of the eyes, Lan Fen transforms from a performed wife into an authentic revolutionary agent, powerfully manifesting the dual tension between personal emotion and revolutionary mission on stage. (Nie Wei, 2024) This treatment transcends the limitations of textual psychological description; through meticulous control of facial musculature, precise calibration of

gaze direction, and instantaneous modulation of expression, the abstract concept of vigilance is rendered visually perceptible and aesthetically embodied. In this way, the dance drama replaces the complex modes of representing human nature found in literariness with a poetics of the body, such that characters' thoughts are no longer conveyed solely through language but are already embedded within their movements and gazes.

In terms of thematic symbolism and atmospheric construction, this backward glance constitutes a condensed expression of the core metaphor of the entire work. The vigilance it conveys is not merely a behavioral response to a specific situation, but also a symbolic representation of the unchanging spiritual state of revolutionaries during their covert operations. (Deng Jiao, 2022) Beneath the apparent tenderness lies an ever-present and unrelenting acuity of perception; behind seemingly tranquil daily life, latent tensions and concealed struggles continue to surge. This gaze interacts with the ensuing tense sound effects and cold lighting, thereby shifting the stage space from the surface-level world of everyday life to a deeper reality fraught with danger. In this way, the dramatic atmosphere undergoes a poetic transformation from warmth to chill, employing bodily movement to articulate a "standing-on-the-edge-of-an-abyss" existential experience that resists full encapsulation by language.

In sum, although the design of this turning glance appears simple, it is by no means an ordinary transitional movement. Rather, it exemplifies how the dance drama *The Eternal Wave*, through the unique properties of its artistic medium, profoundly transforms literary content into artistic form. Through highly condensed and aesthetically refined bodily symbols, the ritualistic implications embedded in synchronized turning, and the precise control of shifting gazes, this segment integrates narrative progression, nuanced psychological depiction, the subtle construction of dual identities, and thematic symbolism into an organically unified visual whole. It embodies the expressive power of "silence surpassing sound." This example

demonstrates that, within the perspective of cross-media creation, literariness can not only be conveyed through the language of dance but can also be elevated—through bodily dynamics and the interaction of gazes—into a more concentrated, immediate, and affectively powerful poetic art form.

2.2 From Text to Soundscape: The Functional Divergence of Repetition Strategies in Opera and Literature

In the opera *The Eternal Wave*, the phrase “the nightingale has arrived” is structurally repeated within choral passages, exemplifying the reproducibility inherent in musicality. This constitutes a typical operatic strategy for reorganizing a literary device within a musical-dramatic structure. Such treatment shifts repetition from a semantic function in text to a structural function in musical progression; instead, through musical development, the dramatic rendering of collective vocal parts, and the gradual accumulation of symbolic meaning, it transforms the original text’s dual implications of anticipation and alarm into an experience that directly engages the audience’s senses and emotions.

Opera is an art form that unfolds within the dimension of time, fundamentally distinct from the spatial organization characteristic of written language. In literary reading, repeated recitation of the same phrase can easily induce fatigue and dull semantic perception. However, within the temporally unfolding auditory process of opera, repetition becomes a primary driving force for the development of musical structure and dramatic conflict. Through subtle adjustments in harmonic effect, orchestration, vocal layering, and performance intensity with each recurrence, the composer achieves gradual variation within a cyclical process. As a result, each reappearance of “the nightingale has arrived” signifies a progressive intensification—whether of mounting tension, the imminent approach of danger, or the consolidation of confidence. Such treatment not only compensates for the limitations of static repetition in written

language but also expands its expressive range within the dynamic process of music.

The use of choral form in this passage adds two further layers of depth to the strategy of repetition: collective psychology and dramatic irony. From the perspective of plot, the progressive youths on stage sing in unison, expressing their ardent anticipation for the “nightingale” as both a revolutionary messenger and an embodiment of hope. From a metaphorical perspective, however, this creates an audiovisual effect akin to fate knocking at the door and the sweeping advance of historical tides, thereby intensifying dramatic suspense and enriching emotional density. The performers’ facial expressions and vocal modulations reinforce one another, guiding the audience’s emotional fluctuations. What the audience receives is not merely the surface meaning of words, but rather a form of collective emotional resonance embedded within the undulating waves of sound. (Xiao Luo, 2013)

This musicalized repetition further expands the literary connotations of the central image of the “nightingale.” The overture establishes a somber tone with the declaration “the nightingale is dead,” followed by the repeated reappearance of “the nightingale has arrived.” Within the developmental trajectory of operatic music, this generates a powerful dramatic contrast while also maintaining a deep semantic continuity. In this way, the “nightingale” evolves from a static textual metaphor into a “sonic protagonist” moving through the dramatic action, bearing the weight of both narrative turning points and spiritual anchorage. The repeatedly intoned lyrics function like tolling bells, inscribing this symbol deeply into the audience’s auditory perception and emotional memory.

The strategy of repetition in opera is not a mere transplantation of literary technique; rather, it is an artistic form determined by the intrinsic integration of music and drama. Through the temporal extension, variation, and cumulative layering of sound, it transforms aspects often understated in literary texts—such as atmospheric construction

and emotional accumulation—into a process of dramatic progression that can be directly perceived through hearing, endowed with both formal aesthetic qualities and emotional evocative power. In this way, a textual motif is transformed into an auditory structure that organizes both narrative expectation and emotional intensity.

2.3 From Monologue to Counterpoint: The Dramatic Expansion of Literary Psychological Representation in Opera

In the opera *The Eternal Wave*, scenes depicting interrogation and suspicion employ the interweaving of vocal counterpoint to construct a field of dramatic irony. At this moment, the work translates the latent psychological activities and complex interpersonal relations found in literature into an audibly perceptible field of psychological tension. This differs from literary techniques that rely on shifts in narrative perspective to reveal inner states, and instead establishes a mode of simultaneous psychological representation in opera. Once rendered through singing, inner psychological activity acquires a legitimate and public form of expression. For instance, Liu Nina's line— "So the nightingale is not Li Xia"—does not merely recount a plot point; rather, it condenses her shock, disappointment, and sense of betrayal into a vocalized expression. Similarly, the Japanese officer's line— "Liu Nina has seemed uneasy of late; could she be playing a double game?" transforms his suspicion, calculation, and surveillance under authority into an audible form. Content that in literary works typically requires interior monologue or a specific narrative perspective is thus reconstituted in opera as highly expressive vocal segments, allowing the audience to enter directly into the characters' cognitive space while bypassing intermediary processes of interpretation and transition.

Through the integration of music and stage performance, interior monologue acquires distinct individuality and heightened emotional tension. Liu Nina's aria employs a sharply descending melodic line to produce dissonant sonorities, thereby

rendering the psychological shock of cognitive disintegration. The performer's manipulation of articulation strength, the suppression of vowels, and the rapid transition of facial expression—from composure to astonishment and suspicion—visually and aurally externalize the collapse of her inner world. In contrast, the Japanese officer's aria utilizes a circuitous low-register melody, controlled pianissimo, and sudden dynamic outbursts to convey an outward calm concealing latent murderous intent. Performance details such as a vacant gaze and trembling fingers further enrich the layered portrayal of suspicion constructed through sound.

The composer arranges Liu Nina's self-doubting aria and the Japanese officer's suspicious aria in a sequentially superimposed manner within the same dramatic time-space, thereby creating, from a musical perspective, a structure akin to montage—one characterized by contrast and irony. This generates a dual process of revelation: on the one hand, it discloses Liu Nina's realization of the true identity of the "nightingale"; on the other, it reveals her own entrapment within a perilous system of scrutiny. Such treatment carries a strong sense of dramatic irony and foreshadows the trajectory of fate, enabling the audience to attain a higher level of awareness than the characters themselves. Consequently, within an atmosphere that is both tense and enigmatic, the audience is able to perceive more profoundly the intricate and cold nature of power relations.

Large sections of the opera *The Eternal Wave* do not rely solely on vocal delivery to convey character psychology; rather, they construct precise musical images through the uniquely operatic mode of "auralizing" inner consciousness. By employing a polyphonic narrative structure, the opera compresses the gradually unfolding inner conflicts and relational tensions of the literary script into concentrated musical-dramatic segments that combine intellectual depth with emotional intensity. This approach not only propels the narrative forward but also projects, within the audience's cognition, a clearer psychological map of power

relations than that available to the characters themselves, thereby showing how opera reorganizes psychological tension and power relations into a simultaneous auditory structure.

3. The Deep Translation of Character and Psychology: The Internalization of “Bodily Poetics” and the Externalization of “Vocal Drama”

Dance drama and opera each establish parallel and functionally equivalent aesthetic systems—namely, “bodily poetics” and “vocal drama.” In dance drama, deep psychological activity is translated into bodily language, character imagery, and emotional expression, embedded within the dynamic coordination of bodily centers and the rhythmic flow of movement. Psychological portrayal is realized through what may be termed “micro-performative expression”: the trembling of fingertips, the shifting of gaze—these refined yet emotionally authentic corporeal details contain a form of psychological vocabulary that directly engages the audience’s intuitive perception, allowing inner states to be manifested through the body.

Opera, by contrast, grants the spiritual world of characters a direct auditory presence. Through melodic characteristics and core motifs, it establishes the tonal foundation of roles while capturing fleeting psychological dynamics with precision. In operatic art, the logic of musical development is simultaneously the logic of emotional progression. While dance drama delineates the inner world through posture and kinetic rhythm in silence, both forms, through their respective creative pathways, probe the complex and nuanced authenticity of human emotion.

3.1 Psychological Monologue in Enclosed Space: The Translational Path from Literary Description to Dance Movement

At approximately the seventh minute of the dance drama *The Eternal Wave*, a solo performance set within a newspaper elevator is presented. With acute awareness of the medium, the choreographer

constructs this stage scene as a transformation of two core issues that run throughout the literary narrative—identity transition and psychological struggle—into the language of dance.

The elevator, as an enclosed transitional space, carries profound metaphorical significance. It is not only a site of physical movement but also a ritualized node where the protagonist Li Xia regulates his psyche and completes identity transformation. Within the confined space after the elevator doors close, the dancer performs through a highly condensed movement vocabulary charged with deep internal conflict. Upon entering, he initially appears in the relaxed state of an ordinary citizen, but almost immediately shifts into a vigilant posture of attentive listening. Tensed muscles and a piercing gaze directed toward an invisible intelligence network highlight the contrast deliberately constructed in the choreography between restraint and exposure, surface appearance and inner essence.

Externally, in response to the social environment, he must maintain composure and propriety; internally, however, rapid fluctuations of breath, subtle flexion and extension of the fingers, and the sudden straightening of the spine reveal his intense focus on intelligence gathering and underlying anxiety. The opening and closing of the elevator doors function as a pivotal dramatic axis: when the doors close, it marks a concealed interval in which the public mask is shed and the true mission is revealed; when the doors open, all inner tension is instantly concealed, and the performer’s expression and body return to an almost indifferent natural state, as he steps calmly into the newspaper office, completing a silent transition from intelligence operative to social employee.

This segment, through the dialectical logic of dance-specific bodily movement, transforms the conflict between professional disguise and inner authenticity—often elaborately depicted in literary texts—into a series of observable bodily dynamics and facial expressions within a defined spatiotemporal frame. (Zhang Fan & Liu Kaili, 2023) The elevator solo thus becomes a highly condensed

theatrical ritual that not only advances the narrative but also profoundly reveals the fundamental contradiction of the undercover agent's existence: his most authentic self can only be entrusted to those fleeting, mechanical intervals of social role transition.

3.2 Poetic Exaggeration: On the Translation and Expansion of Literary Psychological Description through Dance Language

At approximately the twenty-first minute of the dance drama *The Eternal Wave*, a symbolically charged narrative structure is constructed through vertical spatial division and stage choreography. The upper level represents the telegraph operation area, while the lower level depicts domestic life. A clear physical boundary separates the two, visually articulating the coexistence of social responsibility, private life, revolutionary duty, and familial affection borne by the protagonist. This spatial arrangement constitutes a visual refinement and symbolic intensification of the environmental description found in literary texts.

Within this vertically stratified stage structure, Lan Fen's "quiet descent" becomes a paradigmatic instance of translating literary psychological description into dance. The dancer conveys a cautious psychological state—often articulated through textual narration—by significantly slowing her steps, nearly suspending control at the tips of her feet, leaning forward in a listening posture, and maintaining a concentrated, breath-held expression. This form of artistic amplification does not depart from reality; rather, it arises from the medium-specific characteristics of dance drama. Abandoning the naturalistic tendencies of spoken drama, it employs poetic corporeal rhetoric—such as delay, emphasis, and freeze—to intensify the expressive force of inner emotion and intentional action, thereby achieving maximal narrative clarity and emotional impact without reliance on spoken language.

When the two characters receive joyful news transmitted through Morse code, their leaps and bodily extensions adhere to the distinctive

expressive logic of dance drama. In contrast to the restrained and implicit mode of spoken theatre, dance drama amplifies bodily range and intensifies facial expression, transforming exaggerated literary emotions—such as overwhelming excitement—into visible bodily energy perceptible to the audience. This approach fundamentally aligns with the aesthetic purpose of exaggeration in literary rhetoric: to intensify form in order to access the core of emotion. The audience's acceptance of such artistic exaggeration lies in its precise grasp of the deeper truth consistent with the characters' emotional logic within specific dramatic circumstances. In moments of silence, dance language achieves an equivalent—and even enhanced—expression of the emotional depth and dramatic tension found in literature, demonstrating the powerful capacity of dance drama to reconstruct literary psychological representation through its own bodily poetics.

3.3 Beyond the Literary "Character Sketch": Operatic Psychological Imaging

In the opera *The Eternal Wave*, Liu Nina's aria "Life Is but a Play" elevates what is typically a background exposition in literary works into a profound dramatic soliloquy of the soul through opera's distinctive mode of lyrical depth, transforming it into an auditory presentation of existential philosophy. The familiar literary trope "life as theatre" is employed by the character to summarize her understanding of her own existence, encompassing two layers of meaning: first, a reflection on her identity as a spy who must constantly perform under shifting masks; second, an implicit acknowledgment of the individual's powerlessness to determine their own fate when swept along by the tides of history. By positioning such a proposition at a climactic juncture and a key emotional threshold, opera shifts the attention from narrative progression to the character's awareness of her own condition.

This aria reworks the literary function of character introduction into a moment of sustained self-articulation. Rather than statically recounting

background information, it invites the audience to experience and comprehend the character's self-awareness and self-expression at a specific moment, relying on music's capacity to generate and immediately manifest emotion on stage. The aria thus becomes an effective gateway into the character's inner world: it conveys identity while also revealing the psychological motivations behind actions and the existential dilemmas faced. In this sense, inner consciousness itself becomes the primary dramatic event. In doing so, it transforms the character from a functional narrative device into a dramatic subject endowed with a complex interiority. From this perspective, literariness in opera is not confined to storytelling but is reorganized through the temporal extension of music and vocal performance.

4. The Ultimate Translation of Image and Theme: The Construction of Visual Metaphor and Auditory Symbolism

In their pursuit of constructing core imagery and elevating thematic expression, dance drama and opera do not merely provide straightforward illustrations of literary content. Instead, they establish profound metaphorical systems through their respective stage languages. Dance drama tends to employ props and collective bodily movement as poetic signifiers; through transformations of form, trajectories of motion, and the interweaving of group choreography, it constructs a network of visual metaphors that render intangible pressures and the flow of history perceptible, linking individual destiny with collective imagery and thereby generating resonance.

Opera, by contrast, relies on the abstract nature and structural advantages of music to construct an intricate system of auditory symbolism. Through the deployment and development of leitmotifs across the entire work, combined with vocal performance, it enriches thematic expression with layered emotional depth and substantial spiritual resonance. Choral writing, in particular, often serves as the sonic manifestation of historical intention or

the driving force of fate. While dance drama condenses themes through spatialized and embodied visual metaphors, opera deepens them through temporally structured auditory symbolism. Each, through its own artistic pathway, achieves the transformation of literary imagery into stage representation.

4.1 The Elevation of Props: Constructing a Visual Metaphor System from "Black Umbrellas" to a "Labyrinth"

In the dance drama *The Eternal Wave*, the "black umbrella" ensemble sequence vividly demonstrates how dance transforms literary narration and metaphor into a distinctive artistic effect. When numerous umbrellas move in unison, they resemble an endless expanse of mist; their rhythmic rising and falling, all tilted in a single direction, evoke the oppressive atmosphere of storm clouds pressing down upon a city, while also suggesting the pervasive danger and hidden threats within enemy-occupied territory. In this way, danger becomes visually perceptible at a glance.

Within this fluid labyrinthine formation, the choreographic pathways of Li Xia and Lan Fen generate considerable dramatic tension. At times, they intersect at the edges of the umbrella formations; at others, they are separated by shifting black barriers. Their bodies maintain visible proximity while preserving necessary distance. This choreography aptly expresses the inherent contradiction of underground work: physical closeness coexists with enforced emotional and identity-based separation. Although their movements may be synchronized, they do not gaze at one another; after brief contact, they immediately part. (Zhang Fan & Liu Kaili, 2023) This coexistence of synchrony and dislocation translates the literary image of "intimacy yet distance" into a corporeal form charged with emotional tension. The performers' control of facial expression is crucial: while their faces remain outwardly composed, their eyes subtly search and then swiftly withdraw, revealing both deep longing and heightened vigilance.

Here, the “black umbrella” transcends its utilitarian function as a prop and is elevated into a central poetic image of the work. On one level, it evokes the rainy urban environment of Shanghai’s alleyways; on another, it metaphorically represents the hidden dangers within a complex intelligence network and the deeper psychological estrangement it entails. The opening and closing of umbrellas suggest fleeting opportunities, while the shifting formation of the umbrella array visualizes structures of power. The protagonists’ repeated passage through this space resembles an exploration of pathways and vulnerabilities within a rigorous symbolic system—an inherently perilous journey. Through stage imagery alone, the work articulates the literary theme of undertaking missions under constant threat.

4.2 The Superimposition of Time and Space: The Structural Transformation of Flashback and Evidentiary Narration through Stage Juxtaposition

At approximately the sixteenth minute of the dance drama *The Eternal Wave*, the “photo development” sequence introduces an innovative stage language that transforms the literary narrative device of uncovering and tracing crucial evidence into a creative form of cross-media artistic expression, thereby demonstrating the unique literary expressivity of dance as a composite art form.

The staging choice of having the performer face away from the audience constitutes the first level of artistic transformation. The character—journalist A Wei—remains turned away throughout the scene, yet this does not hinder audience comprehension. The tension in his back muscles, the rapid and precise movements within the darkroom, and his forward-leaning posture conveying concentration transform otherwise inexpressible inner states into vivid bodily imagery. This “back-view” mode of presentation shifts the audience’s focus from facial expression to the interpretive reading of bodily movement, thereby achieving a formal transformation from psychological narration to corporeal inscription.

Through spatial division and juxtaposition, the stage generates a profound innovation in narrative form. The choreographer divides the performance space into a darkroom working area and a zone for the reenactment of photographic images. Whenever A Wei develops a photograph in the darkroom, the lighting in the adjacent performance area is activated, and the figures captured in the image (such as Li Xia and Lan Fen), rendered in highly faithful frozen expressions and poses, are dynamically “awakened.” This treatment creates an effect of temporal superimposition: the moment of past capture and the present act of development are made visible simultaneously. The content of memory as evidence and the process of tracing its material carrier are thus visually juxtaposed. The figures within the photograph remain fixed in form, while their counterparts within the main narrative unfold dynamically, establishing a dialogic relationship. Their suspended expressions and stylized poses resemble the literary technique of focusing on critical details and invoking retrospective flashbacks, thereby intensifying both the dramatic tension of evidence and the historical weight it conveys.

This segment (Feng Dalei & Wang Dan, 2023) transcends mere plot narration, ascending to a meta-narrative level concerned with the manifestation of memory and the reconstruction of history. Through its distinctive use of spatial and bodily expression, dance transforms the concrete act of photo development into a dynamic, visualized process of interpreting and revealing evidence. This form, characterized by immediacy, simultaneity, and emotional impact, offers a unique stage-based pathway for translating literary devices such as suspense construction and memory structuring into performative art.

4.3 On “O Heroic You”: From Overture Prophecy to Final Legacy as a Musical Closure

At the conclusion of the opera *The Eternal Wave*, the progressive youths once again sing “O Heroic You,” a theme first introduced in the overture. This artistic strategy moves beyond the conventional literary

device of structural symmetry between beginning and ending. Drawing upon opera's nature as a temporal art, it forms a cyclical musical-dramatic structure in which meaning is progressively elevated. In the overture, "O Heroic You" functions as a generalized eulogy to an unseen hero; when it reappears in the finale, the same melody and lyrics have been reinterpreted through the concrete fates and sacrifices of characters such as Li Xia and Lan Fen, transforming into a tribute and affirmation of real individual lives. This elevation of meaning, achieved through the diachronic unfolding of dramatic time, demonstrates music's unique capacity to accumulate emotion and memory.

This musical closure establishes a solemn aesthetic framework for the entire opera, imbuing the narrative with a pronounced epic quality. It suggests that individual sacrifice does not signify an end, but rather becomes integrated into an ongoing process of spiritual inheritance. As audiences leave the theatre, the heroic theme—personally heard and emotionally internalized—continues to resonate in their minds, producing a profound level of aesthetic and emotional response. This resonance is not merely a reaction to formal structure; rather, through music's mnemonic power and its capacity for thematic variation, opera transforms the heroic motif into a shared spiritual legacy. In doing so, it reveals the core literary attribute through which opera narrates through sound and constructs a lasting field of emotional resonance.

5. Comparative Differences in the Transformation of Literariness in Dance Drama and Opera

Dance drama and opera show different tendencies in their transformation of literariness, largely shaped by the characteristics of their respective media. Dance drama belongs to the realm of spatial art, with its core lying in the exploration of possibilities in space, body, and visuality. It transforms narrative into an art of spatial construction, integrating the inner world into the texture and rhythm of movement through bodily expression and their interaction. Its narrative emerges from the logic inherent in movement itself

and from the visual structures formed through group choreography, relying on condensed imagery to synthesize complex situations within a brief temporal span.

Opera, by contrast, emphasizes temporal extension, auditory expression, and formal structuring. It is an art in which sound unfolds and takes shape along a temporal axis. Through the progression of melody and vocal performance, opera constructs a distinctive auditory form, and its musical-dramatic structure inherently contains the force that propels narrative development, excelling in transforming emotion into perceptible acoustic experience. While dance drama achieves concentrated bursts of meaning through bodily symbolism within a synchronous spatial field, opera realizes the deep sedimentation of emotion through the continuity of sound across a diachronic process. Through different artistic pathways, both rework literary material into stage-specific forms of meaning.

5.1 The Spatial Reorganization of Emotional Development in Dance Drama

A key scene in the dance drama *The Eternal Wave*, occurring around the one-hour-and-twenty-five-minute mark, uses stage spatial construction and bodily narration to present character relationships that are developed in linear sequence in the literary text through a simultaneous visual arrangement. This treatment transforms the internal emotional trajectory into a shared and perceptible aesthetic experience for the audience.

The stage is constructed as a composite field encompassing multiple temporal dimensions and psychological mechanisms. Li Xia and Lan Fen, as a married couple, occupy the central focus of audience attention, while three additional pairs of performers represent mirrored stages of their relationship—initial encounter, growing intimacy, and shared hardship—coexisting within the same physical space. Rather than functioning as simple cinematic flashbacks, this arrangement grants equal ontological presence to past emotional states, present experience, and fragments of memory. From a choreographic perspective, the movement

vocabulary of each stage displays clear diachronic characteristics: initial encounters are marked by restraint and distance; familiarity brings coordination and fluidity; and shared adversity produces mutual support. These thematic movements evolve continuously across stages, resembling a visualized leitmotif that articulates the deep logic of emotional progression.

The innovation of this stage design lies in the shared gesture of “cross-temporal gazing” among the four couples: the present selves look upon their past counterparts with eyes filled with remembrance. At times, these mirrored figures exchange gazes or perform synchronized actions, generating a form of empathy and dialogue that transcends linear temporality. This mode of staging transforms the traditional one-directional output of memory into a ritualized space of self-recognition and emotional healing. When performers accurately capture the emotional characteristics of each stage, the act of gazing—toward both past and future selves—conveys the layered emotional accumulation shaped by time.

This sequence surpasses conventional literary narrative modes by condensing a diachronic process of emotional development into a spatialized structure that can be observed from multiple perspectives and interpreted repeatedly. The depth and weight of conjugal affection are not gradually accumulated through textual narration but are instead immediately and comprehensively revealed through the simultaneous presence and mutual illumination of multiple perspectives. This example mainly highlights the spatial strength of dance drama and serves as a point of comparison with opera’s more temporally sustained mode of development.

5.2 Reverse Temporal Presentation and Narrative Reconstruction in Dance Drama

Combat scenes are no longer presented through realistic depictions of physical struggle; instead, they are rendered through stylized bodily confrontation and controlled stage rhythm. In the concluding section of the dance drama *The Eternal*

Wave, the choreographer employs reverse temporal narration and parallel spatial arrangement to rework literary devices such as retrospective revelation and multi-threaded progression. This highlights the unique narrative charm of dance drama as an art form integrating time and space.

The realization of temporal reversal relies on the creation of an intensifying ticking sound, which generates internal emotional rhythm and guides performers to move according to a reversed temporal logic. Beginning from a state of stillness or conclusion, performers reconstruct preceding events through a series of precisely controlled rotations, backward shifts of bodily center, and inverted sequences of falling movements—kinetic processes that seemingly defy physical causality. In this way, the intense confrontation between Lao Fang and Liu Nina is gradually rewound: from outcome to preceding tension, then to earlier confrontation, unfolding frame by frame in reverse. Facial expressions also undergo reversal, shifting from heightened dramatic intensity back to an initial state of composed disguise. This embodied reverse temporality breaks through the linear structure of literary flashback, endowing retrospective narration with ritualistic quality and visual impact, transforming the search for truth into an aesthetic experience imbued with suspense and a sense of fate.

In another area of the stage, the interaction between Lan Fen and A Wei unfolds in normal chronological order, creating two simultaneous temporalities—one moving backward into the past, the other progressing forward in the present. Through lighting segmentation and precise staging, these two temporalities coexist within a unified visual frame. The audience must continuously shift their attention between them, actively reconstructing causal relationships and dramatic tension. This juxtaposition of dual narrative lines resembles the synchronic reading of parallel chapters, while dance drama’s spatial immediacy allows for direct comparison of emotional tone and rhythm, enhancing narrative layering, density, and expressive power.

This segment exemplifies a sophisticated deconstruction and reconstruction of literary narrative mechanisms on stage. Through reverse bodily movement, linear time is dismantled; through spatial division and juxtaposition, the narrative network is reassembled. In the audience's consciousness, fragmented information is integrated into a coherent whole. Here, the emphasis remains on how dance drama reorganizes narrative sequence through space, rhythm, and bodily reversal rather than on any broader theoretical claim.

6. Conclusion

Taking *The Eternal Wave* as a representative case, this study places dance drama and opera on the same analytical plane, offering a comprehensive examination of the two aesthetic modalities through which literariness is transformed in cross-media translation, as well as their respective operational mechanisms. Dance drama constructs a spatialized and visualized translational system centered on "bodily poetics," reshaping literary narration into

synchronous visual images. Opera, by contrast, forms a temporal and structured system grounded in "vocal drama," achieving auditory aesthetic experience through the temporal unfolding of literary emotional cores.

Despite differences in media characteristics and expressive means, both forms accomplish an innovative translation and aesthetic elevation of the core content of red classic literature. Through a dual analytical framework of "body-sound," this study provides a comprehensive theoretical model for understanding how literariness can be preserved and developed across artistic forms governed by different sensory modalities. Furthermore, effective cross-media transformation cannot rely merely on the transplantation of literary content; rather, it must adhere to the intrinsic properties of each medium, transforming literariness into stage-specific aesthetic forms. In doing so, it offers theoretically grounded and practically meaningful pathways for the contemporary revitalization of red classics, the innovative development of stage art, and the localized application of cross-media theory.

References

- Nie Wei. (2024). 'Integration of Film and Dance' and the Release of New Productive Forces in Image-Making: On the Dance Film *The Eternal Wave*. *Contemporary Cinema*, (7), 40–43, 51.
- Deng Jiao. (2022). The Narrative Art of the Dance Drama *The Eternal Wave*. *Sichuan Drama*, (7), 88–90.
- Feng Dalei and Wang Dan. (2023). Soundscape and the Construction of Emotional Identity in the Dance Drama *The Eternal Wave*. *Sichuan Drama*, (12), 64–67.
- Xiao Luo. (2013). The August First Tribute Performance of the Opera *The Eternal Wave* by the PLA General Political Department Opera Troupe. *Chinese Theatre*, (7), 63.
- Zhang Fan and Liu Kaili. (2023). Narrative Strategies and Aesthetic Value of the Dance Drama *The Eternal Wave*. *Sichuan Drama*, (7), 53–56.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

A Study on the Modes of Narrative Representation and Structural Logic in Artistic Performance Dance in Dance Sport

Sun Weiyi^{1*}

¹ Cheongju University, South Korea

* Correspondence: sun957398@gmail.com

<https://doi.org/10.53104/insights.soc.sci.2026.06002>

Abstract: As Dance Sport has gradually shifted from competitive display toward stage-oriented artistic expression, Artistic Performance Dance has evolved into a key dimension for assessing the comprehensive aesthetic capacity and choreographic sophistication of the field. Unlike the traditional performance paradigm centered on technical display, Artistic Performance Dance places greater emphasis on the refinement of thematic meaning, the creation of situational atmosphere, the portrayal of character relationships, and the progression of the overall structure. As a result, narrativity has increasingly emerged as an indispensable artistic attribute of this genre. Taking Artistic Performance Dance in Dance Sport as its object of analysis, this paper integrates dance narrative theory, dance signification theory, and relevant research on the creation of Artistic Performance Dance. From the perspectives of thematic construction, character interaction, movement language, musical rhythm, spatial arrangement, and visual symbolism, it systematically examines the major modes of narrative representation and further explores their underlying structural logic. This study argues that narrativity in Artistic Performance Dance in Dance Sport is not merely a matter of 'telling a story'; rather, it is a dynamic narrative chain of 'theme establishment–situational development–conflict progression–emotional intensification–closure of meaning,' generated through the ordered integration of body language and stage vocabulary within an established movement system. Narrativity not only enhances the intellectual depth and emotional appeal of a work, but also plays a significant role in promoting the transformation of Dance Sport from formulaic technical display into a complex form of stage art. This study contributes to a deeper theoretical understanding of Artistic Performance Dance in Dance Sport and also provides a feasible point of reference for creative practice and pedagogical training in this field.

Received: 7 April 2026

Revised: 13 April 2026

Accepted: 16 April 2026

Published: 20 April 2026

Citation: Sun, W. (2026). A Study on the Modes of Narrative Representation and Structural Logic in Artistic Performance Dance in Dance Sport. *Insights in Social Science*, 4(2), 14–23.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: dance sport; artistic performance dance; narrativity; modes of representation; structural logic

1. Introduction

As a form of bodily culture integrating normativity, artistry, competitiveness, and spectatorship, Dance Sport has gradually developed a relatively complete system of movement vocabulary and a comparatively stable aesthetic paradigm through its long-term evolution. Traditionally, stage presentations of Dance Sport have tended to emphasize the precision of footwork, the coordination of rhythm, bodily control, and the degree of mutual understanding in partnered collaboration. To a large extent, its stage appeal has been rooted in the aesthetic satisfaction generated by formal rigor and stylistic purity. However, with the continuous renewal of stage-art concepts, contemporary audiences have long moved beyond evaluating dance works merely in terms of whether technical movements are executed accurately. Instead, they are increasingly concerned with whether a work possesses a clear thematic orientation, rich emotional layers, and a complete and unified mode of expression. It is precisely within this shifting context that Dance Sport has gradually broken away from the traditional model dominated by technical display and expanded toward a more integrated artistic construction. Artistic Performance Dance has therefore become an important developmental path in this field that cannot be ignored. Compared with traditional routine-based presentation, Artistic Performance Dance places greater emphasis on the internal unity of the work. Movement is no longer merely technical material to be executed; rather, it begins to form an expressive system together with music, characters, space, and stage atmosphere. In other words, the central questions facing the creator are no longer simply 'how should the movements be arranged,' but rather 'what does the work express,' 'how is this expression established,' and 'why can it persuade the audience.' In this sense, the emergence of Artistic Performance Dance represents not merely an expansion of the performance forms of Dance Sport, but also a shift in creative thinking. (Tian Yanyu, 2020)

It is precisely in this process of transformation that narrativity has gradually come to demonstrate its unique value. Compared with works that rely purely on lyricism, narrative expression is more likely to generate clear structural progression and emotional development, thereby enhancing the overall coherence and dramatic tension of stage performance. At the same time, the introduction of narrativity enables viewers to grasp more smoothly the relationships between characters, the evolution of situations, and the direction of thematic development, thus improving the intelligibility of the work. This is sufficient to show that narrativity does not simply mean the inclusion of plot; rather, it suggests that a work begins to organize meaning in a more directed way. At present, research on Artistic Performance Dance in Dance Sport has already addressed a range of topics, including the creation of realistic themes, the construction of stage time and space, and the factors influencing choreography. However, dedicated discussion of narrativity itself remains relatively insufficient. Of particular significance is the fact that Dance Sport, as an art form, possesses highly distinctive normative requirements and a unique mode of partnered interaction. Its narrative logic can neither be equated with narrative dance in the general sense nor reduced to the logic of dramatic stage works driven primarily by plot progression. In light of this, the present study seeks, on the basis of existing scholarship, to offer a more systematic examination of narrativity in Artistic Performance Dance in Dance Sport, with particular attention to the specific modes through which this quality is manifested and to the structural logic thereby constructed within the work.

2. The Theoretical Connotations of Narrativity in Artistic Performance Dance in Dance Sport

From a broad perspective, narrative is not the exclusive domain of literature and drama. Any art form capable of organizing temporal sequences, constructing networks of relationships, and generating meaningful directionality contains, to varying degrees, the latent possibility of narrativity.

Although dance cannot directly explain character background or causal chains of events through written language or spoken dialogue, it can nevertheless create specific situations, suggest relationships between characters, and propel emotional development through the arrangement of bodily movement, the variation of rhythmic flow, the organization of stage space, and the use of visual symbols. For this reason, narrative in dance is not accomplished through 'telling,' but is gradually generated through 'presentation.' This fundamental characteristic also determines that dance narrative relies more heavily on perceptual immediacy, holistic integration, and the symbolic power of imagery. For a long time, dance has often been described as 'strong in lyricism but weak in narrative.' This judgment, to some extent, reveals the limitations of movement language in directly expressing logical or causal relations, but it does not mean that dance is incapable of narrative expression. (Wang Lei, 2012) In fact, with the renewal of choreographic concepts, narrativity has become an important means through which many works enhance dramatic tension and structural layering. (Xiao Yi, 2026) This study argues that dance is by no means incapable of narration; rather, it cannot simply transplant narrative models from literature or drama. Dance narrative must be rooted in the medium-specific nature of body language and therefore depends more heavily on the interrelatedness of movements, the continuity of emotional flow, and the organic coordination of overall structural progression. This understanding is also in line with broader discussions on narrativity in performance studies.

When considered in relation to the specific genre of Artistic Performance Dance in Dance Sport, narrativity presents even more distinctive ontological features. First, Dance Sport possesses a rigorous system of movement norms and clearly defined stylistic boundaries among dance forms. This means that narrativity cannot exist independently of the ontology of the dance genre itself, but can only be realized through the reorganization of the existing movement system and

the translation of its meaning. Second, Dance Sport is inherently characterized by partnered collaboration and interaction. This interactive relationship is not only the basis on which technical coordination becomes possible, but also potentially provides the conditions for the formation of character relationships. Many movements, while fulfilling functions of leading, following, and counteraction, simultaneously and imperceptibly construct the psychological distance and emotional tension between figures. At the same time, the stage-oriented developmental trajectory unique to Artistic Performance Dance creates broader possibilities for the full unfolding of narrativity. Once a work begins to emphasize thematic conception, character construction, situational atmosphere, spatial arrangement, and the overall effect of visual presentation, movement no longer serves merely as a vehicle for technical display, but is incorporated into a more complex system of signification. Within this system, movement, music, and space are no longer parallel compositional materials; rather, they become organic elements that jointly participate in the production of meaning and interact with one another.

Based on the above analysis, this study argues that narrativity in Artistic Performance Dance in Dance Sport refers to the process by which creators, on the basis of the Dance Sport movement system and stage vocabulary, systematically integrate multiple artistic elements so that, within a limited temporal span, a work may generate a clearly directed theme, perceptible transformations in character relationships, and a progressively unfolding trajectory of emotional development, thereby achieving a fundamental transformation from technical display at the formal level to artistic expression at the level of meaning.

3. Major Modes of Narrative Representation in Artistic Performance Dance in Dance Sport

3.1 Thematic Conception: The Point of Departure for Narrative Formation

Thematic conception constitutes the point of departure for narrative formation. Without a clear theme, even a work rich in movement material is likely to remain at the level of segmental juxtaposition and emotional accumulation, making it difficult to achieve a truly integrated expression. In Artistic Performance Dance in Dance Sport, the theme determines not only what the work expresses, but also how that expression unfolds. The selection of movement, the configuration of character relationships, the shaping of musical temperament, and even the mode of spatial arrangement are all influenced by the thematic orientation. (Wang Lin, 2020)

This study argues that, in Artistic Performance Dance, theme is the spiritual core of the work. It provides all internal elements of the work with a shared direction, thereby preventing movement from being reduced to mere technical arrangement. Particularly in the process of the artistic development of Dance Sport, the subject matter of works has gradually shifted from traditional formulaic aesthetics toward lived experience, cultural memory, and spiritual symbolism. (Jin Hua, 2022) This indicates that theme is no longer a superficial ornament, but has become the conceptual foundation upon which narrative structure develops. For this very reason, mature works tend to organize movement on the premise that the theme is established first, rather than attempting to impose meaning retrospectively after the movement has already been arranged. (He Huaming, 2013)

From the perspective of the sources through which thematic conception is generated, the themes of Artistic Performance Dance in Dance Sport may generally be divided into three categories. The first is derived from pre-existing narrative resources found in literary classics, film and television works,

or folk legends. Through the selection and recreation of such original materials, choreographers reshape them into story structures compatible with the expressive logic of the bodily vocabulary of Dance Sport. The second arises from the choreographer's own observations of social reality and the sedimentation of personal life experience. Such themes often carry a strong sense of emotional authenticity and social concern, as seen in artistic explorations of universal human subjects such as familial affection, reunion and separation, and the growth of life. The third begins with the imagistic treatment of specific cultural symbols or collective historical memories. In such cases, the choreographer does not insist on the reproduction of a complete plot, but instead seeks to evoke cultural association and emotional resonance through the repeated appearance and formal transformation of core images.

It should be emphasized that in Artistic Performance Dance in Dance Sport, thematic conception does not become fixed once established. Rather, throughout the creative process, it remains in dynamic interaction with the movement vocabulary system, the emotional qualities of the music, and the structure of stage space. Put differently, the theme on the one hand provides overarching guidance and directional coherence for the artistic elements of the work, while on the other hand it is continuously adjusted, enriched, and deepened through specific choreographic practice. This bidirectional mechanism means that theme is no longer an abstract presupposition detached from the creative process, but is gradually internalized into the organic whole of the work as the spiritual line running through it from beginning to end. For the choreographer, the establishment of thematic conception is essentially a process of continuously posing and repeatedly responding to the fundamental question of what irreplaceable emotional experience or intellectual meaning the work is intended to convey. Moreover, the degree of clarity in thematic conception directly affects how audiences understand and receive the narrativity of the work. If the theme is overly obscure or lacks clear

orientation, audiences are likely to lose the central clue through which meaning may be grasped, making it difficult to sustain coherent expectations of significance. Conversely, if the theme is expressed too plainly or in an overtly didactic manner, the openness of interpretation and multiplicity of meaning that dance as an art form ought to preserve may be weakened. Accordingly, how to strike an appropriate balance between clarity and richness of implication remains an important question requiring sustained exploration in the choreographic practice of Artistic Performance Dance in Dance Sport.

3.2 Character Relationships: The Central Driving Force of Narrative Progression

Character relationships constitute the central driving force of narrative development in Artistic Performance Dance in Dance Sport. As the duet is the most representative performance form in this field, bodily interaction between performers is inherently relational and directional. Proximity and distance, attachment and release, guidance and resistance not only reflect the technical characteristics of the dance genre, but also gradually translate into emotional change and psychological tension in the course of spectatorship. In this context, characters do not necessarily rely on a fully developed narrative background in order to be established. In many cases, the audience may not know exactly who the stage figures are, yet can still perceive the nature of their relationship through bodily states, modes of interaction, and rhythmic variation. This suggests that character construction in Dance Sport depends primarily on relational logic rather than verbal explanation. This study argues that only when the partner relationship in Artistic Performance Dance is elevated to the level of a narrative relationship can the work acquire the internal momentum necessary for sustained development. Otherwise, however complex the coordination may be, it remains at the level of technical display and fails to generate deeper expressive meaning.

3.3 Movement Language: The True Carrier of Narrative Content

Movement is the ontological medium of dance; accordingly, narrative must ultimately be realized through movement language. In Artistic Performance Dance in Dance Sport, if theme, emotion, and relationship cannot be genuinely borne at the level of movement, they remain only at the level of concept and intention and cannot be transformed into effective stage expression. It should be noted that the narrative meaning of movement is not fixed. The same turn, pause, extension, or separation may convey entirely different emotional meanings in different works. Movement is able to bear narrative not only because of its own formal qualities, but also because of its position within the work, its relation to preceding and subsequent movements, and the way it is integrated with character state and musical rhythm. For this reason, truly mature movement design does not simply pursue technical difficulty or novelty, but rather seeks precision of expression, allowing movement to enter fully into the immediate situation of the work.

From a structural perspective, repetition, progression, contrast, and transformation in movement constitute important means by which a sense of narrativity is formed. In practice, the same movement phrase may shift from smooth continuity to visibly restrained or interrupted execution, thereby allowing the audience to perceive a change in emotional state rather than merely a variation of form. When movement ceases to be a flat arrangement of isolated units and instead accumulates meaning through its connections across time, the audience begins to perceive that some form of change is taking place. This study argues that narrativity in Artistic Performance Dance in Dance Sport is not something added externally to movement, but rather the result of the continual growth of meaning within movement language itself. This is also one of the important features distinguishing Artistic Performance Dance from general technical display.

3.4 Musical Rhythm: The Force that Propels Narrative Time

In Artistic Performance Dance in Dance Sport, music not only provides rhythmic support, but also undertakes the important task of organizing narrative time and shaping emotional atmosphere. It determines how a work begins, and also influences how it turns, accumulates, and moves toward climax. (Tian Yanyu, 2020) From the perspective of performance and reception, music is often the first perceptual point of entry through which the audience enters the work. The texture of melody, the speed of rhythm, and the layering of sound can establish a particular emotional tone within a very short period of time, thereby creating the initial narrative situation of the work. (Jin Dezhaohao, 2023) As the work progresses, changes in music continue to signal internal transitions and tensions, giving movement a clearer sense of direction. If music remains only at the level of matching the beat and does not enter into the emotional organization and structural progression of the work, even rich movement material can easily appear fragmented and flat. By contrast, when music genuinely participates in emotional preparation and the accumulation of conflict, it becomes the implicit narrator of the work. (Liu Lian, 2013)

3.5 Spatial Arrangement: The Visual Unfolding of Narrative Situation

Narrative unfolds not only in movement and music, but also in space. The stronger the theatrical quality of Artistic Performance Dance in Dance Sport, the more evident the role of spatial arrangement becomes in narrative expression. Space is not a neutral background; rather, it is an important condition through which changes in relationships, emotional transitions, and scene construction are made visible. Changes in the distance between two performers constitute the most direct form of spatial narrative. Movement from distance to proximity often signifies the establishment of relationship and emotional convergence, whereas movement from

proximity to distance may suggest dislocation, estrangement, or loss. When group dance is introduced into a work, the spatial structure becomes even more complex. Encirclement and dispersal, interweaving and obstruction, as well as the constant shifting between center and periphery, all contribute to different situational meanings on stage. (Fu Fangman, 2020) Thus, the significance of spatial arrangement lies not simply in deciding where performers stand, but in enabling emotion, relationship, and theme to acquire visual order and layering. This study argues that only when spatial relations are fully integrated into the overall logic of the work does the stage cease to be merely a site of movement display and become instead a field in which narrative takes place.

3.6 Visual Symbols: The Auxiliary Construction of Narrative Atmosphere

Visual symbols such as costumes, props, lighting, and bodily styling constitute an important auxiliary system in the narrative expression of Artistic Performance Dance in Dance Sport. Their value does not lie in directly replacing movement as a means of conveying content, but in helping audiences enter the context of the work more quickly and in reinforcing its sense of historical period, identity, and emotional tone. (Wang Lin, 2020) At the same time, however, visual symbols can only function in a supportive capacity and cannot substitute for the ontological expression of the work itself. If a work relies excessively on costumes and props to indicate its content, this often suggests that its movement semantics and structural progression have not yet been fully established. This study argues that mature Artistic Performance Dance should employ visual elements to supplement environmental signification only after movement and relational logic have already been effectively established. In other words, the function of visual symbols is not to explain the work, but to strengthen it, making its narrative atmosphere more complete and its stage impression more vivid. (Ren Wenhui, 2009)

4. The Structural Logic of Narrativity in Artistic Performance Dance in Dance Sport

If the previous section has examined the concrete elements through which narrativity is represented, a further question arises: how do these elements form an organic relationship of progression within the work itself? A genuinely well-constructed narrative work must not only produce in the audience an intuitive sense that it contains a story, but must also present, at the structural level, a dynamic process of continuous unfolding, layered accumulation, and eventual completion. This study argues that the narrative structure of Artistic Performance Dance in Dance Sport may be understood as a sequence of functions that are closely connected but not always strictly separated in practice: theme generation, situational unfolding, conflict progression, emotional climax, and closure of meaning.

First, thematic generation constitutes the point of departure for narrative logic. Only when a work establishes, at the outset of its creation, a clear central idea, emotional orientation, and relational focus can the subsequent design of movement, arrangement of sections, and organization of music proceed on a coherent foundation. (Tian Yanyu, 2020) The theme not only defines the overall tone of the work, but also determines the trajectory along which the narrative will unfold. If this level lacks sufficient clarity, the work is likely to lapse into a superficial accumulation of movement vocabulary and emotional fragments, making it difficult to generate the internal momentum necessary for sustained development.

Second, situational unfolding is a key stage in the transition from abstract theme to concrete stage expression. The focus here is not on exhaustively explaining every detail of background information, but on providing the audience with an effective path into the world of the work. Through the establishment of movement style, the rendering of musical atmosphere, the presentation of spatial state, and the preliminary delineation of character relationships, the work gradually constructs an

emotional field that can be sensorially perceived, allowing the audience to grasp its basic expressive orientation. Although this stage may appear relatively moderate in terms of rhythmic momentum, it in fact plays an essential preparatory role for the subsequent development of structure. Without sufficient situational preparation, the later eruption of conflict and the arrival of climax are likely to seem abrupt and insufficiently grounded.

Third, conflict progression constitutes the central driving force of narrative development. The 'conflict' referred to here does not necessarily take the form of a clearly dramatic event. It may instead appear as tension and struggle within character relationships, the gradual intensification of movement energy, the strengthening of rhythmic contrast, or even a breakthrough in an already established spatial order. For instance, a shift from synchronized to misaligned movement, or from stable proximity to repeated separation, can make such tension perceptible without relying on explicit plot. The essential function of conflict is to propel the work from a state of equilibrium into a process of change, and from relative stasis into dynamic development. In the absence of this level, the work tends to remain trapped in the repetitive presentation of a single emotional tone and is unable to generate genuine structural tension. As the energy of conflict continues to accumulate, the work gradually moves toward emotional climax. Climax is not the moment of greatest technical difficulty, but rather the moment in which theme, emotion, and relationship become most concentrated and intense. (Tian Yanyu, 2020) At this stage, the density of movement typically increases, the expressive power of the music is significantly heightened, and the interaction between the performers reaches its fullest tension. The audience's deepest emotional memory of a work is often produced precisely at this point. The value of climax lies not merely in its outward impact, but in the fact that it brings all preceding preparation into a concentrated release and eruption, thereby allowing the central meaning of the work to be revealed with maximum force.

Finally, closure of meaning constitutes a necessary stage in the completion of narrative. After reaching climax, a work should not conclude hastily. Instead, through the natural settling of rhythm, the condensed handling of movement, the appropriate repositioning of character relationships, or a meaningful final tableau, the emotional threads and relational lines that have previously unfolded are allowed to settle and resonate, while the theme of the work is retrospectively echoed and elevated at the conclusion. A genuinely effective ending is not achieved by piling up more information, but through a measured act of gathering and condensation that guides the work from external progression toward internal spiritual completion. For this reason, the narrative structure of Artistic Performance Dance in Dance Sport is not a mechanical imitation of dramatic templates, but the product of a fusion between the ontological structure of dance and the logic of meaning progression.

5. The Value of Narrative Construction and Its Practical Implications

The continuing reinforcement of narrativity has brought about a profound shift in the artistic focus of Artistic Performance Dance in Dance Sport. Such works are no longer confined to the one-dimensional presentation of training outcomes and technical competence; rather, they increasingly assume the functions of thematic articulation and emotional expression. This means that, while preserving its inherent normative beauty, Dance Sport has also acquired a more substantial capacity for intellectual expression and a more powerful effect of stage communication. In this sense, the introduction of narrativity has not weakened the ontological characteristics of Dance Sport; on the contrary, it has endowed its formal beauty with a deeper and more compelling foundation of meaning.

As a nonverbal art form, dance is inherently marked by a certain degree of abstraction, while the presence of narrativity enables audiences to grasp the internal logic of a work more readily through character

relationships, changes in movement, and spatial transitions. (Wang Yantong & Cai Yimeng, 2025) From the perspective of communicative effectiveness, the introduction of narrativity effectively narrows the psychological distance between the work and its audience. Although viewers may not be able to retell a work as a complete linear story, they are often able to perceive clearly the gradual progression of emotion, the subtle transformation of character relationships, and the final closure of meaning. It is precisely this aesthetic quality—one that can be perceived and entered into—that allows Artistic Performance Dance to demonstrate broader possibilities both in terms of aesthetic reception and stage dissemination.

Moreover, the construction of narrativity places higher demands on the comprehensive abilities of choreographers and creators. A qualified creator cannot be satisfied merely with the organization and arrangement of movement materials; rather, they must also possess the ability to extract and refine themes, to plan overall structure, to transform movement into expressive meaning, and to coordinate the work as a whole. This point is particularly significant in light of the current reality that many works still exhibit, to varying degrees, such problems as a solid technical foundation but weak content expression, or rich formal means but loose structural logic. Against this background, systematic research centered on narrativity undoubtedly possesses strong practical relevance. Such research continually reminds creators that a truly mature Artistic Performance Dance work is by no means a simple accumulation or assemblage of movement materials and stage effects, but rather an integrated whole achieved through the organic coordination and internal generation of multiple artistic elements under a unified expressive objective. In view of this, future choreographic practice should further establish and reinforce the core principle of 'theme first, structure as the guide, and movement in the service of expression.' Only when movement, music, character, and space are genuinely integrated into a single organic system of

expression can narrativity in Artistic Performance Dance in Dance Sport be effectively transformed from a theoretical concept into a concrete and convincing realization at the level of the work itself.

6. Conclusion

As a key aesthetic characteristic of Artistic Performance Dance in Dance Sport, narrativity is an internal outcome generated in the process by which this genre moves toward a comprehensive form of stage art. Through the systematic integration of multiple elements—including thematic implication, patterns of character interaction, systems of movement vocabulary, the organization of musical rhythm, the arrangement of stage space, and the configuration of visual symbols—narrativity provides a work with a relatively clear trajectory of emotional development and a distinctly layered structural order. This study argues that, in Artistic Performance Dance in Dance Sport, narrative structure often takes the form of a dynamic chain consisting of theme establishment, situational unfolding, conflict progression, emotional

intensification, and closure of meaning. This chain not only reflects the general principles of dance narrative, but also highlights the distinctive path through which Dance Sport expands meaning within an established framework of normative movement.

At the level of theoretical inquiry, greater attention to narrativity helps overcome the limitations of current Dance Sport studies, which have tended to rely excessively on technical analysis, and thus encourages the field to move toward a more integrated perspective grounded in art scholarship. In terms of choreographic practice, research on narrativity offers a more systematic line of thought for thematic conception, movement arrangement, stage deployment, and the communication of overall artistic meaning. Looking ahead, if future studies can incorporate more case analyses and comparative investigations of specific works, research on narrativity in Artistic Performance Dance in Dance Sport will inevitably move in a more refined direction and will be more likely to develop a theoretical discourse with clearer ontological specificity.

References

- Fu Fangman. (2020). A Brief Analysis of the Creation of the Dance Work "Autumn Moon in the Han Palace". *Home Drama*, (10), 117.
- He Huaming. (2013). Analysis and Research on Narrative Dance Creation. Northeast Normal University.
- Jin Dezhaoh. (2023). An Analysis of the Visual Presentation of Group Dance in "The Song of Everlasting Sorrow" in the Construction of Time and Space. *Appreciation Magazine*, (06), 93–96.
- Jin Hua. (2022). On New Innovations in Chinese International Standard Formation Dance under a Cross-Cultural Context—Taking the Work "To Live" as an Example. *Dance Fashion*, (13), 90–92.
- Liu Lian. (2013). *A Course in Dance Narratology*. Shanghai: Shanghai Music Publishing House.
- Ren Wenhui. (2009). An Analysis of the Origins of International Standard Dance and Shanghai-Style Culture from the Dance Drama "The Song of Everlasting Sorrow". *Journal of Beijing Dance Academy*, (02), 94–100.
- Tian Yanyu. (2020). An Analysis of Influencing Factors in the Choreography of International Standard Dance Performance Dance. Beijing Sport University.
- Wang Lei. (2012). Types of Dance Composition. *Beifeng Yinyue*, (08), 42.
- Wang Lin. (2020). A Study on the Semantic Application of Narrative Dance Works. Hainan University.
- Wang Yantong, Cai Yimeng. (2025). A Study on the Value of Narrativity and Emotional Expression in the Creation of the Dance "Turning the Mountain". *Golden Key (Chinese and Mongolian)*, (04), 77–79.
- Xiao Yi. (2026). Exploring the Influence of Narrative Creative Structure on the Development of Contemporary Dance. *Dazhong Wenyi*, (03), 65–67.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

Why Singapore's Healthcare Model Cannot Be Directly Replicated in Mainland China: A Comparative Policy Perspective

Wei Mingyang^{1*}

¹ AnnpoBio Pharmaceuticals (Guangdong) Co., Ltd., Guangzhou 510515, China

* Correspondence: AnnpoBio Pharmaceuticals (Guangdong) Co., Ltd., Guangzhou 510515, China

<https://doi.org/10.53104/insights.soc.sci.2026.06003>

Received: 29 April 2026

Accepted: 5 May 2026

Published: 11 May 2026

Citation: Wei, M. (2026). Why Singapore's Healthcare Model Cannot Be Directly Replicated in Mainland China: A Comparative Policy Perspective. *Insights in Social Science*, 4(2), 24–31.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Singapore achieves a world-leading life expectancy of 83 years while allocating only 4.47% of its GDP to healthcare, whereas mainland China's health expenditure reached 7.9% of GDP in 2023 with a life expectancy gap of 5 to 6 years. This paper argues that Singapore's apparent efficiency stems from four institutional mechanisms embedded in its colonial legacy, compulsory savings architecture, direct state payment to physicians, and exclusion of foreign workers. None of these mechanisms can be transplanted into mainland China, given fundamental differences in fiscal capacity, population scale, urban-rural duality, and demographic trajectory. Using a comparative institutional analysis framework, this review demonstrates that China's post-2000 demographic inversion, incomplete contribution base, and self-financing hospital model collectively render the Singaporean template inapplicable. The paper concludes that healthcare system reform must respect path dependence as a structural given rather than a policy failure.

Keywords: healthcare financing; Medisave; Singapore-China comparison; fiscal sustainability; demographic transition

1. Historical Institutional Evolution of Singapore's Healthcare System

1.1 Colonial Legacy and the Cultural Constraints of Chinese Migrants

No nation's healthcare system emerges in isolation; Singapore's contemporary institutional configuration is an amalgamation of ancestral governance traditions, local elite stewardship, and British common law. The city-state's healthcare framework is in large part a legacy of British colonial

rule, which introduced Western medical institutions, standardized training for physicians, and a legal environment conducive to contractual enforcement in health insurance. However, colonial legacy alone does not explain Singapore's distinct institutional choices.

The majority of Chinese migrant laborers and merchants who settled in Singapore came primarily to earn a living, and many held the cultural expectation of returning to their ancestral homeland in old age. This so-called *luoye guigen* (落叶归根)

orientation meant that they were unwilling to bear higher taxes for future healthcare and retirement needs that they did not intend to utilize in Singapore (Ding YL, 2018). Cultural attitudes toward aging and end-of-life care continue to shape health-seeking behavior among older Singaporeans. This cultural constraint pushed the post-independence government away from a British-style tax-funded National Health Service and toward a system based on individual medical savings, a design that respected migrants' preference for portable, personally owned accounts rather than social pooling.

1.2 The S+3M Core Architecture: Subsidies, Savings, Insurance, and Safety Nets

Singapore's healthcare financing rests on four complementary pillars: government subsidies (Subsidies), mandatory medical savings accounts (Medisave), national catastrophic insurance (MediShield Life), and a means-tested safety net (Medifund). Government subsidies are straightforward: the state directly covers a portion of citizens' medical expenses using public finances, and individuals pay only the remainder. But this post-subsidy out-of-pocket payment is drawn not from disposable income alone but from each citizen's mandatory Medisave account.

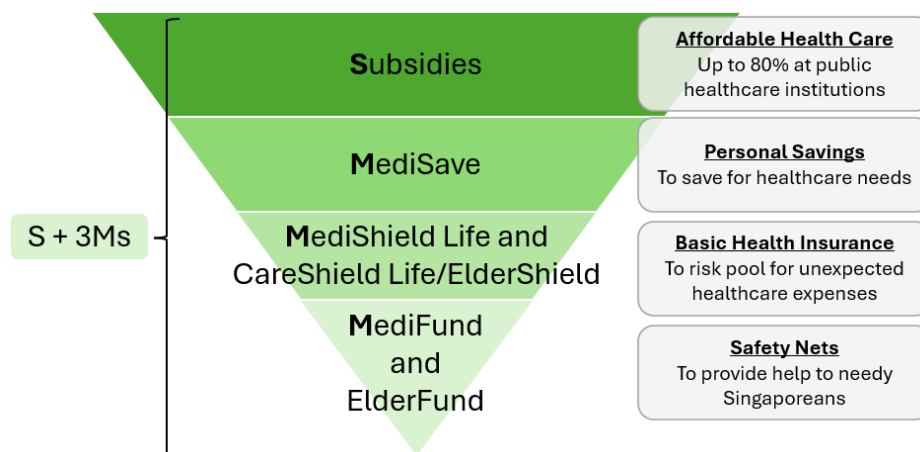


Figure 1. Singapore's S+3M Healthcare Financing Architecture

Source: Phang XNS, Talib A. (2018). The Singapore Model of Managing Healthcare Cost. *Res J Econ*, 2(2), 1000121, Figure 1.

The inverted pyramid illustrates the layered structure from universal government subsidies at the top to targeted safety nets at the base.

Medisave is a state-mandated, individually owned medical savings account into which both employees and employers deposit a fixed proportion of monthly income. Funds in this account belong fully to the individual and their immediate family; unlike a social pooling system, these funds cannot be diverted to pay for other people's medical expenses. Medisave earns the benchmark interest rate plus one percent, with a guaranteed minimum of four percent. Primary uses include inpatient cost-sharing, day surgery, selected chronic disease

outpatient services, preventive care, and payment of annual premiums for MediShield Life. Critically, Medisave cannot be used for general outpatient visits; citizens must pay out of pocket for minor illnesses, a rule designed to discourage unnecessary healthcare utilization. Guo et al. (2025) projected lifetime healthcare costs among older adults in Singapore and found that rising multimorbidity substantially increases cumulative medical expenditure over time. This trajectory implies that even a well-designed savings model faces growing pressure as populations age and chronic disease burdens rise.

1.3 Direct State Payment to Physicians: The Ministry of Health Salary Model

Singapore's public hospitals operate as restructured entities under the Ministry of Health Holdings umbrella, which means they maintain their own accounts but are not dependent on clinical revenue to fund physician salaries. In practice, doctor compensation is managed through the public healthcare cluster system and is structurally decoupled from individual hospital revenue performance, prescription volume, number of diagnostic tests ordered, or consumption of medical supplies. A physician's earnings are not affected by prescribing more drugs, ordering extra examinations, or utilizing more consumables. This design eliminates the financial conflict of interest that distorts clinical decision-making in self-financing hospital systems.

Singapore's physician compensation structure features a high base salary plus clearly defined professional grades. Income is stable and transparent, while promotion and performance evaluation rely on professional competence, research output, teaching responsibilities, and the quality of clinical care, with no connection to revenue generation. Tan et al. (2021) described how Singapore's restructured hospital system, operating under the MOH Holdings cluster model, is designed to decouple physician compensation from clinical revenue, with professional advancement linked to quality and performance rather than service volume. This design principle is intended to insulate clinical decision-making from financial pressure, removing the institutional incentive to overprescribe or order unnecessary tests.

1.4 Public Hospital Ward Class and Differential Subsidy Mechanisms

When a Singaporean citizen or permanent resident is hospitalized, the reimbursement rate depends on the ward class they choose. Higher-class wards provide better amenities but receive lower government subsidies; lower-class wards offer more basic conditions but receive substantially higher

subsidies. This tiered structure creates price signals that nudge patients toward cost-conscious choices without denying access to necessary care. Those who value privacy and comfort pay more; those who prioritize affordability accept basic accommodations in exchange for higher subsidy rates.

This design embeds consumer choice within a regulated framework, discouraging the overconsumption typical of free-at-point-of-care systems. Tan et al. (2021) described how Singapore's ward-class subsidy structure creates differential price signals that guide patient choices toward lower-amenity wards without compromising clinical quality, noting that the same medical care is provided regardless of ward class. The system does not eliminate out-of-pocket spending but channels it through Medisave in a way that makes patients aware of resource constraints while protecting them from catastrophic expenses.

2. Institutional Explanations for the Efficiency of Singapore's Healthcare System

2.1 Demand-Side Constraints: No Free Healthcare and the Principle of Prudent Care-Seeking

Although a young Lee Kuan Yew had been impressed by Britain's free healthcare system during his studies at Cambridge, he governed Singapore by a fundamentally different principle: cradle-to-grave welfare, he believed, would erode the individual drive for self-improvement. As recounted in Haseltine (2013), the Lee administration encountered early evidence of what economists call moral hazard. Patients given free antibiotics took the medication for only two days, discontinued when they did not immediately feel better, and discarded the remainder; the same patients would then visit a private clinic, pay out of pocket, and complete the full course. This observation crystallized the governing logic that "free equals waste." The government accordingly introduced a 50-cent fee for each outpatient visit at public facilities, doubled on public holidays. The signal was deliberate: healthcare is not an unlimited

buffet funded by the state, and citizens bear personal responsibility for their own medical decisions.

The institutional consequences of this philosophy are embedded in the system's design. Medisave explicitly excludes reimbursement for general outpatient visits, meaning that patients pay out of pocket for minor illnesses and must therefore weigh the cost before seeking care. For inpatient admissions, reimbursement is not a flat rate but varies by ward class: higher-amenity wards attract lower government subsidies, while basic ward accommodation receives substantially more support. Citizens thus internalize real price signals at every point of contact with the healthcare system. The result is a population that understands healthcare as a managed personal expenditure rather than an entitlement. Government health expenditure accounts for less than five percent of GDP, yet residents are protected from catastrophic costs through Medisave balances accumulated over decades of mandatory contributions.

2.2 Supply-Side Governance: Institutional Elimination of Medical Rent-Seeking

Singapore's healthcare system sharply limits corruption by structurally eliminating financial incentives between doctors, hospitals, and pharmaceutical or device suppliers. Public-sector physicians receive compensation managed through the public healthcare cluster system and are not reliant on clinical revenue, with salaries set at levels that remove any financial motive to profit from prescriptions or procedures. Drugs and consumables are procured centrally with transparent prices, leaving no opportunity for kickbacks. Inpatient services operate under DRG-based cost controls, meaning that additional tests, procedures, or expensive drugs do not increase physician income or hospital revenue.

Unlike many hospitals in other countries, Singapore's public hospitals do not operate under a self-financing model and are evaluated on quality, efficiency, affordability, and patient experience rather than on revenue-generating indicators. This

design feature has been recognized as a global best practice. Tan et al. (2021) described how Singapore's healthcare system, with its cluster-based physician compensation structure, managed clinical redeployment during the COVID-19 pandemic in ways consistent with a system where physician earnings are not tied to service volume, unlike the incentive pressures observed in fee-for-service contexts. Singapore has cut off every major rent-seeking channel in the healthcare chain, ensuring a clean system and significantly reducing unnecessary medical spending.

2.3 Tiered Service Delivery: From General Practice Clinics to Tertiary Hospitals

Above the GP network lies Singapore's unique system of 26 public polyclinics, which serve as semi-public primary care institutions responsible for chronic disease management, routine diagnostics, vaccinations, and maternal and child health. Polyclinics function as an intermediate layer between GP clinics and hospitals, absorbing the vast majority of routine and low-acuity cases. Approximately 30 public hospitals with around 12,000 beds nationwide concentrate on severe conditions, emergency care, surgeries, and high-complexity treatments.

Because lower levels of the system successfully absorb most minor and routine cases, public hospitals do not experience the overwhelming congestion typical of large tertiary hospitals in mainland China. Guo et al. (2025) projected disease burden and lifetime healthcare costs among older adults in Singapore, providing context for understanding why effective demand filtering at the primary care level matters for system sustainability. Singapore's polyclinic model concentrates routine chronic disease management away from hospitals, allowing specialist resources to be directed where they yield the greatest clinical value.

2.4 The Structural Distinction Between Mandatory Savings and Pay-As-You-Go Financing

Singapore's Medisave represents a funded, individually owned savings model, whereas

mainland China's social health insurance operates largely on a pay-as-you-go basis with partial individual accounts. In China, the employee's personal contribution enters an individual account, while the employer's contribution enters a pooled social fund over which individuals have no control. Personal accounts earn very low interest, yet outpatient care is reimbursable, creating incentives for overutilization that Singapore explicitly avoids by excluding general outpatient visits from Medisave coverage.

This financing distinction has profound implications for intergenerational equity and fiscal sustainability. Singapore's funded model means that each generation saves for its own healthcare, whereas China's pay-as-you-go system transfers resources from current workers to current retirees. Lim et al. (2023) documented the increasing burden of asthma acute care in Singapore over 15 years, noting that even rising chronic disease prevalence has not destabilized the system because contribution histories are long. In China, by contrast, the rapid aging of the population has compressed the window for contribution accumulation, making a transition to a funded model mathematically impossible for current middle-aged cohorts.

3. Structural Barriers Preventing China from Replicating Singapore's Model

3.1 The Order-of-Magnitude Gap in Population Size and Fiscal Capacity

With 1.4 billion people and roughly 4 million physicians in the public hospital system, adopting a Singapore-style model in which physician salaries are fully decoupled from hospital revenue and funded through the public cluster system would require trillions of RMB in annual expenditure. Singapore's approach works because the city-state employs only several thousand public-sector doctors. China's fiscal position cannot sustain such a burden. Huang et al. (2024) evaluated China's primary healthcare services efficiency using a three-stage DEA-Malmquist model and confirmed that

technical efficiency is already declining under current financing constraints.

Moreover, Singapore's GDP per capita exceeded US\$82,000 in 2023, while mainland China's remained below US\$13,000. A low expenditure share in a high-income economy reflects both allocative efficiency and the exclusion of large population segments from public financing. If China were to attempt Singapore-level public spending at 4.47% of GDP, the absolute amount would be approximately US\$800 billion annually, a figure larger than the entire GDP of the Netherlands. At that scale, efficiency gains alone cannot compensate for the demographic coverage obligations that China carries.

3.2 Urban-Rural Duality and the Coverage Dilemma of Informal Employment

A large proportion of rural residents and informal-sector workers in China lack employers who can contribute to their medical insurance. An estimated 300 million workers are in informal employment, including rural residents, self-employed vendors, domestic workers, and platform gig workers, who often have no contribution record at all or rely on the low-premium Urban-Rural Resident Basic Medical Insurance, which is voluntary and offers limited benefits. Li and Han (2023) demonstrated that total health expenditure across Chinese provinces exhibits strong positive spatial autocorrelation, meaning fiscal pressure in one region cannot be isolated from neighboring demands.

If the state were to fully subsidize this group to replicate Singapore's universal Medisave coverage, the fiscal pressure would again reach trillion-RMB levels, far beyond China's current capacity. Liu et al. (2019) documented substantial catastrophic health expenditure among migrant workers in western China, consistent with the broader financial vulnerability of populations with weaker employment-linked insurance protection. Implementing a Medisave-style mandatory individual account would require either mandating contributions from workers earning at subsistence level, which is politically untenable, or having the

state subsidize their accounts in full, which is fiscally beyond current capacity.

3.3 Self-Financing Public Hospitals and the Systemic Roots of Medical Corruption

Because Chinese public hospitals must cover most of their operating costs through clinical revenue, the system inherently generates pressure to expand service volume and creates structural room for informal income. Li and Chen (2023) examined barriers to community healthcare delivery from a nurse perspective in urban China, documenting how performance metrics tied to revenue production distort clinical priorities. Xiao et al. (2026) conducted an interrupted time-series analysis of healthcare services utilization during the COVID-19 pandemic and found that Chinese hospitals experienced severe revenue shocks when patient volumes dropped, with service patterns shifting upon reopening in ways that reflected underlying revenue pressures rather than purely clinical need. This is not a problem of individual moral failing but a systemic equilibrium arising from fiscal underfunding. Chen and Guan (2024) proposed patient-centered lean healthcare management from a humanistic perspective, but lean management cannot compensate for structural deficits in government subsidy. In Singapore, public hospitals are evaluated on quality, efficiency, affordability, and patient experience rather than on revenue-generating indicators. China cannot replicate Singapore's clean physician payment system without first solving the underlying fiscal equation. Raising taxes substantially to fund direct salary payments through the public cluster system is politically infeasible, while accepting continued self-financing preserves the attendant corruption risks.

3.4 Political Legitimacy Constraints: The Impossibility of Excluding Any Resident Group

Singapore has 6 million residents, of whom 2 million are foreign workers who receive no government healthcare subsidies, relying instead on employer-mandated private insurance with limited coverage and high cost-sharing. This exclusion is not an

oversight but a deliberate design feature that allows Singapore to report a 4.47% GDP healthcare expenditure while maintaining high-quality care for citizens. Panesar (2025) analyzed Singapore's health reforms in response to aging and noted that even within the citizen population, political debates about subsidy cuts are contentious, yet foreign workers have no vote and no political voice.

Mainland China cannot legally or politically replicate this exclusion mechanism. Migrant workers from central and western provinces who labor in coastal manufacturing hubs are Chinese citizens with constitutional rights to social security benefits, regardless of whether their employers fully comply with contribution requirements. In practice, the Chinese state faces a strong political and institutional expectation to provide basic medical protection across the entire citizen population, which makes exclusion-based financing strategies far less feasible than in Singapore. In China, the sheer scale of the claimant population creates a fiscal obligation that cannot be arbitrated away through exclusion.

4. Was There Ever a Historical Window for Emulation?

4.1 The 1990s: Weak Savings Base and Missing Financial Infrastructure

At the end of the 20th century, when Singapore's Medisave system was already mature, mainland China had only just overcome subsistence shortages, and household savings were minimal. Successful mandatory savings systems require not only legal compulsion but also a pre-existing culture of formal financial account ownership. In 1990s China, the rural financial system was underdeveloped, most households kept savings in cash or informal rotating credit associations, and income volatility was extreme. Implementing a universal medical savings account would have required first building a national financial infrastructure and achieving universal bank account penetration, a project that took another two decades.

Moreover, the export-driven industrialization strategy depended on low labor costs that precluded high mandatory contribution rates. Singapore's contribution rates for Medisave alone have ranged from six to eight percent of wages. In 1990s China, imposing such rates would have eliminated the cost advantage that attracted foreign direct investment to coastal special economic zones. The sequencing constraint was fundamental. China needed low labor costs to industrialize, but low labor costs precluded the savings-based welfare model that Singapore built only after industrialization was already complete.

4.2 The 2000s: Demographic Inversion Closed the Window Before It Opened

By the time China had accumulated sufficient fiscal capacity to consider adopting a more advanced social security system, roughly circa 2005 to 2010, the population structure had already shifted toward an inverted pyramid. The one-child policy, initiated in 1979, began producing slower working-age population growth by the late 1990s, and the dependency ratio started rising much earlier than demographic projections had anticipated. Age-period-cohort dynamics that shape disease burden follow the same trajectory as healthcare financing strain; a rapidly aging population compresses the very window that a funded savings model requires to mature.

Singapore established its S+3M model during a period of sustained high fertility and demographic stability, with total fertility rates remaining above replacement until the mid-1980s. This gave the city-state a long window to accumulate Medisave balances across cohorts. Evidence from Singapore's own experience is instructive here: Juang et al. (2026) showed that even rising multimorbidity costs among COPD patients have not destabilized the Singapore system, precisely because contribution histories are long enough to absorb the pressure. In China, any attempt to implement a pure Medisave model today would require current workers to save for both their own future care and the current care of their parents' generation, a double burden that

Singapore never imposed because the elderly cohort when Medisave was introduced had shorter life expectancies and lower healthcare utilization.

5. Conclusion

The comparative analysis demonstrates that Singapore's healthcare efficiency is not a universal template but a locally adapted solution to a specific set of demographic, fiscal, and administrative conditions. The city-state's low expenditure share depends on a closed eligible population with formal employment, implementation of mandatory savings before demographic aging, direct Ministry of Health physician payment enabled by small scale, and exclusion of one-third of residents from the subsidy system. Mainland China lacks every one of these preconditions.

This does not mean China's healthcare system is failing in absolute terms. Life expectancy has increased from approximately 68 years in 1990 to 77 years in 2023, a gain of nearly a decade. Tan et al. (2023) documented Singapore's home recovery approach during COVID-19, demonstrating that even efficient systems face operational challenges. China's challenges are different but not necessarily greater. The task at hand is to manage a universal system for 1.4 billion people across vast geographic and economic disparities, rather than to optimize a closed system for 4 million citizens with complete formal employment.

Chinese financial thought offers a useful frame here. The concept of *yingkui tongyuan* (盈亏同源) holds that the source of gain and the source of loss are structurally identical. Singapore's healthcare model illustrates this principle with unusual clarity. The very features that produce its efficiency are precisely the features that prevent its replication elsewhere. Singapore's small population, centralized governance, and exclusion capacity enable low spending but also create vulnerability to external shocks and labor shortages. China's large population, fiscal constraints, and universal coverage obligations create inefficiencies but also generate resilience through scale and domestic market depth. The task for Chinese health policy

researchers is not to lament the impossibility of copying Singapore but to identify second-best reforms that respect path dependence while improving allocative efficiency within existing constraints.

References

- Chen M, Guan Q, Zhuang J. (2024). Patient-centered lean healthcare management from a humanistic perspective. *BMC Health Serv Res*, 24(1), 1261.
- Ding YL. (2018). Characteristics of Singapore's health protection system evolution and its implications for China. *Chin J Health Policy*, 11(10), 34-42.
- Guo X, Tysinger B, Wee HL, Subramaniam M, Ma S, Ng TP, Chen C. (2025). Disease burden, lifetime healthcare cost and long-term intervention impact projections among older adults in Singapore. *Nat Aging*, 5(7), 1358-1369.
- Haseltine WA. (2013). *Affordable Excellence: The Singapore Healthcare Story*. Washington DC: Brookings Institution Press.
- Huang R, Li W, Shi B, Su H, Hao J, Zhao C, Chai J. (2024). Evaluating China's primary healthcare services' efficiency and spatial correlation: a three-stage DEA-Malmquist model. *Front Public Health*, 12, 1366327.
- Juang YR, Lim LHM, Chotirmall SH, Abisheganaden J, Koh MS, Tsai MJ, Liew MF, Yii ACA, Tiew PY, Price D, Tan KB, Chen W. (2026). Healthcare Costs and Trends of Multimorbidity in COPD Patients: A Population-Based Study in Singapore. *Int J Chron Obstruct Pulmon Dis*, 21, 563.
- Li B, Chen J. (2023). Barriers to community healthcare delivery in urban China: a nurse perspective. *Int J Qual Stud Health Well-being*, 18(1), 2220524.
- Li J, Han X. (2023). Spatiotemporal Evolution and Drivers of Total Health Expenditure across Mainland China in Recent Years. *Int J Environ Res Public Health*, 20(1), 597.
- Lim LHM, Chen W, Amegadzie JE, Lim HF. (2023). The increasing burden of asthma acute care in Singapore: an update on 15-year population-level evidence. *BMC Pulm Med*, 23(1), 502.
- Liu L, Zhang X, Zhao L, Li N. (2019). Empirical analysis of the status and influencing factors of catastrophic health expenditure of migrant workers in western China. *Int J Environ Res Public Health*, 16(5), 738.
- Panesar D. (2025). Singapore's health reforms in response to an aging society. *J Public Health Policy*, 46(4), 847-857.
- Tan CC, Lam CSP, Matchar DB, Zee YK, Wong JEL. (2021). Singapore's health-care system: key features, challenges, and shifts. *Lancet*, 398(10305), 1091-1104.
- Tan HYT, Yau JWK, Toh MPHS, Vasoo S, Leo YS. (2023). Coronavirus disease and home recovery: a Singapore perspective. *Western Pac Surveill Response J*, 14(5 Spec edition), 1-7.
- Xiao H, Bai G, Liu F, Cui Y, Unger JM. (2026). Policy stringency during the COVID-19 pandemic and healthcare services utilization in China: An interrupted time-series analysis. *PLoS Med*, 23(3), e1004672.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

Research on Digital Exhibition Design of China Industrial Design Museum

Xu Dan^{1,2*}, Rahah bt. Hasan¹, Tang Zijie²

¹ Faculty of Applied and Creative Arts, University Malaysia Sarawak, Sarawak, Malaysia

² Faculty of Design & Art, Yancheng Institute of Technology, Yancheng, Jiangsu, China

* Correspondence: 195290014@qq.com

<https://doi.org/10.53104/insights.soc.sci.2026.06004>

Abstract: Under the strategic background of digital transformation, digital exhibition has become a vital approach for design museums to strengthen the efficiency of cultural communication. Taking China Industrial Design Museum as the research subject, this paper focuses on its prominent deficiencies in current digital display, including inadequate digitalization of collections, insufficient interactive experience and outdated audio-visual facilities. Integrating interdisciplinary theories such as environmental psychology and immersion theory, this study conducts qualitative evaluation on the current situation of museum digital display through field investigation and statistical analysis. It identifies areas of relatively low visitor satisfaction concerning digital collection presentation, human-machine interaction and experiential attraction. Correspondingly, proposes corresponding optimization strategies from four dimensions: interactive exhibition arrangement, human-oriented spatial environment, intelligent digital technology and comprehensive supporting facilities. Specific measures cover immersive scene restoration, digital twin collection database construction, cloud museum development and educational space expansion. The research conclusions can may provide practical reference for the digital upgrading of China Industrial Design Museum, as well as theoretical foundation and practical reference for the construction and renewal of similar design museums.

Keywords: design museum; digital exhibition; optimal design

Received: 27 April 2026

Revised: 7 May 2026

Accepted: 8 May 2026

Published: 12 May 2026

Citation: Xu, D., Hasan, R. bt. & Tang, Z. (2026). Research on Digital Exhibition Design of China Industrial Design Museum. *Insights in Social Science*, 4(2), 32–55.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

1.1 Research Background

Since China issued the cloud migration, data application and intelligent empowerment initiative within the 14th Five-Year Plan in 2021, digital

empowerment has evolved into a fundamental driving force promoting industrial transformation across diverse sectors (Gao, P., 2022). Such a developmental trend is particularly evident in the museum industry, which is currently undergoing a profound global transition from static physical

display modes to comprehensive digital exhibition systems (Shan, J. X., 2018). As vital carriers of design cultural heritage, design museums cover multiple disciplines including product design, industrial design, graphic design, fashion design and architectural design, and inherently possess innovative advantages. In the context of the big data era, design museums are required to break traditional operational constraints and integrate digital technologies into exhibition planning, so as to effectively undertake cultural inheritance and public service responsibilities. Digital transformation is currently reshaping the overall exhibition logic and spatial presentation modes of contemporary museums (Parry, R., 2010). Scientifically constructed digital exhibition systems can not only improve the preservation efficiency and communication scope of design cultural heritage, but also create immersive visiting scenes for audiences, thereby realizing the maximum transmission of cultural connotations and social values.

Located on the eastern coast of the Yangtze River Delta, Shanghai is one of the earliest cities in China to develop creative industries and has long served as the core representative region of national industrial design development. The China Industrial Design Museum is situated within the International Industrial Design Center in Baoshan District, Shanghai. As the first specialized museum focusing on industrial design in China, it systematically presents the complete developmental trajectory of local industrial design and clearly demonstrates the practical achievements of contemporary Chinese design, especially the innovative development of modern design in Shanghai. Nevertheless, field research indicates that the museum still faces prominent deficiencies in digital exhibition construction, including insufficient digital exhibit resources, inadequate interactive experience, outdated multimedia supporting systems, and rigid and homogenized display forms. In this regard, conducting targeted post-occupancy evaluation on the current digital exhibition environment of the China Industrial

Design Museum and proposing feasible optimization strategies to improve overall visiting quality has become an urgent practical research task.

1.2 Research Significance

1.2.1 Theoretical Significance

The Outline of the 14th Five-Year Plan and the Long-Range Objectives Through the Year 2035 emphasizes the development of smart cultural tourism, encouraging museums to develop online digital experience products, construct big data platforms, and promote emerging cultural tourism services such as immersive scenarios, virtual exhibition halls, and high-definition live broadcasts. Nevertheless, design museums in China started relatively late, and relevant research on digital exhibition practices remains in the exploratory stage, lacking systematic theoretical frameworks. Based on post-occupancy evaluation theory, this study constructs a comprehensive evaluation method for digital exhibition environments and applies it to the practical analysis of design museums. The research expands the theoretical boundary of museum studies from an innovative perspective and provides new methodological ideas and practical pathways for the diversified application of post-occupancy evaluation within the museum discipline.

1.2.2 Practical Significance

First, as one of the earliest and most influential private professional design museums in China, the China Industrial Design Museum is currently undergoing critical digital transformation and confronting multiple practical challenges. This study conducts a systematic post-occupancy evaluation of the museum's existing digital exhibition systems, identifies core spatial and technical deficiencies, and proposes targeted improvement and optimization strategies. The research outcomes effectively enhance the overall visitor experience of the China Industrial Design Museum and provide practical guidance and actionable references for the digital upgrading and

spatial renewal of other similar design museums nationwide.

Second, from the perspective of user experience research and design discipline development, the evaluation findings support the formulation of human-centered digital renewal strategies for museum exhibition spaces. This research provides reliable theoretical foundations and design suggestions for the future planning, renovation, and innovative construction of digital exhibition systems in design museums. Furthermore, the optimized digital environment can effectively improve public visiting satisfaction, strengthen the cultural influence of design museums, and consolidate their professional positioning within the urban cultural ecosystem.

2. Theoretical Foundations

2.1 Conceptual Definition of the Design Museum

In museum studies and design studies, a design museum is generally understood as a specialized cultural institution that collects, preserves, studies, and exhibits design-related objects, documents, processes, and ideas.

In this study, a design museum is defined as a formal cultural institution centered on design culture, undertaking the integrated functions of collection, exhibition, academic research, public education, and cultural promotion. It focuses on design works, creative processes, design theories, and social influences of design activities. Its core characteristics are reflected in multiple dimensions. Centering on the fundamental theme of design, such museums cover interdisciplinary fields including industrial design, graphic design, fashion and costume design, and environmental design. They balance artistic appreciation and practical application, emphasizing the close correlation between design, daily life, social development, and industrial innovation. Different from traditional exhibition venues that merely highlight the aesthetic value of finished works, design museums prioritize the presentation of design procedures and the dissemination of design thinking. Meanwhile, they

emphasize practicality and public participation, encouraging audiences to perceive, understand, and participate in design activities through interactive spatial experiences.

In summary, the design museum discussed in this paper refers to a non-profit permanent cultural institution that takes design as the core theme. It integrates systematic collection preservation, professional academic research, public cultural exhibition, educational communication, and industrial innovation empowerment. It connects historical design heritage, contemporary design practice, and future design development, promoting academic exchanges and industrial coordination within the design industry. Its core values lie in inheriting design culture, popularizing professional design knowledge, stimulating creative innovation, and facilitating the in-depth integration of design resources with social development, cultural inheritance, and technological progress.

2.2 Overview of Digital Exhibition

Digital exhibition design refers to the process of converting diversified cultural information into standardized digital forms and presenting them in museum spaces (Chen, G., 2020). It not only realizes multi-dimensional visual presentation of exhibits, but also undertakes comprehensive functions of information transmission, spatial atmosphere shaping, and visitor flow organization (Li, S. D., 2017). In recent years, theoretical and practical research on digital exhibition technology has developed rapidly across the cultural heritage field. However, targeted research focusing specifically on digital exhibition optimization for design museums remains insufficient and relatively fragmented. Therefore, this study systematically sorts out the basic connotation and theoretical framework of museum exhibition design. Combined with the unique disciplinary attributes, functional positioning, and audience characteristics of professional design museums, the research conclusions can provide theoretical reference and practical guidance for the digital transformation and

spatial exhibition upgrading of similar design museums.

2.2.1 Definition of Digital Exhibition

1) Digitalization

The concept of digitalization originates from the Latin word “digitus”, which originally means finger. With the continuous popularization and iterative upgrading of digital information technology, digitalization has become an essential technical foundation and core driving force for industrial innovation and social operation. It has profoundly changed people’s daily lifestyles, behavioral habits, and information acquisition modes, bringing comprehensive structural changes to social production and daily consumption. Essentially, digitalization relies on computer technology and network data processing technology, providing fundamental technical support for the networking, virtualization, and intelligent development of cultural information resources.

2) Traditional Exhibition Design

Traditional museum exhibition is dominated by static physical display of tangible cultural relics and design objects (Wang, H. J., 2018). Physical exhibit arrangement has long been the most direct and mainstream display method in conventional museum operation. Design works inherently integrate artistic aesthetics and practical functional attributes (Yin, D. B., 2019). Nevertheless, most traditional museum exhibition spaces arrange exhibits simply in chronological order (Su, D. H., 2015). Such single static exhibition mode presents obvious limitations. It focuses excessively on one-way cultural knowledge indoctrination, ignores visitors’ emotional experience and interactive demands, and fails to fully release the cultural value and connotation of design exhibits.

3) Digital Exhibition

Digital exhibition is a comprehensive innovation model formed by the organic integration of digital technology system and traditional museum exhibition design system. On this basis, this study defines digital exhibition as an innovative spatial

presentation method that adopts digital information technology to digitize physical exhibits and cultural resources, and relies on intelligent electronic equipment and interactive terminal facilities to realize multi-scene, multi-dimensional, and immersive cultural display.

2.2.2 Types of Digital Display

Driven by the rapid iteration of digital information technologies, the digital display forms adopted by domestic museums have gradually shifted from rigid, single-dimensional presentation modes toward diversified and multi-scene interactive systems. In current museum practices, digital exhibition methods can be scientifically categorized into two major types: one-way information transmission and two-way human-computer interaction.

1) One-way Transmission Modes in Digital Display Digital Projection Sand Table

A projection sand table relies on computer graphics technology to construct highly realistic three-dimensional visual models. With the assistance of professional projection equipment, virtual three-dimensional or four-dimensional data models are superimposed onto physical sand table carriers. This technology enhances the overall visual presentation effect of spatial scenes, strengthens the sense of spatial realism, and effectively optimizes the immersive perception of visitors during the viewing process.

Digital Cinema System

Digital cinema equipment includes various projection forms such as arc-screen projection, circular dome projection, folded-screen projection, and gauze-screen projection. Built with professional video playback hardware in relatively enclosed or semi-enclosed exhibition spaces, digital cinemas broadcast high-definition cultural films on customized large-size screens. Such facilities deliver immersive audio-visual shock, efficiently attract audience attention, systematically convey exhibit information and historical context, and enable visitors to comfortably engage in deep cultural perception.

Pepper's Ghost Imaging System

Based on optical imaging principles, the phantom imaging system integrates physical entity models with virtual three-dimensional ghost images. Combined with multi-angle shooting technology and human visual perception characteristics, the system realizes realistic visual integration and dynamic interaction between real objects and virtual images. Supported by three-dimensional surround sound, intelligent lighting, environmental fragrance and smoke auxiliary effects, the overall exhibition atmosphere becomes highly vivid and immersive. For instance, the cultural program National Treasure, jointly produced by CCTV and the Palace Museum, widely adopted a 360° holographic phantom imaging system. By suspending three-dimensional virtual images above physical exhibition cabinets, the program effectively displayed artifact details and historical background information in a vivid visual form.

Holographic Projection System

The holographic projection system realizes suspended three-dimensional imaging in real exhibition spaces based on beam-splitter optical principles. Through real shooting and three-dimensional digital modeling of design works or cultural relics, virtual product images are dynamically superimposed onto real exhibition environments. This method constructs a comprehensive display system combining static physical scenes and dynamic virtual images, significantly enriching the visual layering of digital exhibitions.

2) Two-way Interactive Modes in Digital Display

Touch Interactive Display

Touch interaction relies on interactive terminals such as touch screens and smart interactive desktops, combined with multi-point sensing and gesture recognition technologies. Visitors can independently browse exhibit data, historical evolution, and cultural connotations through clicking, sliding, zooming and other simple operations. This interactive mode emphasizes public participation and active exploration, transforming visitors from passive viewers into

active participants in the cultural communication process.

Somatosensory Interactive Display

Somatosensory interaction realizes real-time human-computer communication by capturing human body gestures and limb movements. Using high-precision cameras and intelligent sensors, the system converts physical behaviors into digital control signals, enabling real-time linkage between visitors and exhibition content. This form of interaction provides intuitive, natural and highly immersive visiting experiences suitable for large public exhibition spaces.

Virtual Spatial Interaction

Virtual spatial interaction relies on virtual reality (VR), augmented reality (AR), and mixed reality (MR) technologies to generate highly simulated digital environments. Such technologies can either restore real historical scenes or construct completely virtual creative spaces, providing multi-sensory feedback including vision, hearing and even tactile simulation. Typical practical cases include the VR immersive exhibition Eternal Notre-Dame, the AR interactive experience of Terracotta Army in Xi'an, and the MR architectural restoration project adopted by the Nanyue King Museum, all of which effectively improve the spatial immersion and cultural perception ability of visitors.

2.2.3 Characteristics of Digital Display

Digital technologies effectively enhance the interactivity and communication efficiency of museum exhibitions (Economou, M., 2015). In general, digital museum exhibitions present four typical characteristics, including multi-dimensional narratives beyond temporal and spatial limitations, immersive experience integrating virtual and real elements, innovative exhibition paradigms in the digital era, and audience-participatory museum construction (Liu, G. Q., 2020).

1) Multi-dimensional Narratives Breaking Temporal and Spatial Constraints

Exhibition narratives transmit cultural information through physical exhibits and diversified media carriers (Chen, L. S., 2016). Museum narrative

design systematically organizes historical, cultural and scientific content through carefully selected physical collections, innovative display media, diversified exhibition methods and supporting service facilities, so as to present professional knowledge to audiences in a logical and vivid storytelling form. This process is not limited to simple information transmission; it also serves as effective behavioral guidance, capturing visitors' attention, visualizing abstract concepts, and reorganizing scattered cultural data. In this way, audiences can naturally understand cultural connotations while enjoying the visiting process. The integration of multimedia digital devices significantly strengthens scene attraction, optimizes attention guidance in exhibition routes, and ensures continuous and layered visiting perception. Meanwhile, digital exhibitions interpret core themes from multiple perspectives and dimensions, constructing richer, more interesting and open narrative contexts. Such environments enable visitors to independently explore exhibition logic and cultural implications with higher subjective initiative.

2) Immersive Experience with Virtual-Real Integration

The introduction of digital media enables the organic combination of physical exhibits and virtual technology, constructing hybrid exhibition scenarios where real entities and digital coexist. This transformation provides audiences with enhanced sensory stimulation, immersive atmosphere, virtual scenes and personalized visiting experiences. Creating immersive perceptual environments has become a core developmental trend in contemporary digital museum design (Zhou, B., 2021). Different from traditional static exhibitions dominated by physical objects, pictures and texts, digital displays embed virtual elements into real spatial scenes seamlessly, generating highly realistic and vivid exhibition atmospheres and comprehensively improving visitor satisfaction. Compared with conventional exhibition spaces, digitally empowered environments feature stronger spatial openness. During the visiting process,

audiences not only observe physical collections, but also appreciate visual aesthetics and spiritual shock brought by virtual digital scenes.

3) Innovative Exhibition Paradigm Adapted to the Digital Era

With the arrival of the digital era, traditional physical exhibition modes can no longer fully satisfy the increasingly diverse experiential demands of modern audiences. Contemporary exhibitions are required to interpret cultural themes through physical collections while overcoming the inherent limitations of single-object display. Digital exhibition technology not only optimizes the presentation effect of physical cultural relics and enriches spatial exhibition layers, but also acts as an effective medium helping visitors intuitively understand the historical context, cultural background and emotional stories behind exhibits. Furthermore, digitalization injects continuous innovation vitality into museum operations. Multi-sensory perception, multi-dimensional presentation, interactive participation and interesting scene experience have gradually become indispensable core elements of modern museum exhibition design.

4) Museum Co-Construction Based on Audience Participation

Driven by the digital revolution, museums have gradually transformed from traditional knowledge-oriented venues into interactive cultural spaces that stimulate public exploration and creative thinking. The unique interactive advantages of digital display have promoted profound institutional changes in museum operation logic. Such interactivity enables audiences to shift from passive knowledge receivers to active participants in cultural activities (Wang, X. M., 2020), and promotes deep emotional communication between visitors and exhibits, effectively improving public engagement and visiting interest. Fundamentally, the audience's social role has been upgraded from passive recipients to co-creators of exhibition content and contributors of cultural knowledge. In-depth interactive participation strengthens visitors' sense of identity and belonging, and accelerates the

functional upgrading of museums as public education and cultural communication institutions. Under the participation and joint construction of audiences, museums successfully realize the transformation from one-way cultural output to two-way interactive communication.

In this study, these theoretical perspectives are used mainly as analytical references for evaluating the China Industrial Design Museum. Environmental psychology supports the assessment of spatial comfort, lighting, circulation, and rest nodes. Immersion theory helps explain visitors' expectations for scene reconstruction, multi-sensory experience, and interactive participation. Digital heritage conservation provides the basis for discussing digital collection archives and virtual display. Post-occupancy evaluation offers the methodological logic for linking visitor feedback with later design optimization. Therefore, the following empirical analysis is organized around exhibition experience, spatial environment, digital technology, and supporting service facilities.

3. Overview and Empirical Research on the Digital Exhibition of China Industrial Design Museum

3.1 Overview of the China Industrial Design Museum

3.1.1 Geographic Location Overview

The China Industrial Design Museum is situated within the International Industrial Design Center in Baoshan District, Shanghai. Geographically, it is bordered by Songfa Road to the north, Yixian Road to the east, and Changyi Road to the south. As the first domestic professional museum themed exclusively on industrial design, it systematically exhibits high-quality design works and innovative achievements created by outstanding designers. The museum intuitively presents the complete developmental panorama of China's industrial design industry and clearly outlines the progressive achievements of Chinese design, especially the practical development of modern design in Shanghai. The supporting facilities within the

International Industrial Design Center include the Shanghai Industrial Design Center and interdisciplinary university laboratories, forming a profound regional design cultural atmosphere. In addition, high-level educational institutions such as Fudan University and Shanghai Baoshan Vocational College are distributed in the surrounding area, creating convenient conditions for long-term academic cooperation and joint research between the museum and universities. The Shanghai Glass Museum is located on the northeast side of the site. Overall, the China Industrial Design Museum possesses superior geographical advantages and comprehensive resource conditions for integrating industrial practice with university education.

3.1.2 Significance of Museum Establishment

First, the museum enables contemporary designers to expand their research vision from simply reviewing international design history to conducting integrated comparative research on both global design history and localized Chinese industrial design history. The existing research data and practical materials of Chinese industrial design are relatively fragmented and scattered. The construction of a specialized industrial design museum effectively supplements physical research resources and improves the systematicness and integrity of theoretical research on Chinese design development.

Second, the formal operation of the China Industrial Design Museum promotes the iterative upgrading and value reconstruction of industrial design products with practical application value. The core positioning of the museum is not limited to retrospective collection and simple memory of traditional old industrial products. Instead, it focuses on exploring innovative design logic based on historical design resources, driving secondary innovative redesign of traditional industrial elements, and generating new high-value industrial design creative achievements.

Third, the museum realizes the dual-value leap from single academic research value to integrated industrial practical value. The theoretical research of

Chinese industrial design requires the mutual verification of written literature and physical cultural relics. However, the existing systematic written documents related to Chinese industrial design are relatively insufficient. Therefore, the collaborative research model combining physical design products, professional written materials and historical video archives has become an inevitable developmental direction for the construction and functional optimization of the China Industrial Design Museum.

3.1.3 Research Value of Field Investigation

The selection of the China Industrial Design Museum (Figure 1) as the core empirical case of this study is based on typical practical and theoretical rationales. Firstly, it boasts high positioning matching degree. As a first-tier professional museum focusing on the whole industrial design industry in China, it integrates multiple core functions including cultural exhibition, public education, academic research, creative incubation and design practice. Its practical exploration of digital exhibition construction has typical industrial representativeness in the field of design museums. Secondly, it has prominent practical reference value. The museum is reconstructed from abandoned old industrial factories. It not only completely retains the original historical texture and industrial site characteristics of industrial heritage, but also integrates contemporary innovative modern design concepts into the overall spatial renovation (Li, Q., 2018). The mature reconstruction experience and prominent practical spatial problems existing in the museum can provide reliable empirical reference and optimization enlightenment for other similar design museums renovated from old industrial buildings. Thirdly, it has typical regional representativeness. Located in Shanghai, a core city leading the development of China's creative and design industries and a world-class UNESCO City of Design, the museum is surrounded by a strong urban design cultural atmosphere. Local citizens have high aesthetic cognition and diversified experiential demands for design culture. Its digital

exhibition practice can truly reflect the actual developmental status, practical difficulties and future optimization demands of large-scale urban professional design museums.

In terms of collection scale and category, by the completion of the field investigation, the museum has collected more than 800 pieces of standardized design collections. These works fully cover three complete developmental stages: the handicraft era, the traditional industrial era and the modern digital era. The specific collections include classic Bauhaus industrial design products, winning works of top international design awards such as Red Dot Design Award and IF Design Award, representative excellent works of contemporary Chinese industrial design, and classic design masterpieces created by Yang Mingjie. The collection categories comprehensively cover furniture innovative design, electronic product interface design, transportation tool modeling design, new material application samples and other diversified types, forming a complete and standardized industrial design collection system. It provides solid physical resource support and reliable basic conditions for subsequent spatial investigation, empirical data research and regular public educational activities.

3.2 Display Type Analysis

3.2.1 Array Display in China Industrial Design Museum

For homogeneous industrial products of different eras, such as radios and thermos flasks from various periods, the museum adopts full-wall shelving for dense and unified array arrangement. Such intensive layout produces strong visual tension and clearly presents the iterative evolution trajectory of product forms and functional structures. Through rigorous spatial order and quantitative aggregation, array display intuitively reflects the essential characteristics of modern industrial design, including standardized manufacturing and large-scale batch production. The scale effect constructs a monumental spatial atmosphere and forms a macro narrative of industrial progress. Parallel

arrangement facilitates typological comparison, enabling visitors to rapidly recognize the evolutionary logic of similar design works within a unified visual field. Serving as a high-density visual archive, this display mode carries massive historical and technical information within limited exhibition space. Beyond pure aesthetic arrangement, array display functions as a spatial medium for recording and respecting the continuous development of industrial civilization.

3.2.2 Deconstruction Display in China Industrial Design Museum

Classic sophisticated industrial products, such as mechanical cameras and traditional typewriters, are professionally disassembled into independent structural components. These disassembled parts are presented through suspended installation or flat tiling display. The deconstructed exhibition method enables visitors to observe not only the external appearance of design works, but also the precise internal mechanical structure, modular assembly logic and engineering matching relationships. It effectively reveals that high-quality industrial design emphasizes both external aesthetic modeling and internal structural rationality.

3.3 Current Situation of Digital Exhibition in China Industrial Design Museum

3.3.1 AR and QR Code Guidance System

QR codes are placed beside key exhibits throughout the exhibition halls. By scanning the codes with mobile devices, visitors can automatically obtain real-time voice explanations, view 360-degree panoramic product details, and browse in-depth designer background stories. This lightweight digital auxiliary system improves visiting convenience and enriches multi-dimensional information interpretation without additional hardware investment.

3.3.2 Multimedia Video Installation

Multimedia video installations in the museum aim to break the limitations of static physical display and transform the exhibition space into a digital theater for interpreting industrial civilization. Multiple projection screens are arranged in key areas to continuously broadcast documentaries on industrial development and historical factory assembly line footage. Dynamic videos restore product operating principles and internal textures, bringing static physical exhibits to life. Historical footage reconstructs real social and economic contexts, injecting emotional and social dimensions into industrial relics. Meanwhile, multi-screen linkage establishes a systematic digital archive. Combined with basic interactive induction technology, the installation effectively enhances on-site perception and supplements dynamic information that static exhibits cannot convey.

3.3.3 Interactive Experience Screens

Interactive experience screens break the traditional “no touching” rule in museums and transform visitors from passive viewers into active participants. Through virtual operation simulation and interactive demonstration, visitors can directly experience the human-computer interaction logic of design products and compensate for the inability to operate physical exhibits on site. The equipment strengthens immersive perception and increases visiting interest. Meanwhile, it supports independent information retrieval, allowing audiences to selectively explore design details according to personal preferences. The interactive screens fully reflect the user-centered core concept of industrial design and promote the museum’s transformation from one-way knowledge indoctrination to two-way interactive communication.



Figure 1. Interactive electronic display screens in the museum

Source: Self-photographed by the author.

3.3.4 Questionnaire Design

Based on the constructed digital exhibition evaluation index system, this study adopts questionnaire distribution to conduct systematic post-occupancy evaluation of visitors' actual experience in the China Industrial Design Museum. The questionnaire consists of two parts. The first part collects basic demographic information, including gender, age, educational background, residential location and visiting modes. The second part adopts the semantic differential method. According to the 24 established evaluation indicators of digital exhibition, opposite adjective pairs are set to form a five-level satisfaction scale, including strongly agree, agree, neutral, disagree, and strongly disagree. The corresponding quantitative scores are defined as 2, 1, 0, -1, and -2 respectively. Statistical analysis of user satisfaction data can objectively reflect visitors' comprehensive evaluation and perceptual feedback on each spatial and digital indicator.

The 24 indicators were developed according to the main components of digital exhibition experience, including exhibition presentation, spatial environment, digital technology application, and auxiliary service facilities. These dimensions correspond to the practical characteristics of design museums, where visitors are expected not only to

view finished products, but also to understand design processes, technological mechanisms, and interactive functions. The five-level semantic differential scale was used to capture visitors' intuitive satisfaction with each indicator. In the scoring process, positive values indicate relatively satisfactory experience, 0 indicates a neutral perception, and negative values suggest that the corresponding aspect does not fully meet visitors' expectations.

3.3.4.1 Basic User Information Analysis

Located in Baoshan District, Shanghai, China Industrial Design Museum is the first specialized museum focusing on industrial design in China. A total of 250 questionnaires were distributed, and 247 valid samples were recovered, with an effective recovery rate of 98.8%. All collected data met the research standards.

Demographic statistics show that the gender ratio of respondents is balanced, with males accounting for 48% and females accounting for 52%. The age groups are divided into seven categories: under 15 years old, 15–19 years old, 20–29 years old, 30–39 years old, 40–49 years old, 50–59 years old, and over 60 years old. The research participants mainly include surrounding residents, nearby office workers, tourists and students. Among all respondents, 96% have received higher education.

Detailed demographic data are shown in the following table.

Table 1. Summary of Basic User Information of China Industrial Design Museum

Basic Information	Sub-items	Frequency	Frequency Rate (%)
Gender	Male	119	48
	Female	128	52
	Total	247	100
Age	Under 18 years old	0	0
	19-29 years old	163	66
	30-39 years old	36	15
	40-49 years old	29	12
	50-59 years old	19	7
	60 years old and above	0	0
	Total	247	100
Educational Background	Primary education	4	2
	Secondary education	6	2
	Higher education	101	41
	Postgraduate Education (Master & Doctorate)	136	55
	Total	247	100
Occupation	Student	137	55
	Enterprise staff	101	41
	Public servants	9	4
	Others	0	0
	Total	247	100
Residence	Yangtze River Delta region	97	39
	Other domestic regions	150	61
	Overseas regions	0	0
	Total	247	100

Source: Taken by the author.

It should also be noted that the respondent profile is relatively concentrated. Most participants are young visitors with higher education backgrounds, especially students and enterprise staff. This structure is consistent with the professional orientation of an industrial design museum and may reflect an important part of its actual audience. However, the findings mainly reveal the expectations of a digitally literate visitor group and should not be simply generalized to all potential museum visitors.

3.3.4.2 Analysis of Questionnaire Results of China Industrial Design Museum

Visitor experience has become a core quantitative index for evaluating the comprehensive service level of modern museums (Wang, L., 2020). Based on the post-occupancy evaluation data of China Industrial Design Museum, this section systematically

analyzes user feedback from five core dimensions, including overall evaluation results, exhibition display performance, spatial environmental experience, digital technology application and auxiliary supporting service quality.

1) The overall questionnaire data presents an obvious negative skewness distribution. Among the

24 established evaluation indicators, 22 items show negative weighted scores, accounting for 91.7% of the total dimension quantity. Only 2 indicators obtain positive comprehensive scores, merely occupying 8.3%. The statistical results objectively reflect that most visitors have low comprehensive satisfaction with the overall visiting environment, digital service level and spatial experience of the museum, and only a few basic service details meet public psychological expectations.

2) Comparative analysis of single-dimensional indicators shows that visitors give the lowest comprehensive scores to the conventional exhibition and display system. In the subsequent spatial renewal and digital renovation process, it is necessary to focus on optimizing interactive interestingness, scientific lighting layout and dynamic exhibition adjustment mechanism to improve the overall presentation effect of physical exhibits.

3) User satisfaction with digital display facilities and intelligent service systems is also generally low. Although individual positive indicators such as design heritage digital protection and integrated media information services obtain relatively favorable evaluations, most practical digital function modules fail to meet actual visiting demands. The overall satisfaction of digital technology dimension ranks the lowest among all evaluation dimensions, which should be regarded as the core optimization priority in the later renovation design.

4) The comprehensive evaluation score of auxiliary service facilities is relatively unsatisfactory. Prominent practical problems include insufficient rest and negotiation spaces, imperfect industry-university-research supporting facilities, inadequate sanitary service configuration and limited cultural and creative product exhibition areas. These practical shortcomings provide direct empirical basis and key optimization directions for the subsequent functional expansion and spatial reconstruction of the museum.

4. Spatial Optimization Design Strategies of China

Industrial Design Museum

Combined with the quantitative evaluation conclusions and practical field investigation problems obtained from the above post-occupancy evaluation, this research takes digital display empowerment as the core optimization starting point. Corresponding targeted spatial renewal strategies are proposed based on the four major evaluation dimensions, so as to effectively solve the current practical bottlenecks of insufficient digital construction, single functional coordination and poor visitor experience in the museum.

4.1 Design Objectives and Practical Significance

4.1.1 Core Design Objectives

(1) Optimize interactive exhibition and display system. Traditional static physical display modes are difficult to fully interpret the complex mechanical internal structure and innovative design thinking logic of industrial products. The optimization strategy breaks the simple stacking display of single cultural relics, introduces immersive digital scene restoration and professional deconstruction display methods, strengthens the narrative coherence of exhibition content through intelligent digital technology, and helps visitors systematically understand the iterative evolution logic from industrial batch manufacturing to innovative personalized design.

(2) Upgrade humanized spatial environment. The original industrial heritage space of the museum has unique historical and industrial texture advantages, but there are obvious deficiencies in environmental atmosphere construction and human comfort perception. The renovation scheme introduces scientific intelligent lighting design and human-centered guiding circulation planning to relieve visual fatigue of long-time visiting. Meanwhile, digital immersive scene creation and interactive experience devices are added to build two-way effective communication channels between visitors and exhibition spaces, fully mobilize public active

participation, and create a comprehensive visiting atmosphere with both profound industrial heritage texture and contemporary modern aesthetic perception.

(3) Improve intelligent digital service system. Facing the practical contradiction between limited physical exhibition space and massive industrial design historical materials, it is urgent to construct a high-standard smart design museum. AR, VR and other immersive digital technologies are adopted to restore the full-scale operation logic of large industrial mechanical equipment. A complete online digital resource archive is established to break the physical space boundary of offline exhibition halls, realizing in-depth extension of cultural information and comprehensive upgrading of interactive immersive visiting experience.

(4) Expand diversified auxiliary service functions. To enhance the sustainable operational capacity and comprehensive social influence of the museum, the single traditional sightseeing-oriented visiting mode must be broken. By adding professional design workshops, academic lecture halls and integrated cultural and creative leisure areas, the research improves popular science education, social leisure and industry exchange functions, and constructs a composite cultural ecosystem integrating exhibition, academic research, practical learning and cultural tourism experience.

4.1.2 Practical Value and Research Significance

1) Design innovation value. The overall development of design museums in China is still in the initial exploratory stage. At present, there are only four professional design museums in the Yangtze River Delta, namely China Industrial Design Museum, China National Design Museum, Yang Mingjie Design Museum and Ningbo Industrial Design Museum. As the earliest built professional industrial design museum in the region, the in-depth digital display optimization research of this project can effectively improve public visiting efficiency and perceptual experience, and promote the popularization of professional

design culture and standardized construction concept of design museums across the country.

2) Cultural inheritance value. Digital technology provides reliable technical support for the efficient protection and innovative communication of industrial design cultural heritage (Zhang, N., 2019). In the digital cultural era, the presentation forms of cultural resources are constantly innovating with social development and public cultural demands. The introduction of digital display systems into professional design museums can systematically sort out and scientifically protect precious design heritage resources, optimize user immersive experience, strengthen academic design research and cross-regional cultural communication, and provide practical support for enhancing national cultural soft power and consolidating cultural self-confidence.

3) Practical educational value. Design museums have become important offline practical teaching bases for university design majors. Many colleges and universities rely on surrounding professional design museums to carry out auxiliary teaching of design theory courses. Most visitors to design museums are design practitioners and design students. Optimizing the digital display level and interactive experience environment can not only deepen the theoretical learning effect of college students, but also lay a solid practical foundation for subsequent professional practical courses and innovative design training.

4) Social development value. As an authoritative public platform for releasing professional design trends and sorting out urban industrial cultural context, design museums undertake the important responsibility of activating urban cultural vitality and boosting regional cultural and economic development. The introduction of digital interactive display technology can visualize abstract professional design information and optimize on-site visiting perception. During the immersive visiting process, the public can systematically understand design concepts, form a good social atmosphere focusing on innovative design, and encourage all groups in society to actively

participate in design innovation and cultural creative activities.

4.2 Optimization Strategies

Based on the established post-occupancy evaluation framework and visitors' practical feedback on the China Industrial Design Museum, this section proposes targeted optimization strategies from four dimensions, including exhibition arrangement, spatial environment, digital technology application, and auxiliary service improvement, so as to solve existing spatial and experiential deficiencies. The following strategies are not intended to be implemented at the same level of urgency. Measures related to interactive display, digital interpretation, lighting improvement, circulation organization, and rest facilities should be regarded as short-term priorities, because they directly respond to the low satisfaction scores in exhibition presentation, digital technology, and service facilities. Other measures, such as cloud museum construction, NFT-based cultural and creative products, and industry-university-enterprise cooperation platforms, are more suitable as medium- and long-term development directions, depending on funding, operation capacity, and institutional cooperation conditions.

4.2.1 Experience Optimization: Constructing Interactive and Diversified Exhibition Displays

1) Enhancing immersive scenes and multi-sensory experience

The introduction of immersive scene reconstruction and multi-sensory experience design aims to break the rigid, isolated and silent viewing atmosphere of traditional exhibitions and inject vivid vitality into cold industrial relics. For a long time, most exhibits in the museum are displayed in static forms, completely separated from the original production scenarios and living contexts. Without environmental background support, mechanical industrial products often appear obscure to ordinary visitors and fail to generate effective emotional resonance. Essentially, industrial design is not merely the production of physical objects, but

a direct reflection of lifestyles and productivity characteristics in specific historical periods. Through spatial and digital renovation, the traditional one-way viewing mode can be transformed into comprehensive multi-sensory engagement. Such optimization reconstructs the emotional connection between visitors and exhibits, enabling audiences to perceive the development context of industrial civilization through vision, hearing and tactile interaction. The strategy effectively lowers the threshold of cultural understanding, visualizes abstract historical memories, and promotes the transformation of the museum from a simple collection warehouse into a more perceptible cultural space.

2) Promoting perspective display and dynamic interactive presentation

The adoption of perspective exhibition and dynamic interaction fundamentally breaks the natural limitations of industrial exhibits, in which external appearances are visible while internal structures remain hidden. The core essence of industrial design lies in sophisticated internal mechanical structures and systematic operating logic, which cannot be fully reflected through traditional static display methods. Conventional exhibition only presents external modeling features, making it difficult for visitors to appreciate internal gear transmission, circuit layout and technological craftsmanship. Such superficial display greatly reduces the popular science value and exploratory attractiveness of the museum. By applying exploded structural display, transparent superposition screens and dynamic interactive installations, complex mechanical principles can be visualized and simplified for public understanding. The design satisfies visitors' curiosity about internal operating mechanisms, especially young audiences, and transforms passive knowledge reception into active independent exploration. This measure turns static design specimens into dynamic logical processes, helping visitors deeply understand the technical heritage and craftsmanship spirit behind local manufacturing. In addition, the museum currently relies excessively on text and graphic explanations

with outdated presentation methods, resulting in limited communication efficiency. Supplementing digital media equipment such as projection systems and intelligent display screens can significantly enrich exhibition layers and improve overall narrative effectiveness.

3) Expanding in-depth digital experience based on VR and AR technology

Virtual reality technology can construct highly immersive virtual environments and realize the effective integration of physical scenes and virtual digital information (Li, M., 2021; Zhao, Z. Y., 2020). The introduction of VR and AR technologies enables the museum to break the temporal and spatial limitations of physical exhibition spaces and reshape interactive relationships between visitors and industrial heritage. Restricted by cultural relic protection regulations, audiences cannot closely touch or operate physical industrial exhibits on site, and large-scale mechanical equipment cannot demonstrate internal dynamic operating logic under static display conditions. The integration of VR and AR helps build unlimited cloud exhibition spaces and relieves the contradiction between abundant collections and limited indoor areas. With the support of digital twin technology, visitors can virtually disassemble precision instruments, simulate driving historical industrial vehicles, and perspectively observe internal core components in immersive virtual scenes. The strategy applies cutting-edge digital technologies to inherit classic industrial civilization, transforming single visual appreciation into two-way in-depth exploration. In this way, industrial historical development is no longer limited to static physical display, but becomes an intuitive, accessible and interactive digital cultural experience.



Figure 2. Comparison of the China Industrial Design Museum before and after VR/AR digital renovation

Source: Self-photographed by the author.

4) Adding temporary exhibition halls and implementing dynamic spatial adjustment mechanisms

Industrial design is a rapidly developing and continuously innovative discipline. Over-reliance on fixed permanent exhibition layouts fails to reflect cutting-edge design trends and emerging technological breakthroughs in a timely manner, gradually disconnecting museum content from current social concerns. Such rigid exhibition modes easily reduce visitors' willingness to revisit and lead to a one-time visiting phenomenon. The addition of flexible temporary exhibition spaces and dynamic adjustment mechanisms aims to break the static solidification limitations of traditional permanent displays and construct resilient exhibition spaces that keep pace with contemporary design development. By setting up multi-functional temporary exhibition areas and adopting modular, movable exhibition facilities, the museum achieves

flexible and rapid curation capabilities. This enables the regular introduction of international touring exhibitions, avant-garde design concept exhibitions, and new product launch activities, ensuring that exhibition content remains fresh and diverse. Meanwhile, the multi-purpose space can also accommodate academic forums, design competitions, and industry exchange events. This measure transforms the museum from a closed historical collection space into an open and dynamic design communication hub, continuously generating cultural and industrial value and maintaining the long-term vitality of the museum.

4.2.2 People-Oriented Principle: Constructing Reasonable and Comfortable Spatial Environment

1) Participatory design and gamified visiting circulation planning

The charm of industrial design lies not only in finished products, but also in the collision of creative thinking and the whole innovative design process. Nevertheless, traditional single-linear visiting routes easily cause visual fatigue and mental burnout. Under the conventional display-viewing mode, visitors remain in a passive viewing position and cannot fully understand designers' problem-solving logic and creative innovation process. The renovation integrates task-driven mechanisms and role-playing gamified experiences into the overall circulation system, transforming traditional exhibition areas into open co-creation spaces. Visitors are converted from passive spectators into active design participants. Through interactive puzzle solving, simulated component assembly, and immersive design decision-making experiences, audiences can intuitively perceive the complete logical process from conceptual brainstorming to final product shaping. This optimization breaks the rigid impression of traditional popular science education, embedding professional design knowledge into entertaining interactive scenarios. Each visiting experience becomes a creative practice process that enhances visitors' sense of achievement and innovative thinking. The strategy fundamentally changes the dull passive reception

mode of traditional museum visits and transforms the educational function of the museum into an enjoyable, interactive, and knowledge-oriented active exploration journey.

Restricted by the original spatial layout, the existing planar functional zoning cannot fully meet the diversified experiential and operational demands of modern museums. Therefore, reasonable expansion and integrated renovation of surrounding supporting areas are carried out. The museum is located within a comprehensive industrial park with complete supporting resources, including numerous design incubation bases and university joint laboratories. Such superior industrial and educational resources provide favorable external conditions for the diversified functional development, interdisciplinary cooperation, and long-term innovative operation of the museum.



Figure 3. Plan comparison of the exhibition area of China Industrial Design Museum before and after renovation

Source: Drawn by the author.

2) Balanced Cold and Warm Integrated Lighting Design

Industrial exhibits are mainly composed of metal, glass and composite materials, covering multiple historical periods of industrial development. The traditional single light source and excessively cold white lighting with a simplistic industrial style often make exhibits look rigid and monotonous, easily causing visual fatigue among visitors. Such rigid lighting methods fail to convey the humanistic temperature and emotional value behind design works. By introducing intelligent color temperature adjustment and zoned lighting layout, the museum realizes targeted lighting design for different exhibits. High-color-temperature cold light is adopted to highlight the tough lines and metallic texture of mechanical equipment, fully reflecting the rationality and precision of industrial manufacturing. Low-color-temperature warm light is used to wrap daily necessities and historical documents softly, evoking the warm life atmosphere and emotional memories of past eras. The dialectical balance of light and shadow constructs a rhythmic visual narrative. Visitors can shuttle between rational technological atmosphere and perceptual historical context, obtaining professional, clear, comfortable and immersive viewing experience. The design reshapes the physical texture of exhibits and the emotional temperature of the space, effectively relieving the cold and alienated atmosphere commonly seen in industrial-themed exhibition halls.

3) Coherent and Flowing Narrative Circulation

The evolution of industrial design is not scattered independent display of individual products, but a continuous developmental process driven by technological accumulation, material innovation and aesthetic iteration. Outdated and chaotic visiting circulation easily leads to temporal and spatial cognitive disorder. It is difficult for visitors to grasp the internal development context of Chinese manufacturing from imitation to independent innovation and from traditional manufacturing to intelligent manufacturing, resulting in fragmented cognition and incomplete overall understanding. Through renovation, a progressive and well-structured narrative

circulation is constructed. The museum perfectly synchronizes visitors' physical movement in space with the logical evolution of industrial design development. This measure abandons the crude exhibition mode of simple exhibit stacking and transforms the whole museum space into a readable three-dimensional historical record through systematic spatial narrative planning. In this way, visitors can clearly perceive the developmental trajectory of China's industrial design during the whole visiting journey.

4) Rhythmic Layout of Rest Nodes

The rhythmic layout of rest nodes in China Industrial Design Museum aims to alleviate the widespread museum fatigue and provide necessary breathing and thinking intervals for high-density continuous visiting activities. Industrial design exhibitions involve professional technical popularization, complex mechanical structure identification and long walking distances. High-intensity information input and continuous visual stimulation easily cause dual physical and mental exhaustion, resulting in scattered attention and impetuous emotions in the later stage of the visit. Combined with the transformation of exhibition narrative chapters and the psychological rhythm of passenger flow, scientific rest nodes are reasonably arranged to form a benign spatial rhythm of viewing, thinking, resting and continuing to visit. These nodes are not merely simple seating areas, but functional settling zones for thinking and recovery. The fully humanized layout reflects refined design care. Visitors can pause to appreciate the design wisdom behind exhibits at a steady pace, transforming intensive and tiring visiting into relaxed, elegant and comfortable cultural appreciation experience.

4.2.3 Technology Empowerment: Constructing Diversified and Intelligent Digital Exhibition System

1) Supplementing Diversified Digital Technology Exhibits

Supplementing digital technology exhibits broadens the connotation boundary of traditional industrial

design and promotes the transformation of exhibition focus from physical shape display to interactive digital experience. Traditional industrial design exhibitions are limited to physical dimensions such as mechanical structure, material craftsmanship and external modeling. In the intelligent interconnected era, core design research gradually extends to user interface design, user experience optimization and algorithm logic research. Relying solely on traditional hardware exhibits cannot fully reflect the overall development leap of Chinese manufacturing from physical processing to digital intelligent production, resulting in the lack of contemporary developmental context. By introducing intelligent wearable devices, AI interactive terminals, virtual simulation equipment and typical service design cases, the museum intuitively presents the new integration trend of hardware and digital virtual interaction. Modern industrial design is no longer limited to static physical shaping, but evolves into a dynamic systematic design containing data flow, human-computer interaction and scenario service linkage. The museum therefore acts not only as a recorder of traditional industrial history, but also as a predictor of future intelligent lifestyles.

2) Constructing Digital Twin Cultural Heritage Database

The construction of a digital twin heritage database breaks through the physical limitations of natural aging of physical collections and insufficient exhibition space, building a stable digital archive for precious industrial cultural heritage. Industrial design relics such as ancient design manuscripts, out-of-print prototypes and early mechanical equipment face irreversible risks including paper embrittlement, metal oxidation, material aging and component loss. Traditional physical preservation can only delay aging but cannot resist natural erosion. Restricted by limited exhibition area, a large number of large-scale industrial equipment are stored in warehouses for a long time, unable to exert educational and research value. With digital twin technology, micron-level high-precision 3D scanning and full-element data reconstruction are

conducted on cultural relics. The morphological features, surface textures and complex internal structures of physical exhibits are converted into permanently stored digital assets. The renovation realizes digital symbiosis protection of cultural relics, avoids cultural heritage loss caused by physical aging, and supports non-destructive virtual disassembly, restoration and in-depth academic research for researchers and the public. It lays a solid data foundation for future cloud exhibition and cross-regional academic sharing.

3) Building Intelligent Digital Operation Service System

The introduction of an intelligent digital system abandons the extensive manual operation mode and builds a real-time sensing and self-regulating digital brain for the whole museum. The intelligent system reconstructs traditional visiting experience and breaks the one-way static communication limitations of conventional exhibitions. It transforms obscure historical and cultural information into perceivable, participatory and immersive interactive content, effectively lowering the appreciation threshold, meeting the visiting needs of all-age audiences, enhancing attraction and user stickiness among young groups, and improving comprehensive museum management and service capabilities (Wu, Z. Q., 2021). The intelligent upgrading responds positively to the national cultural digital development strategy, promotes the in-depth integration of traditional industrial culture and modern digital technology, revitalizes industrial cultural relics, and realizes the creative transformation and innovative development of excellent traditional culture. The museum is upgraded from a static exhibition venue to an accessible, approachable and sustainable public cultural platform. The intelligent digital system summarizes and integrates exhibit information of different exhibition areas into a unified digital terminal. Visitors can independently search for detailed exhibit introductions according to personal preferences, greatly improving visiting autonomy and convenience. In view of the large volume of some industrial products that are inconvenient for

comprehensive observation, the digital system provides all-round three-dimensional images to realize multi-angle panoramic display.

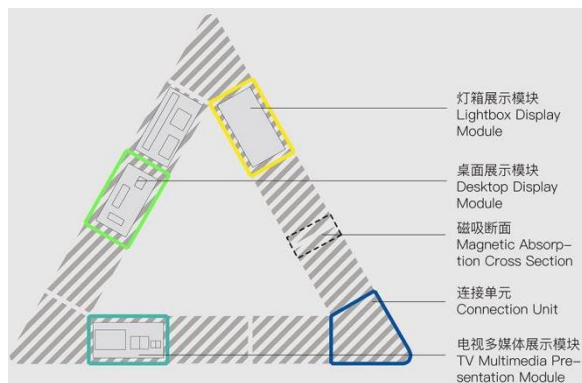


Figure 4. Rendering of the intelligent exhibition system in China Industrial Design Museum

Source: Drawn and Self-photographed by the author.

4) Development of Cloud Museum and NFT Cultural and Creative Products

The development of a cloud-based online museum and non-fungible token (NFT) digital collections aims to break the physical and geographical limitations of offline venues, reconstruct the cultural communication and operational logic of the museum, and expand the museum's online communication channels. As an important public space for displaying innovative industrial wisdom, relying solely on offline visiting and physical cultural and creative sales limits radiation scope, failing to reach global design enthusiasts and meet the digital consumption demands of Generation Z for virtual cultural assets. Traditional physical cultural and creative products lack unique scarcity

and are difficult to carry the profound historical connotation and intellectual property value of industrial design collections. The construction of a cloud museum realizes all-weather global online exhibition without time and space restrictions. Supported by blockchain and NFT technology, precious industrial design manuscripts and out-of-print prototype models can be endowed with unique digital certificates, realizing digital right confirmation and permanent digital collection of industrial cultural heritage. The strategy transforms passive viewing behavior into active cultural possession. It not only expands the audience coverage and diversified revenue channels of the museum, but also activates the sustainable circulation value of industrial design heritage in the digital era through blockchain technology.



Figure 5. Alipay NFT exclusive skin of China Industrial Design Museum

Source: China Industrial Design Museum · Official Website.

4.2.4 Comprehensive Extension and Improvement: Construction of Complete and Convenient Auxiliary Service System

1) Expansion of professional educational practical spaces

The addition of independent educational spaces breaks the traditional dilemma of emphasizing collection storage while ignoring public education, upgrading the museum from a simple historical exhibition room to a comprehensive training incubator for improving public design literacy. Industrial design is an applied discipline focusing on logical reasoning, hands-on practice and material perception. Traditional static exhibition only presents the final product appearance. Visitors can only observe the surface shape through glass cabinets but cannot deeply understand the core design thinking and complex creative process. One-way knowledge indoctrination without interactive participation makes abundant collections fail to effectively cultivate innovative thinking among young people, resulting in superficial social education effects. By adding professional design workshops, popular science classrooms and STEAM maker spaces, a complete cognitive closed loop of visiting, learning and practical creation is established. The strategy complements the practical educational function, enabling the museum to become an important second classroom outside campus. Through model assembly, structural disassembly analysis and creative design painting activities, innovative awareness is cultivated among teenagers, and high-quality talents with both aesthetic literacy and engineering practical ability are reserved for the future development of Chinese manufacturing industry.

2) Construction of integrated cultural and creative experience center

Cultural and creative development is an important way to realize the value transformation of museum cultural resources (Chen, X. H., 2021). The construction of a specialized cultural and creative center connects the last link between cultural appreciation and daily consumption, transforming

industrial design aesthetics in exhibition cabinets into accessible lifestyle products for the public. Essentially, industrial design integrates artistic aesthetics, commercial value, practical functions and material technology. If the museum only provides static ornamental display without supporting cultural and creative consumption channels, visitors cannot fully perceive the practical value of design in improving life quality, and long-term cultural communication effects cannot be formed. Single ticket revenue cannot support sustainable museum operation and academic research, resulting in the difficulty of cultural value transformation. The renovated cultural and creative area integrates product sales, new design product release and life aesthetics experience. It is not only a simple commercial space, but also a portable mobile exhibition hall that can be integrated into daily life. The strategy realizes the dual goals of museum sustainable operation relying on cultural consumption and efficient cultural output. Classic design elements with historical value are popularized among ordinary families through modern cultural and creative carriers. Meanwhile, it provides commercial transformation channels for contemporary designers and promotes the living inheritance of excellent industrial design culture.

3) Optimization of human-oriented public service facilities

The optimization of supporting service facilities fully practices the people-oriented design philosophy, extending the exhibition focus from exhibits themselves to humanistic care and building a warm and inclusive public cultural space. As a typical venue advocating the concept of design improving life, imperfect basic supporting facilities such as insufficient rest seats, inadequate storage space, lack of catering service and incomplete barrier-free facilities easily cause physical discomfort and psychological museum fatigue, shortening visiting duration and reducing overall satisfaction. The absence of humanized services contradicts the core industrial design concept of user experience priority. The renovation adds scientific rest nodes, intelligent luggage storage

systems, maternal and infant rooms and high-quality light catering service, cooperating with digital intelligent service terminals. It eliminates practical obstacles during visiting and realizes seamless comfortable spatial experience. The measures effectively prolong visiting duration, improve visitor satisfaction and revisit willingness, and practically demonstrate that excellent industrial design exists not only in exhibition cabinets, but also in every humanized service detail.

4) Building industry-university-enterprise cooperative linkage platform

Building in-depth cooperative connections with enterprises bridges the gap between historical industrial collections and contemporary industrial development. The museum is transformed from an independent cultural exhibition platform into a core hub of industrial innovation, realizing the in-depth integration of industry, education, research and exhibition. The practical vitality of industrial design originates from commercial application and mass production. Isolated museum operation disconnected from manufacturing development cannot give full play to the inspirational and guiding value of design resources. Enterprises often face difficulties in design transformation and brand upgrading, while museums possess abundant design cases and aesthetic resources lacking effective output channels, resulting in resource mismatch. The renovation builds joint innovation laboratories, new product release halls and industry exchange salons to connect classic design heritage and intelligent manufacturing future. It enables enterprises to obtain historical theoretical support and high-standard exhibition exposure, and helps museums serve the real economy, promoting the transformation from Made in China to Created in China.

5) Addition of themed catering and leisure areas

The construction of themed catering leisure areas upgrades the single visual visiting experience to multi-sensory lifestyle experience, continuing industrial design narrative through taste and spatial perception. Without supporting themed catering spaces, visitors can only watch exhibits remotely

rather than experience design in daily use. Single functional experience easily interrupts visiting routes due to physical demands and misses the opportunity to display industrial design in catering scenarios. The themed catering area integrates classic ergonomic furniture, design tableware and industrial-style atmosphere, forming a usable dynamic exhibition space. Chairs, tableware and service facilities in the area are all practical design exhibits. The area effectively relieves visiting fatigue, prolongs staying time, creates social and punch-in scenarios, and enables visitors to intuitively perceive how design aesthetics serve daily diet and life in leisure time.

5. Conclusion and Future Prospects

5.1 Research Conclusions

Taking the China Industrial Design Museum as the typical research case, this study integrates interdisciplinary theoretical foundations including environmental psychology, digital heritage conservation and immersive interaction theory. By adopting theoretical framework deduction, field on-site investigation and questionnaire quantitative analysis, this paper systematically constructs a comprehensive evaluation system for digital display effect of design museums and further proposes targeted improvement countermeasures. The major research conclusions are drawn as follows.

First, the multidimensional practical bottlenecks of current digital exhibition construction are systematically identified. Supported by field spatial measurement and statistical data of 247 valid visitor questionnaires, the research verifies that the museum suffers from comprehensive deficiencies covering exhibition, space, technology and service dimensions. In terms of exhibition presentation, the overall display mode remains relatively rigid and static, lacking interactive narrative design and immersive scene reconstruction, while the traditional multimedia playback system fails to meet contemporary visiting demands. In terms of spatial environment, the functional zoning arrangement is unreasonable, the human-oriented

spatial comfort is insufficient, and the progressive narrative logic of visiting circulation is fragmented. In terms of digital technology application, the digital reconstruction coverage of physical exhibits is relatively low, and the human-computer interactive response efficiency needs to be further improved. Only digital heritage protection and integrated media information services obtain relatively positive user feedback. In terms of auxiliary supporting services, intelligent interpretation guidance, cultural and creative commercial supporting facilities and industry-university-research cooperative platforms are obviously inadequate. The above empirical results suggests that the current digital service level cannot match the experiential expectations of modern museum audiences.

Second, the demographic characteristics and hierarchical demand preferences of core visitor groups are quantitatively summarized. The survey statistics indicate that the dominant visitors are young residents aged 19 to 29, accounting for 66% of the total samples, among which students and enterprise practitioners account for 55% and 41% respectively. Up to 96% of respondents have received formal higher education, and 61% of visitors come from non-core areas of the Yangtze River Delta. Such user groups generally possess proficient digital operation literacy, with strong willingness to participate in immersive interactive scenes and intelligent personalized services. They pursue in-depth interpretation of design logic and industrial cultural connotation behind physical exhibits, and simultaneously attach importance to spatial comfort, walking smoothness and service convenience during the whole visiting process. The research indicates the core user orientation and realistic demand basis for subsequent spatial renewal and digital optimization design.

Third, a four-dimensional collaborative closed-loop digital optimization system is constructed. Corresponding to the quantified evaluation weaknesses and actual user demands, this study puts forward systematic renovation strategies from four synergistic dimensions of exhibition

reconstruction, spatial regeneration, digital empowerment and functional supplement. At the exhibition level, the optimization measures include building full-sensory immersive scenes, adding perspective dynamic interactive displays, introducing VR and AR deep immersive experience modules, and setting up flexible temporary exhibition spaces to realize real-time iterative updating of exhibition content. At the spatial level, the renovation integrates gamified task-driven circulation, balanced dual-temperature intelligent lighting, continuous narrative visiting routes and rhythmically arranged humanized rest nodes. At the digital level, the strategies cover expanding intelligent digital exhibits, establishing high-precision digital twin heritage archives, constructing full-scene intelligent management platforms, and developing cloud online museums and NFT digital cultural and creative assets. At the service level, the scheme includes expanding practical educational maker spaces, upgrading integrated cultural and creative experience centers, optimizing barrier-free public facilities, building school-enterprise collaborative innovation platforms, and adding themed industrial-style catering leisure areas. Ultimately, a preliminary four-dimensional optimization framework featuring experience upgrading, spatial adaptation, technological empowerment and functional extension is formed.

5.2 Research Prospects

This research mainly focuses on the actual operational difficulties and digital display deficiencies of the China Industrial Design Museum, and pertinently proposes localized spatial and digital improvement strategies based on empirical data. Nevertheless, the applicability, scalability and cross-scene adaptability of the proposed optimization schemes have not been verified through comparative analysis with other types of professional design museums. In follow-up in-depth research, diverse resource endowments, spatial scales, operational positioning and industrial service attributes of different design museums

should be fully considered. On the premise of classified scenario discussion, the existing strategic framework can be dynamically adjusted, supplemented and optimized, so as to effectively enhance the practical operability and universal popularization value of the research outcomes and provide reliable theoretical references and practical paths for the high-quality digital transformation of domestic design museum clusters in the future.

Fund Projects

This research was supported by Research on the Service Ecology and Optimization Strategy of Jiangsu Design Museum Empowered by Metacosmos, Jiangsu Province, China, 2022 (22YSB022), and Research on Digital Ecology and Scenario-based Service Strategy of Design Education Resources in Local Colleges and Universities, Yancheng College of Technology, Jiangsu Province, China, 2022.

References

- Chen, G. (2020). *Research on digital exhibition and display design*. China Architecture & Building Press.
- Chen, L. S. (2016). *Theory and practice of museum exhibition curation*. Cultural Relics Press.
- Chen, X. H. (2021). Integrated development mechanism of cultural and creative industries under museum digital empowerment. *Cultural Industry Research*, 18(4), 33-34.
- Economou, M. (2015). Museums and interactive digital technology innovation. *Museum Management and Curatorship*, 30(2), 18-19.
- Gao, P. (2022). Research on the digital transformation development paths of contemporary museums. *Science, Technology and Culture*, 8(3), 14-15.
- Li, M. (2021). Practical application and scenario expansion of virtual reality technology in museum exhibitions. *Modern Information Technology*, 5(12), 27-28.
- Li, Q. (2018). Conservation strategies and adaptive reuse methods of modern industrial heritage resources. *Architectural Journal*, 59(5), 20-21.
- Li, S. D. (2017). *Fundamentals of exhibition design principles*. China Architecture & Building Press.
- Liu, G. Q. (2020). Practical research on the systematic construction of digital museum platforms. *Library Tribune*.
- Parry, R. (2010). *Museums in a digital age*. Routledge.
- Shan, J. X. (2018). *The power of museums*. SDX Joint Publishing Company.
- Su, D. H. (2015). *General introduction to museum studies*. Cultural Relics Press.
- Wang, H. J. (2018). *Basic theories of Chinese museology*. Higher Education Press.
- Wang, L. (2020). Visitor perception and behavioral experience evaluation in public museum spaces. *Tourism Tribune*, 35(8), 24-25.
- Wang, X. M. (2020). Interactive experience optimization of new media exhibition spaces. *Zhuangshi*, 33(6), 19-20.
- Wu, Z. Q. (2021). Systematic planning and intelligent construction path of smart museum clusters. *City Planning Review*, 45(7), 31-32.
- Yin, D. B. (2019). *Introduction to design studies*. Hunan Science and Technology Press.
- Zhang, N. (2019). High-precision digital preservation and innovative inheritance of cultural heritage resources. *Sciences of Conservation and Archaeology*, 41(2), 25-26.
- Zhao, Z. Y. (2020). Interface optimization and interactive logic design of augmented reality spatial applications. *Computer Engineering*, 46(9), 27-28.
- Zhou, B. (2021). Spatial design strategies of immersive exhibition scenarios in cultural museums. *Packaging Engineering*, 42(10), 19-20.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

An Exploration of the Characteristics of Abstract Painting and AI-Generated Abstract Painting in the Age of Artificial Intelligence: A Freudian Perspective

Wen Yanan^{1,2}, Mohd Zahuri bin Khairani^{1*}

¹ Universiti Pendidikan Sultan Idris, Perak 35900, Malaysia

² Huainan Normal University, Anhui 232038, China

* Correspondence: 3437216649@qq.com

<https://doi.org/10.53104/insights.soc.sci.2026.06005>

Received: 13 May 2026

Revised: 19 May 2026

Accepted: 20 May 2026

Published: 26 May 2026

Citation: Wen, Y., & Mohd Zahuri bin Khairani. (2026). An exploration of the characteristics of abstract painting and AI-generated abstract painting in the age of artificial intelligence: A Freudian perspective. *Insights in Social Science*, 4(2), 56–65.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Currently, with the widespread application of artificial intelligence technology in the field of artistic creation, AI generated abstract paintings have gradually become a research hotspot. However, there is still a gap in the systematic comparative research on the psychological level between AI and traditional abstract paintings, especially in depth exploration within the framework of Freudian psychoanalytic theory. Through textual analysis, case comparison, and theoretical interpretation, this study systematically dissects the visual transformation mechanisms of the human subconscious in traditional abstract paintings—such as the connection between Kandinsky’s “The Spiritual in Art” and the id impulse. The research findings indicate that traditional abstract painting is a visual crystallization of the interplay between human subconsciousness, instinctual desires, and external reality, while AI generated abstract painting is a patterned recombination of human artistic data by algorithms, lacking genuine spiritual experience and instinctual drive. This paper aims to provide a new perspective for understanding the essential boundaries of artistic creation in the AI era and to expand the application of psychoanalytic theory in the field of digital art.

Keywords: AI generated abstract painting; traditional abstract painting; Freud’s psychoanalytic theory; subconscious; instinctual drive; art comparison

1. Introduction

Since the 20th century, abstract painting has always been committed to “abandoning figurative imitation and directly reaching the spiritual core.” From

Kandinsky’s Concerning the Spiritual in Art to Mondrian’s “Neoplasticism,” human artists have transformed the emotions, desires, and conflicts in their subconscious into visible visual languages through the free combination of colors, lines, and

compositions (Washton Long, 1975). Traditional abstract painting originates from the artist's subjective emotions, intuition, and experience, and emphasizes unique, original expression through physical media. (Novák, J., 2020)

In recent years, artificial intelligence technologies represented by Generative Adversarial Networks (GANs) and diffusion models have been able to quickly generate works that conform to the style of abstract painting. From the "AI Kandinsky" trained based on art history data (Liu et al., 2025) to the "abstract visual generator" that can be customized through text instructions, it seems that artificial intelligence is replicating and even surpassing human abstract creative abilities (L et al., 2025).

For example, AI tools like DALLÉ can generate high quality images based on textual descriptions, which offers new possibilities for creating abstract art.

From the perspective of Freudian psychoanalysis, artistic creation is regarded as the expression and sublimation of unconscious desires, conflicts, and complexes. Abstract artists often do not pursue the concrete depiction of their works, but instead convey emotions and ideas through lines, colors, shapes, and compositions. For example, an abstract expressionist painting (Figure 1) may have chaotic and energetic lines and colors that can be interpreted as the projection of the artists inner conflicts or intense emotions.



Figure 1. Yang Jiayong, *Desire*, Oil on canvas, 140x240cm, 2016

Source: Provided by the artist.

Freud's psychoanalytic theory provides an important theoretical framework for understanding

the psychological connotations of abstract art works. However, the application of this theory in artificial intelligence abstract painting has not been fully discussed (Levine, M., 2018).

This study systematically analyzes the differences in spirituality between artificial intelligence and human beings in abstract painting creation, filling the gap in the psychoanalytic research of digital art. By comparing and analyzing the similarities and differences in artistic expression between artificial intelligence abstract painting and traditional abstract painting, this study provides new theoretical support and practical guidance for the development of art creation, art psychology, and artificial intelligence art.

2. Literature Review

2.1 The Current Research Status of AI Generated Abstract Painting

Artificial intelligence generated abstract art employs algorithms and machine learning models to create images (Liu, 2023). These algorithms can be trained on extensive datasets of existing artworks to learn patterns and styles, thereby generating new and original pieces (Chamberlain et al., 2018). Current academic research on AI generated art primarily focuses on technical principles (such as algorithm optimization and model training) (Chen, 2024) and market value (such as auction prices and collection trends) (Sidorova, 2019).

For example, Eduardo Kac's research on the "interactivity of AI art" shows that viewers can influence the process of AI generated artworks by inputting instructions or parameters, which can produce customized and personalized artistic experiences (Yang, 2025). Benjamin Davis's exploration of AI art copyright issues is also noteworthy. In the field of abstract painting, research mostly concentrates on the accuracy of style imitation (such as AI's replication of Mondrian's geometric compositions), with less emphasis on in depth comparisons at the level of spiritual connotations (De Silva Garza & Zamora Lores, 2011).

Some studies indicate that there may be negative biases against AI art, with people perceiving it as less creative or authentic than human created artworks (Horton et al., 2023). Although some scholars (such as Susan Stewart) have proposed that “AI art lacks emotional experience,” they have not systematically discussed it in combination with psychoanalytic theory (Frankfeldt, 2025).

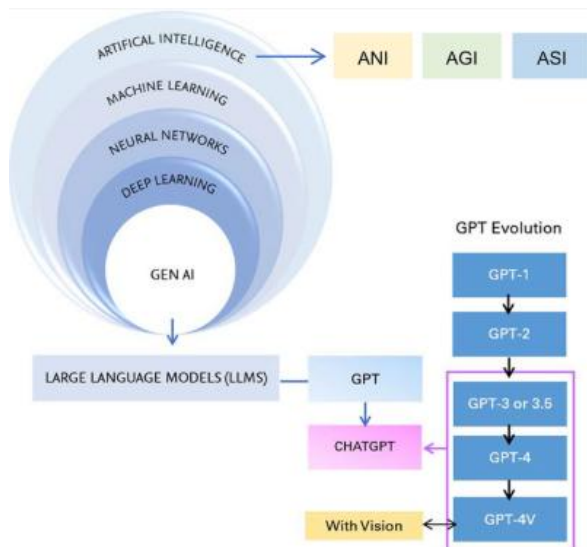


Figure 2. Source: Unveiling the landscape of generative artificial intelligence in education: a comprehensive taxonomy of applications, challenges, and future prospects. Education and Information Technologies.

Figure 2 illustrates the hierarchical relationship of AI related concepts and the evolution of the GPT model. AI generated abstract painting is a manifestation of the deep integration of artificial intelligence technology and artistic creation. It not only promotes the innovation of artistic expression forms but also provides artists with new creative tools and collaborative models (N et al., 2024).

Some scholars argue that although artificial intelligence can imitate various artistic styles and create visually appealing compositions, it lacks the conscious intention and emotional depth of human artists (Bhise & Kamble, 2025).

The artistic expression in AI generated art is more closely related to the technical capabilities of the algorithms and the aesthetic preferences encoded in

the training data (Hung et al., 2020). It is important to consider whether artificial intelligence is merely a tool or a true creative partner (Moruzzi, 2022). As pointed out by Zhuo (2020), despite the ability of AI generated abstract painting to mimic the styles of traditional abstract painting, there remains a gap in evoking emotional resonance and subconscious associations among viewers. (Zhuo, 2020)

2.2 Psychoanalytic Studies of Traditional Abstract Painting

The application of Freudian psychoanalytic theory in the study of traditional abstract painting has a long history. Ernst Kris pointed out in “Art and Psychoanalysis” that Kandinsky’s abstract colors are “the visual sublimation of id impulses” (Potts, 2012). Jackson Pollock’s “drip painting” is a typical example—he laid the canvas on the ground and randomly dripped and splashed paint from a can while moving freely, with the creative process full of randomness and free bodily movements (such as “Lavender Mist”) (Figure 3). According to psychoanalytic theory, artistic creation is a symbolic expression of the artist’s unconscious impulses and internal conflicts (Paula, A., 2016).

Pollock’s “unconscious mental state” during the creative process, as well as his own acquaintance with psychoanalytic theory, has led his works to often be seen as projections of his inner world (Ziwei, Z., 2023). For example, some studies have pointed out that Pollock’s paintings can be regarded as the narrative carriers of his “inner existence” (Morrissette et al., 2024). He embedded images—so called “Polloglyphs”—into his works through the “drip painting” technique and disguised them with dripping paint, thereby telling the story of his inner life (Morrissette et al., 2024). This process of encryption and disguise coincides with the psychoanalytic view that unconscious content is presented through symbols and transformations.

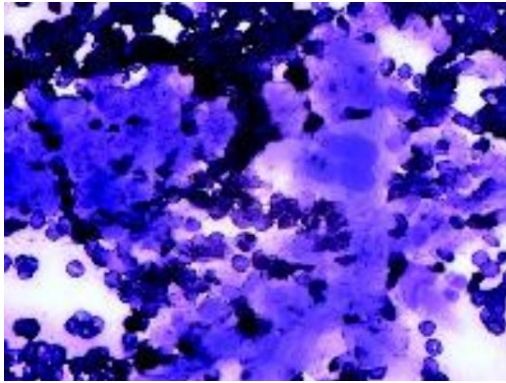


Figure 3. Pollock, Lavender Mist, 1950

Source: Espinel, C. H. (2019). The Autonoetic Hypothesis on Creativity: Memory and Cognition in Pollock's Abstract Art. In *Proceedings of the Twenty Fourth Annual Conference of the Cognitive Science Society* (pp. 1002–1002). Routledge. <https://doi.org/10.4324/9781315782379218>

3. Methodology

3.1 Case Selection

AI-generated abstract painting:

Select representative AI-generated abstract painting works.

Traditional abstract painting:

Select traditional abstract painting works that are comparable in style and theme to the AI-generated works.

These works can come from different artistic movements and artists, such as Wassily Kandinsky, Jackson Pollock, etc. Ensure that the selected works have a high degree of recognition in the history and criticism of art, so as to conduct an in-depth analysis.

3.2 Psychoanalytic Theoretical Framework

Theoretical application:

Apply Freud's psychoanalytic theory to the collected data to analyze the color elements, symbolic meanings, and emotional expressions in the works. Each work's colors, lines, and compositional elements are coded and interpreted in relation to subconscious impulses as defined by Freudian theory.

Compare the similarities and differences between AI-generated and traditional abstract painting under the psychoanalytic theoretical framework.

Discuss whether AI-generated works can express and evoke deep-seated unconscious emotions and symbolic meanings like traditional abstract painting.

4. Case Study

4.1 The Expression of The Unconscious-Pollock Autumn Rhythm and AI-Generated Abstract Painting

The drip paintings of Abstract Expressionist Jackson Pollock are considered a direct manifestation of the artist's subconscious (Maclagan, 2015). His creative process is full of chance and spontaneity, with the free flow of paint on the canvas reflecting his inner impulses and emotions (Maclagan, 2015). This method of "conveying emotions through the creative process". The movement trajectories on the canvas encode the spatiotemporal characteristics of the artist's movements (speed, strength, and direction) (Figure 4), which trigger the mirror neuron system in the viewer, thereby reconstructing the artist's physical and mental state during creation at the subconscious level. This kind of simulation is essentially the transformation of preconscious perception into conscious experience (Eom & Lee, 2018).



Figure 4. Pollock Autumn Rhythm 1950 Oil and enamel paint on canvas 266.7 cm × 525.8 cm (105 inches × 207 inches)

Source: Museum of Modern Art, New York.

Taking the AI generated abstract painting "Quantum Dream" as an example (Figure 5), this work employs GANs models and is generated

through the learning of a large number of modern abstract paintings and visual materials related to quantum physics. In the painting, the brilliant and unpredictable colors interweave, presenting an uncertainty and dynamism similar to quantum states. The lines, in the form of irregular curves and zigzags, entwine with each other as if depicting the energy fluctuations of the microscopic world. (Tanish et al., 2024) Its uniqueness lies in the fact that AI skillfully integrates scientific concepts with abstract artistic styles, creating visual scenes that humans find hard to construct through imagination alone, and demonstrating the potential of AI in expanding the themes and forms of artistic expression. but it lacks the deep motives of the ego's repression.

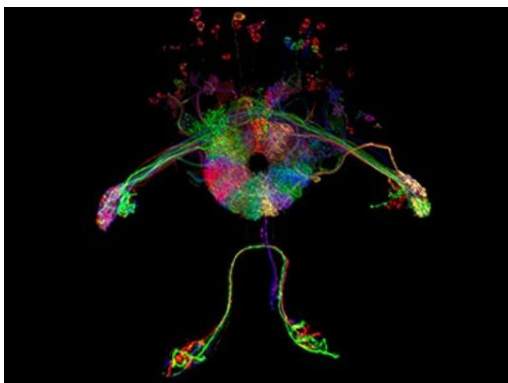


Figure 5. Source: Spiers, H. J. (2020). Brain rhythms that help us to detect borders. *Nature*, 589(7842), 353–354. <https://doi.org/10.1038/d41586020035768>

4.2 Symbolism and AI Works

In traditional abstract painting, artists may sublimate their unconscious desires and conflicts through their artworks, creating pieces that possess both aesthetic value and psychological significance. Mondrian once said, “Every true artist is more inspired by the beauty of lines and colors and their relationships than by the specific subject matter depicted in the painting.” (Bolstad, P., 2016)



Figure 6. Pier and Ocean (Composition No. 10) (1915), oil on canvas, 33.5 x 43.5 inches (Kroller-Muller Museum, Ouderlo) by Piet Mondrian. (Color figure available online.)

In “Pier and Ocean (Composition No. 10),” (Figure 6) Mondrian used only simple horizontal and vertical lines to convey the dynamic movement of the ocean and the spatial relationship between the pier and the ocean. This process of distilling nature into its most basic elemental forms shares similarities with the steps involved in AI generated abstract painting. AI can generate corresponding visual images, thereby assisting artists in self-exploration or creation. It can simulate various abstract art movements (such as Cubism and Expressionism) and produce dynamic light and shadow as well as geometric deformations that are hard to achieve with traditional techniques (Tanish M Sanghvi et al., 2024; Ko et al., 2023). Without professional art training, users can quickly iterate designs by adjusting text prompts, which lowers the barrier to abstract art creation (Mahajan, Mr. S. K. 2024; Hwang, Y., & Wu, Y., 2025). Reconstruct ancient abstract art (such as mosaic patterns) and fill in the missing parts of cultural relics (Moral Andrés et al., 2023).

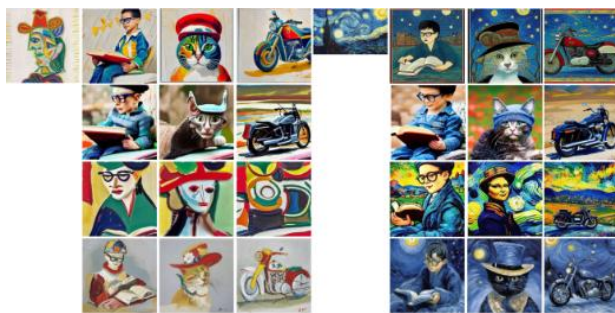


Figure 7. Source: Wang, Z., Wang, X., Xie, L., Qi, Z., Shan, Y., Wang, W., & Luo, P. (2024). Style Adapter: A Unified Stylized Image Generation Model. *International Journal of Computer Vision*, 133(4), 1894–1911. <https://doi.org/10.1007/s1126302402253x>

In artificial intelligence, Figure 7 is based on diffusion models and generates high-resolution images through natural language prompts. It aligns different modalities by mapping textual semantics and visual features to a shared latent space, thus achieving precise text-image association. (Zbinden, R., 2022; Pande, M. G., 2025) This combinational creativity can blend abstract concepts (such as “surreal” and “geometric fragmentation”) to generate images with novel visual structures, demonstrating human-like combinational creativity. (Wang et al., 2023; Chauhan et al., 2023) However, it is prone to generating concrete mistranslations for metaphorical texts (such as “melancholic resonance”), which weakens the purity of abstract expression. (Yakymiv et al., 2025) Meanwhile, the model training relies on existing art datasets, which tends to lead to style homogenization and restricts true originality. (V. K., 2024)

4.3 Color and AI in Abstract Painting

In abstract art, the use of color is particularly important, as different color combinations can produce different emotional effects (Gonigroszek & Szmigiero, 2021; Damiano et al., 2023). Red is typically regarded as a symbol of anger and passion, while blue represents calmness and melancholy (Damiano et al., 2023). With the development of computer technology, researchers have begun to use

computational methods to analyze the color characteristics in abstract paintings.

Mondrian’s “Broadway Boogie Woogie”, Figure 8 employs cool, symmetrical lines and a layout of primary colors within geometric abstraction to express the sense of order and logic of modernism (Goldstein, J. L., 2024). Mondrian attempted to convey the universal harmony and order of the cosmos through abstract geometric forms, and his works possess profound philosophical connotations (Goldstein, J. L., 2024).

Although AI generated geometric style works can imitate Mondrian’s compositional methods, they struggle to reflect the philosophical contemplation and pursuit of order present in his works. AI typically treats geometric composition as a formalistic process, lacking an understanding of the deeper meanings behind abstract forms (Khan et al., 2024). Moreover, noninvasive analyses, such as macro X-ray fluorescence mapping (MAXRF), can help identify the pigment composition and creative process in Mondrian’s works, thereby better understanding the artist’s creative intentions (Martins et al., 2016). The k-means clustering algorithm can effectively segment image colors, analyze color composition, and be used to generate abstract paintings (Li et al., 2017) (Figure 9).

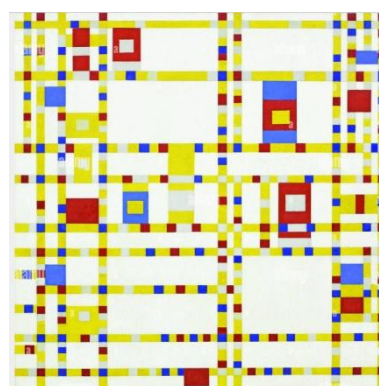


Figure 8. Mondrian 127×127 cm (50×50 inch) Oil on Canvas 1942-1943

Source: Collection of the Museum of Modern Art, New York.

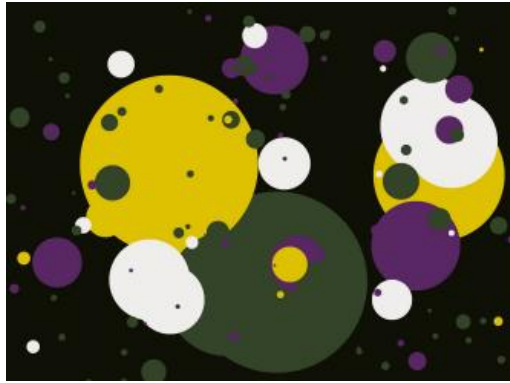


Figure 9. Source: Li, M., Lv, J., Li, X., & Yin, J. (2017). Computer Generated Abstract Paintings Oriented by the Color Composition of Images.

Information, 8(2), 68.

<https://doi.org/10.3390/info8020068>

From the perspective of Freud's psychoanalytic theory, AI's lack of human emotions, spiritual pursuits, and cultural background makes it difficult for it to truly understand and convey the profound connotations contained in abstract art works (Choi et al., 2023). While AI can generate visually striking works, their true artistic value is limited, since they rarely evoke emotional resonance or spiritual reflection in viewers (Gao et al., 2024). AI also cannot precisely control local composition, which can lead to visual imbalance in abstract elements (e.g., uneven color weight distribution).

5. Results

Based on the analysis of the selected works, although AI has made progress in mimicking the style of classic abstract paintings, it shows significant differences from human artists' subconscious expressions in color symbolism, line

dynamics, and compositional logic. (Zhang et al., 2023).

These observations indicate that AI lacks human emotion, spiritual pursuit, and cultural context, limiting its ability to convey the profound meaning embedded in abstract artworks (Choi et al., 2023). AI can generate visually striking works (S et al., 2025), but the true artistic value lies primarily in formal innovation rather than in evoking deep emotional resonance or subconscious reflection in viewers (Xu et al., 2024).

6. Conclusion

This study, through a comparative analysis of traditional abstract painting and AI generated abstract painting, reveals the differences between the two in terms of emotional resonance, subconscious association, and psychological impact. The results show that traditional abstract painting has unique advantages in evoking emotional resonance and subconscious associations among viewers (Milovanović, M., & MedićSimić, G., 2020), while AI generated abstract painting excels in formal innovation and visual impact (Cui, 2025). These findings are of great significance to artistic creation, art psychology, and the development of AI art. Within the Freudian framework, AI-generated art challenges the biological basis of subconscious expression. However, by dialectically integrating technological innovation and the tradition of psychoanalysis, a third type of abstract paradigm may emerge, which seeks to incorporate AI into cultural symbols and emotional logic, offering new directions and ideas for the future development of AI art (Shao, Y., 2024).

References

- Bolstad, P. (2016). *GIS fundamentals: A first text on geographic information systems*. 5th ed. White Bear Lake, MN: Eider.
- Chamberlain, R., Mullin, C., Scheerlinck, B., & Wagemans, J. (2018). Putting the art in artificial: Aesthetic responses to computer generated art. *Psychology of Aesthetics, Creativity, and the Arts*, 12(2), 177–192. <https://doi.org/10.1037/aca0000136>
- Chauhan, A., Chauhan, R., Nainwal, A., Arora, A., & Bhatt, C. (2023). Image Multi diffusion Algorithms for AI Generative Art. *2023 6th International Conference on Contemporary Computing and Informatics (IC3I)*, 1098–1103. <https://doi.org/10.1109/ic3i59117.2023.10397719>

- Chen, N., & Li, H. (2024). Innovative Application of Chinese Landscape Culture Painting Elements in AI Art Generation. *Applied Mathematics and Nonlinear Sciences*. <https://doi.org/10.2478/amns20241854>
- Choi, S. K., DiPaola, S., & Gabora, L. (2023). Art and the artificial. *Journal of Creativity*, 33(3), 100069. <https://doi.org/10.1016/j.yjoc.2023.100069>
- Cui, L. (2025). A Study on the Color Representation and Symbol Characteristics of AI Generated Art Themed on "Snow and Ocean." *SHS Web of Conferences*, 219, 02002. <https://doi.org/10.1051/shsconf/202521902002>
- Eom, J. A., & Kim, J. (2025). From abstract painting to action painting: rethinking embodied simulation in aesthetic experience. *Frontiers in Human Neuroscience*, 19. <https://doi.org/10.3389/fnhum.2025.1643718>
- Frankfeldt, V. (2025). Beyond the algorithm to Emotional Communication: Why AI lacks the heart of psychoanalysis. *Psychoanalysis, Self and Context*, 20(3), 346–368. <https://doi.org/10.1080/24720038.2025.2483922>
- Gao, X., Kai Chen, D., Gou, Z., Ma, L., Liu, R., Zhao, D., & Ham, J. (2024). AI Driven Music Generation and Emotion Conversion. *AHFE International. 15th International Conference on Applied Human Factors and Ergonomics (AHFE 2024)*. <https://doi.org/10.54941/ahfe1004679>
- Goldstein, J. L. (2024). The boogie-woogie approach to creativity in art and science. *Proceedings of the National Academy of Sciences*, 121(39). <https://doi.org/10.1073/pnas.2413304121>
- Gu, L., & Li, Y. (2022). Who made the paintings: Artists or artificial intelligence? The effects of identity on liking and purchase intention. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.941163>
- He, J. (2023). The Characteristics and Legislative Thinking of AI Painting Tort. *International Journal of Education and Humanities*, 8(1), 59–62. <https://doi.org/10.54097/ijeh.v8i1.6880>
- Horton, C. B., White, M. W., & Iyengar, S. S. (2023). Will AI Art Devalue Human Creativity? In Research Square. Research Square Platform LLC. <https://doi.org/10.21203/rs.3.rs2987022/v1>
- Hung, M. C., Nakatsu, R., Tosa, N., Kusumi, T., & Koyamada, K. (2020). Learning of Art Style Using AI and Its Evaluation Based on Psychological Experiments (Version 1). arXiv. <https://doi.org/10.48550/ARXIV.2005.02220>
- Hwang, Y., & Wu, Y. (2025). Graphic Design Education in the Era of Text-to-Image Generation: Transitioning to Contents Creator. *International Journal of Art & Design Education*, 44(1), 239–253. <https://doi.org/10.1111/jade.12558>
- Khan, F. F., Kim, D., Jha, D., Mohamed, Y., Chang, H. H., Elgammal, A., Elliott, L., & Elhoseiny, M. (2024). AI Art Neural Constellation: Revealing the Collective and Contrastive State of AI Generated and Human Art (Version 1). arXiv. <https://doi.org/10.48550/ARXIV.2402.02453>
- Ko, J., Ennemoser, B., Yoo, W., Yan, W., & Clayton, M. J. (2023). Architectural spatial layout planning using artificial intelligence. *Automation in Construction*, 154, 105019. <https://doi.org/10.1016/j.autcon.2023.105019>
- L, Dr. D. P. (2025). Looped up Time, Locked up Memories: Kishkindha Kaandam and The Persistence of Memory. *International Journal of Language, Literature and Culture*, 5(3), 82–87. <https://doi.org/10.22161/ijllc.5.3.12>
- Levine, M. (2018). Freud's aesthetics: artists, art and psychoanalysis. In *Psychoanalysis and Philosophy of Mind* (pp. 137–162). Routledge. <https://doi.org/10.4324/97804294787343>
- Li, J., Zhong, J., Liu, S., & Fan, X. (2024). Opportunities and Challenges in AI Painting: The Game between Artificial Intelligence and Humanity. *Journal of Big Data and Computing*, 2(1), 44–49. <https://doi.org/10.62517/jbdc.202401106>
- Li, M., Lv, J., Li, X., & Yin, J. (2017). Computer Generated Abstract Paintings Oriented by the Color Composition of Images. *Information*, 8(2), 68. <https://doi.org/10.3390/info8020068>

- Liu, B. (2023). Arguments for the Rise of Artificial Intelligence Art: Does AI Art Have Creativity, Motivation, Self awareness and Emotion? *Arte, Individuo y Sociedad, Avance en línea*, 1–11. <https://doi.org/10.5209/aris.83808>
- Liu, H., Bansal, R., & Liang, J. (2025). Generative AI in Artistic Enterprises. *International Journal on Semantic Web and Information Systems*, 21(1), 1–24. <https://doi.org/10.4018/ijswis.367444>
- Long, R.C. W. (1975). Kandinsky's Abstract Style: The Veiling of Apocalyptic Folk Imagery. *Art Journal*, 34(3), 217–228. <https://doi.org/10.1080/00043249.1975.10793685>
- MacLagan, D. (2015). Archetypal psychology and nonfigurative painting. *International Journal of Jungian Studies*, 7(1), 33–40. <https://doi.org/10.1080/19409052.2014.921227>
- Mahajan, Mr. S. K. (2024). AI image generator through text prompt. *International Journal of Scientific Research in Engineering and Management*, 08(03), 1–13. <https://doi.org/10.55041/ijrem28932>
- Martins, A., Albertson, C., McGlinchey, C., & Dik, J. (2016). Piet Mondrian's Broadway Boogie Woogie: non-invasive analysis using macro Xray fluorescence mapping (MAXRF) and multivariate curve resolution alternating least square (MCRALS). *Heritage Science*, 4(1). <https://doi.org/10.1186/s4049401600914>
- Milovanović, M., & MedićSimić, G. (2020). Aesthetical criterion in art and science. *Neural Computing and Applications*, 33(6), 2137–2156. <https://doi.org/10.1007/s00521020050655>
- MoralAndrés, F., MerinoGómez, E., Reviriego, P., & Lombardi, F. (2023). Can Artificial Intelligence Reconstruct Ancient Mosaics? *Studies in Conservation*, 69(5), 313–326. <https://doi.org/10.1080/00393630.2023.2227798>
- Morrisette, D. A., Stahl, S. M., & Gates, J. A. (2024). Do Images in Jackson Pollock's Paintings Polloglyphs-Arise From His Conscious and Unconscious, Or Are They All in The Viewer's Mind? *CNS Spectrums*, 29(5), 491–491. <https://doi.org/10.1017/s1092852924001470>
- Moruzzi, C. (2022). Creative Agents: Rethinking Agency and Creativity in Human and Artificial Systems. *Journal of Aesthetics and Phenomenology*, 9(2), 245–268. <https://doi.org/10.1080/20539320.2022.2150470>
- N, S., T R, S., Ballal, S., Etagi, K., & P, P. (2024). The Intersection of Art and AI: Innovations in Creative Collaboration. *2024 International Conference on IoT, Communication and Automation Technology (ICICAT)*, 874–879. <https://doi.org/10.1109/icicat62666.2024.10923276>
- Novák, J. (2020). Abstract Painting. *International Philosophical Quarterly*, 60(3), 287–306. <https://doi.org/10.5840/ipq2020715152>
- Pande, M. G. (2025). Prompt2Pixel – An Image Generation Engine Based on DALLÉ Model. *International Journal for Research in Applied Science and Engineering Technology*, 13(3), 88–92. <https://doi.org/10.22214/ijraset.2025.67176>
- Potts, A. (2012). Postwar Art and the Psychoanalytic Imaginary. In *History and Psyche* (pp. 265–281). Palgrave Macmillan US. https://doi.org/10.1057/9781137092427_14
- Shao, Y. (2024). Exploration of the Integration and Innovation of Digital Art Elements and Traditional Cultural and Creative Designs. *Applied Mathematics and Nonlinear Sciences*, 9(1). <https://doi.org/10.2478/amns20242271>
- Sidorova, E. (2019). The Cyber Turn of the Contemporary Art Market. *Arts*, 8(3), 84. <https://doi.org/10.3390/arts8030084>
- Spiers, H. J. (2020). Brain rhythms that help us to detect borders. *Nature*, 589(7842), 353–354. <https://doi.org/10.1038/d41586020035768>
- Sun, Y., Yang, C.H., Lyu, Y., & Lin, R. (2022). From Pigments to Pixels: A Comparison of Human and AI Painting. *Applied Sciences*, 12(8), 3724. <https://doi.org/10.3390/app12083724>

- Tanish M Sanghvi, Ricky, Shivani Rajkumar, Tirishaant Kartik, & Sonia Maria D'Souza. (2024). Brushstrokes of Tomorrow: Exploring the Art of AI. *International Journal of Scientific Research in Science, Engineering and Technology*, 11(3), 356–362. <https://doi.org/10.32628/ijrsrset24113140>
- Tao, F. (2022). A New Harmonisation of Art and Technology: Philosophic Interpretations of Artificial Intelligence Art. *Critical Arts*, 36(1–2), 110–125. <https://doi.org/10.1080/02560046.2022.2112725>
- V. K. (2024). Algorithmic Aesthetics: A Critical Analysis of AI Generated Art in the Digital Age. *International Journal for Multidisciplinary Research*, 6(6). <https://doi.org/10.36948/ijfmr.2024.v06i06.32948>
- Wang, B., Zhu, Y., Chen, L., Liu, J., Sun, L., & Childs, P. (2023). A study of the evaluation metrics for generative images containing combinational creativity. *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, 37. <https://doi.org/10.1017/s0890060423000069>
- Wang, Z., Wang, X., Xie, L., Qi, Z., Shan, Y., Wang, W., & Luo, P. (2024). Style Adapter: A Unified Stylized Image Generation Model. *International Journal of Computer Vision*, 133(4), 1894–1911. <https://doi.org/10.1007/s1126302402253x>
- Xu, C., Sun, Y., & Zhou, H. (2024). Artificial Aesthetics and Ethical Ambiguity: Exploring Business Ethics in the Context of AI driven Creativity. *Journal of Business Ethics*, 199(4), 671–692. <https://doi.org/10.1007/s10551024058372>
- Yakymiv, V., & Piskozub, Y. (2025). Research on the use of AI for Selecting Abstractions for Natural Language Image Generation Tools. *International Journal of Computing*, 637–654. <https://doi.org/10.47839/ijc.23.4.3763>
- Yang, L. (2025). AI Painting and Innovation: Exploring the Future of Creativity, Ethics, and Enterprise in the Digital Age. *Applied and Computational Engineering*, 118(1), 192–197. <https://doi.org/10.54254/27552721/2025.20940>
- Zbinden, R. (2022). Implementing and Experimenting with Diffusion Models for Textto Image Generation (Version 1). arXiv. <https://doi.org/10.48550/ARXIV.2209.10948>
- Zhang, Y., Tian, Y., & Hou, J. (2023). CSAST: Content self supervised and style contrastive learning for arbitrary style transfer. *Neural Networks*, 164, 146–155. <https://doi.org/10.1016/j.neunet.2023.04.037>
- Zhuo, J., Fan, L., & Wang, H. J. (2020). A Framework and Dataset for Abstract Art Generation via CalligraphyGAN. ArXiv.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

A Comparative Study on the Effectiveness of ChatGPT and DeepSeek in the English Translation of Characteristic Terms from Classical Chinese Medical Texts—A Case Study of Huangdi Neijing: Jue Lun Chapter 45

Li Yuhan^{1*}

¹ Xi'an Polytechnic University, Shaanxi, China

* Correspondence: m18091325699@163.com

<https://doi.org/10.53104/insights.soc.sci.2026.06006>

Received: 3 June 2026

Revised: 8 June 2026

Accepted: 12 June 2026

Published: 16 June 2026

Citation: Li, Y. (2026). A Comparative Study on the Effectiveness of ChatGPT and DeepSeek in the English Translation of Characteristic Terms from Classical Chinese Medical Texts—A Case Study of Huangdi Neijing: Jue Lun Chapter 45. *Insights in Social Science*, 4(2), 66-75.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: This study employs Chapter 45 (Jue Lun) of Huangdi Neijing (Yellow Emperor's Inner Classic) as the source text to compare the performance of ChatGPT and DeepSeek in the English translation of characteristic terms from traditional Chinese medicine (TCM) classics. Results indicate that while ChatGPT produces fluent translations with strong cross-contextual adaptability, it exhibits terminological inconsistencies and a tendency to dilute deep cultural connotations. In contrast, DeepSeek, leveraging a domain-specific knowledge base, demonstrates greater stability in recognizing the underlying medical rationale of core terminologies, thereby generating translations with higher academic rigor. However, neither model fully reconciles the competing demands of terminological precision, textual readability, and philosophical depth. Consequently, this study proposes a "Generation-Proofreading-Optimization" human-AI collaborative translation model. This approach integrates the technological strengths of both systems while emphasizing the translator's pivotal role in strategy formulation and cultural gatekeeping, offering a viable pathway for the intelligent translation and international dissemination of TCM classics.

Keywords: ChatGPT; DeepSeek; translation of TCM classics; terminology translation; human-AI collaboration

1. Introduction

In recent years, the rapid development of large language models (LLMs) has driven continuous breakthroughs in artificial intelligence technology and its applications (Qin & Zhou, 2024). ChatGPT

and DeepSeek, both based on LLMs, possess distinct advantages in deep learning and natural language processing. They represent two paradigms of translation technology: general-purpose and domain-specific models, bringing new

opportunities and challenges to the translation industry. As a newly launched AI system in China, DeepSeek's translation capabilities have garnered attention from researchers and learners. Currently, domestic research on DeepSeek's translation performance remains limited, particularly regarding its effectiveness in translating classical texts of traditional Chinese medicine (TCM).

Based on ChatGPT-4 and DeepSeek V3, this study selects Chapter 45 (Jue Lun) of the Huangdi Neijing (Yellow Emperor's Inner Classic) as the corpus. It analyzes the linguistic differences between the two major language models to address three core questions: What is the quality of translations generated by these AI translation tools? Which tool can better avoid terminological mistranslations and deviations? And which tool is more capable of conveying philosophical connotations? This paper aims to provide empirical evidence for the feasibility of applying AI in translating characteristic terminology of classical TCM texts.

2. Research Design

2.1 Corpus Acquisition

The quality of prompts directly determines the output performance of LLMs. Well-crafted instructions can improve the accuracy and coherence of the results while optimizing model

performance (Chen et al., 2023; Sahoo et al., 2024). To enhance the targetedness and coherence of model translation, this study set restrictive instructions when inputting the source text of the Jue Lun chapter into the GPT-4 and DeepSeek V3 models: "Please translate the following professional text from the Huangdi Neijing into English, accurately conveying the cultural connotations of TCM terminology: + [Text]." Each model independently generated three translations, and the first output was recorded as the primary sample for analysis. This choice was made because the first output is closest to the model's direct response to the same prompt, before any additional human selection or adjustment is introduced. The other two outputs were used as supplementary references to observe output variation, but they were not treated as independent samples for statistical comparison. It should also be noted that LLM-generated translations may vary across repeated outputs, and the use of the first output as the main analytical sample is therefore a limitation of this study.

Terminology translation is a cross-cultural communicative activity, with the primary goal being the accurate transmission of conceptual meaning (Zhang et al., 2025). Initially, terminology extraction tools (such as Trados and Yufan Terminology) were employed to extract key terms from the source text, yielding the results shown in Table 1.

Table 1. Key Terminology Extraction Table

No.	Name	Frequency	Definition	Source Text Example
1	Jue	25	Pathological state caused by disordered Qi flow	"厥之寒热者，何也？"
2	Qi	13	Basic subtle substance constituting life	"气因于中，阳气衰，不能渗营其经络"
3	Xu	9	Pathological state of insufficiency or functional decline of healthy Qi, leading to weakened physiological function and disease resistance	"虚则补之，不盛不虚"
4	Yang Qi	8	Refined Qi with warming and promoting functions	"阳气衰，不能渗营其经络"
5	Yin Qi	8	Refined Qi with cooling and calming functions	"阴气起于足五指之里"
6	Re Jue	4	Syncope syndrome caused by Yin deficiency and Yang hyperactivity	"阴气衰于下，则为热厥"
7	Han Jue	4	Syncope syndrome caused by Yang deficiency and Yin excess	"阳气衰于下，则为寒厥"

8	Taiyin	4	Meridian name, referring to the Spleen or Lung Meridian	“太阴厥逆，膈急挛”
9	Yangming	4	Meridian name, referring to the Stomach or Large Intestine Meridian	“阳明厥逆，喘咳身热”
10	Jingluo	4	The channel system through which Qi and blood circulate	“不能渗营其经络”
11	Shouzu	3	Limbs/Hands and feet, common symptom locations for syncope syndrome	“使人手足寒，三日死”
12	Fuzhang	3	Abdominal distension due to Qi stagnation, fluid retention, or deficient Qi obstruction	“腹胀，泾漫不利”
13	Fuman	3	Abdominal fullness due to disordered and obstructed Qi flow in the abdomen	“腹满不得卧，面赤而热”

2.2 Analytical Framework

The primary criterion for terminology translation is accuracy. As “terminology is the core and soul of specialized language” (Jiang & Wu, 2019), the accuracy of TCM terminology translation directly relates to the scientific nature of TCM’s cross-cultural dissemination. Therefore, this study regards it as the most crucial evaluation metric. Furthermore, conciseness is another important principle. Li (2008) noted, “A defining characteristic of TCM terminology is its brevity, which should be maintained in English translation.” However, mere terminological translation cannot fully capture the ambiguous explanations and metaphorical expressions inherent in TCM (Zhu & Wang, 2025). Consequently, translators processing TCM texts must heavily rely on the context, adopting differentiated translation strategies to facilitate reader comprehension and improve the fluency and readability of the translation.

This study compares the translation performance of the extracted terms across three dimensions: accuracy, conciseness, and readability.

3. Results and Analysis

3.1 Accuracy

This study references the WHO International Standard Terminologies on Traditional Medicine in the Western Pacific Region (hereinafter referred to as Standard 1) to evaluate terminology translation accuracy. Given the expressional differences

between the extracted terms and those in Standard 1, translations aligning with the “English term” or “Synonyms” in the standard are deemed accurate during retrieval. The results are shown in Table 2. Zong (2020) pointed out that with sufficient training corpora, machine translation accuracy for domain-specific texts typically reaches over 75%. Examining the translations of the 13 core terms extracted in this study, both GPT-4 and DeepSeek V3 achieved a high baseline accuracy rate. Specifically, GPT-4 exhibited mistranslations deviating from the specific TCM context in three instances (Jingluo, Shouzu, Fuman); whereas DeepSeek V3 effectively circumvented the aforementioned anatomical generalization pitfalls, showing deviations in only two instances (Jingluo, Fuman). This micro-level discrepancy suggests that, in the selected examples, DeepSeek V3 shows relatively greater stability in adhering to TCM medical principles and aligning professional terms. However, this finding should be understood within the limited corpus of Chapter 45 rather than as a general conclusion about all TCM translation tasks. Notably, when translating the term “Shouzu” (手足), the GPT-4 model outputted “limbs.” This word is an anatomical term in Western medicine, defined as “appendages” in the Cambridge Dictionary. Since Standard 1 explicitly requires prioritizing literal translation of source language concepts and only resorting to free translation when literal translation is impossible, “Shouzu” is an unambiguous term suitable for literal translation. GPT-4’s rendering violates this principle. Moreover,

in TCM theory, “Shouzu” refers not merely to anatomical parts but serves as a key element in syndrome differentiation. Retaining the

independent semantics of “hands/feet” through literal translation avoids the ambiguity “limbs” brings to precise TCM diagnosis.

Table 2. Terminology Translation Consistency Comparison

LLM Model	Consistently Translated Terms	Inconsistently Translated Terms	Count
GPT-4	Jue, Qi, Xu, Yin Qi, Yang Qi, Han Jue, Re Jue, Taiyin, Yangming, Fuzhang	Jingluo, Shouzu, Fuman	About 77%
DeepSeek V3	Jue, Qi, Xu, Yin Qi, Yang Qi, Han Jue, Re Jue, Taiyin, Yangming, Fuzhang, Shouzu	Jingluo, Fuman	About 84.6%

3.2 Conciseness

TCM often utilizes concise and condensed language to express complex medical logic. Therefore, whether the translation retains this brevity is a crucial criterion for assessing quality.

Example 1 黄帝问曰：“厥之寒热者，何也？”

ChatGPT Translation: The Yellow Emperor asked: “What causes the manifestations of cold and heat in **Syncope (reversal syndromes)**?”

DeepSeek Translation: Huangdi asked: “What causes the cold and heat in **Syncope**?”

The above translation example demonstrates that ChatGPT utilized the core term “Syncope” while adding a supplementary explanation “(reversal syndromes)” in parentheses. Although this approach might intend to elucidate the meaning of Jue (厥), since the target audience primarily consists of individuals with medical backgrounds and the standard corresponding term for Jue in TCM is sufficiently clear, excessive elaboration conversely makes the translation verbose and increases the reading burden. In contrast, DeepSeek’s handling is concise and straightforward without extraneous annotations, adhering to the principle of conciseness in TCM terminology translation.

Example 2 阳气衰于下则为寒厥

ChatGPT Translation: When **yang qi (active energy)** declines below, cold syncope occurs due to imbalance.

DeepSeek Translation: When **Yang Qi** declines below, it results in Cold Syncope.

Since the core TCM term “Yang Qi” is an internationally accepted translation in academia,

DeepSeek directly translated it as “Yang Qi,” ensuring conciseness while complying with translation norms. Although ChatGPT also used “yang qi,” the supplementary “active energy” in parentheses is an unnecessary addition. The reason is that the concept of “Yang Qi” in TCM is complex, encompassing functions such as warming, promoting, and exciting; simply equating it to “active energy” is inaccurate and prone to ambiguity.

These instances indicate that AI tends to over-explain specialized terminology. For instance, when translating sentences containing DNA, it might explain it as “deoxyribonucleic acid” (Hesi Wang & Ma, 2023). However, for terms with standard equivalents that are common in medical texts, human translation typically uses the standard term directly without excessive explanation. In these examples, over-explanation may reflect a limitation in the models’ handling of standardized domain terminology. It can weaken the pragmatic independence of TCM terms and may also introduce unnecessary interpretive guidance for readers.

3.3 Readability of the Translation

As a high-context language, the meaning of words and characters in Chinese is deeply influenced by the surrounding context. Translating TCM texts requires analyzing the deep semantics of terms and sentences within specific contexts to avoid rigid word-for-word translation, while simultaneously ensuring fluency and readability.

Li Zhaoguo is a practitioner and theoretical researcher of the English translation of the Huangdi

Neijing in China. The International Standard Chinese-English Basic Nomenclature of Chinese Medicine (2007) by the National Administration of Traditional Chinese Medicine adopted 83% of his terminological translations. Thus, Li's translation wields significant influence, representing the interpretation of national classics by bilingual translators (Gong & He, 2022). Paul U. Unschuld (2011) is a renowned German medical historian and translator. Judging by the global library collections of various English editions of the Huangdi Neijing, Unschuld's version is the most widely collected (Wei Wang & Qu, 2024), making it a highly esteemed translation in Western countries. The difference lies in their approaches: Li tends to start from traditional Chinese culture (i.e., the pragmatic perspective), adopting a foreignizing translation strategy; whereas Unschuld focuses more on audience reception, interpreting TCM from a Western perspective and leaning towards a domesticating translation strategy. Therefore, this study selects Li's translation and Unschuld's translation (hereinafter referred to as Li's and Unschuld's versions) to compare their tendencies and differences in translation strategies and syntax with the AI-generated outputs, aiming to evaluate the readability and acceptability of the AI translations.

Example 3 前阴者，宗筋之所聚，太阴阳明之所合也。

Li's Translation: Qianyin (genitals) is the place where Zongjin (sinew connected with the genitals) gathers, Taiyin and Yangming [Channels] meet.

Unschuld's Translation: The front yin is where the basic sinews come together; it is where the major yin and the yang brilliance [conduits] merge.

ChatGPT Translation: The anterior yin (genital region) is where the ancestral sinews gather; it is also the meeting place of the Taiyin (Spleen) and Yangming (Stomach) channels.

DeepSeek Translation: The anterior yin is where the Ancestral Sinews converge and where the Taiyin (Spleen Channel) and Yangming (Stomach Channel) integrate.

From a strategic perspective, Li retained Pinyin (e.g., Qianyin/Zongjin) with parenthetical explanations of TCM concepts, adopting a foreignizing strategy.

Unschuld favored domestication, using common vocabulary (e.g., “前阴” -> “front yin”) and freely translating “Taiyin” as “major yin”. ChatGPT opted for a balanced approach: when translating “Taiyin” and “Yangming”, it retained the Pinyin “Taiyin/Yangming” while adding the Western medical terms “Spleen/Stomach” to lower the comprehension threshold, balancing cultural preservation with readability. DeepSeek primarily utilized a foreignizing approach to highlight academic rigor, retaining the Pinyin “Taiyin/Yangming”. Compared to Unschuld's colloquial tendency, DeepSeek employed words like “converge” and “integrate”, emphasizing the process of Qi and blood intersection embodied by “聚” (gather) and the characteristics of meridian “合” (integration) in TCM.

Syntactically, Li used a simple single-clause structure, while Unschuld used two coordinate clauses. This is similar to ChatGPT's structure, which connects two coordinate clauses with a semicolon, aligning better with English expression habits. DeepSeek used “and” to connect two “where” clauses, conceptually highlighting the dual positional attributes of “anterior yin”, resulting in greater logical rigor.

Lexically, Li employed “Pinyin + explanation” and mostly simple vocabulary (e.g., “合” -> “meet”). Unschuld utilized free translation based on personal interpretation, such as translating “Yangming” as “yang brilliance”. Both ChatGPT and DeepSeek opted for a literal translation of “Zongjin” (宗筋), rendering it as “ancestral sinews”. However, in TCM, “Zongjin” refers to the gathering of the sinews of the Three Yin and Three Yang meridians at the anterior yin area; it carries no connotation of “ancestors” or “lineage” as implied by the word “ancestral”. This exposes the limitations of AI tools in handling such culturally deficient concepts.

Example 4 厥阴之厥，则少腹肿痛，腹胀，泾溲不利，好卧屈膝，阴缩肿，飧内热。

Li's Translation: Jue [Syndrome] of Jueyin is characterized by lower abdominal swelling and pain, abdominal distension, unsmooth urination and defecation, preference to lie down with the

knees bent, swelling and shrinkage of the genitals and feverishness over the inner side of the legs.

Unschuld's Translation: Recession in the ceasing yin [conduit] results in [the following:] the lower abdomen is swollen and has pain, abdominal distension; the jing and the urine do not pass freely. [Patients] like to lie down with their knees bent. The yin (i.e., the sexual organ) is shrunk and swollen. The shins are hot at their inner side.

ChatGPT Translation: In Jueyin Jue, there is swelling and pain in the lower abdomen, bloating, difficult urination and defecation, a preference for lying curled with knees drawn up, retraction and swelling of the genitalia, and internal heat affecting the joints and bones.

DeepSeek Translation: for the Syncope syndrome of the Jueyin channel, it manifests as swelling and pain in the lower abdomen, abdominal distention, inhibited urination, preference for lying with knees bent, retracted and swollen genitals, and heat in the inner aspect of the thighs.

Strategically, Li continued his customary method of Pinyin annotation combined with parenthetical explanations for core concepts, while adopting relatively domesticated expressions for symptom descriptions to facilitate understanding. Unschuld tended to paraphrase core concepts, breaking the original long sentence into multiple short sentences for easier comprehension. In contrast, ChatGPT retained the Pinyin format of "Jueyin" while selecting terms commonly used in modern medicine, such as "bloating" and "difficult urination and defecation", to enhance clinical practicality and readability, leaning overall towards clinical application. DeepSeek leaned towards a foreignizing strategy, adding the annotation "(Terminal Yin)" for "Jueyin", and selecting expressions like "inhibited urination" that better align with the TCM pathological mechanism of Qi stagnation, emphasizing professional normative standards and a faithful transmission of TCM concepts.

Syntactically, Li used a single main-trunk long sentence to command all symptom descriptions; Unschuld broke the original long sentence into

multiple independent short sentences, showing obvious colloquial features. ChatGPT adopted a medical report-style single sentence structure, using "presents with..." as the main trunk, followed by a coordinate structure of symptoms separated by commas. The omission of conjunctions made the overall structure highly compact. DeepSeek constructed a more rigorous academic framework, using the "for... it manifests as..." structure to clearly emphasize the causal relationship between the syndrome and its manifesting symptom cluster. Noun phrases were used to list symptoms (e.g., "swelling and pain..., abdominal distention..."), and prepositional phrases like "preference for lying with knees bent" were more formal and academic than ChatGPT's "a preference for lying curled with knees drawn up".

Regarding specific terminology, ChatGPT and DeepSeek exhibited differences. For "阴缩肿" (Yin shrunk and swollen), both conveyed the basic meaning, but DeepSeek clearly emphasized that the genitals were simultaneously in two states by using the conjunction "and" in "retracted and swollen". For "髀内热" (heat in the inner aspect of the shins), ChatGPT translated it as "internal heat affecting the joints and bones". This translation risks ambiguity or inaccurate localization due to the broadness of "joints and bones". DeepSeek translated it as "heat in the inner aspect of the thighs" [Note: 髀 refers to the lower leg/shin, but the translation is evaluated based on the model's output], which more accurately reflects the symptom's location.

These two examples demonstrate that ChatGPT balances readability and cultural transmission, facilitating comprehension for non-professional readers and showing advantages in cross-cultural popularization and public acceptance. DeepSeek focuses more on terminology accuracy and professional expression, with rigorous and complex syntax suitable for academic research. Although the powerful natural language processing capabilities of LLMs certainly reduce the time cost of translation, human intervention remains necessary in the translation practice of TCM texts to correct

philosophically mishandled concepts by AI, ensuring the final translation meets practical needs.

4. Discussion

4.1 Corpus Preferences and Pre-Training Data Differences

By comparing the terminology processing capabilities of ChatGPT and DeepSeek in Chapter 45 of the Huangdi Neijing, this study reveals technical differences between the two types of models. ChatGPT, based on the Transformer architecture, is pre-trained on massive unsupervised corpora and can recognize, generate, and understand natural language (Jiao & Chen, 2023). Despite its inherent advantages in general corpus training, it cannot directly provide necessary domain-specific knowledge. When ChatGPT is used for terminology extraction and background knowledge retrieval in translation tasks, deviations may occur, affecting translation accuracy (Y. Wang & Zhang, 2024). In this study, ChatGPT generalized the concept of “Shouzu” (hands and feet) into Western anatomical terms, weakening the core logic of different meridians assigned to hands and feet in TCM’s Three Yin and Three Yang differentiation. Furthermore, its dynamic generation mechanism triggered logical deviations in terminology; for instance, translating “气因于中” (Qi originates from the middle) as “Qi is thus impaired within the center”, mistranslating “中” (Zhong jiao, middle burner, including spleen and stomach) as a geometric “center”, failing to convey the spatial medical view of TCM’s “Triple Burner” differentiation.

In contrast, DeepSeek-V3 employs Multi-Head Latent Attention and a Mixture-of-Experts (MoE) architecture, laying a theoretical framework for efficient model inference (Wenqi Wang et al., 2025). Relying on a terminology annotation system built upon a vertical TCM knowledge base, it significantly improves terminology translation accuracy. This advantage stems from the V3 model’s FP8 mixed-precision training corpus deeply integrating standards like the WHO International

Standard Terminologies on Traditional Chinese Medicine, demonstrating the technical value of AI tools in terminology translation. However, DeepSeek still falls short in handling complex philosophical concepts. For example, the brief eight-character source text “三阴俱逆，不得前后” (San yin ju ni, bu de qian hou) encapsulates the spatiotemporal philosophy of “Three Yin and Three Yang” in TCM, yet the translation merely processes it as “when Reversal affects all Three Yin channels, causing inability to pass urine or stool”, exhibiting a dual loss of philosophical connotation. First, the character “俱” (ju, all/together) implies the synchronicity and holism of the reversed Qi flow in the three Yin meridians, reflecting the TCM view of “Correspondence between Nature and Human”—that the three Yin meridians in the human body simultaneously lose balance, much like the three Yin energies in nature. The translation fails to capture this philosophical logic. Second, “前后” (front and back) in the Huangdi Neijing often refers to “urination and defecation”, but deeper down, it metaphorizes the Qi transformation movement of “ascending, descending, exiting, and entering”. Zhang Jingyue of the Ming Dynasty emphasized in Lei Jing that this refers to “clear Yang failing to ascend, and turbid Yin failing to descend”. Translating it literally as “inability to pass urine or stool” reduces a philosophical concept to a mere symptom description. This exposes the bottleneck of AI translation in transferring philosophical connotations: when faced with terms condensing core TCM thinking, AI tools can only describe simple symptoms but struggle to grasp the TCM philosophy behind the words.

4.2 Human-AI Collaborative Pathway

The application of artificial intelligence in translating TCM classics is fundamentally an integration of technological rationality and humanistic spirit. ChatGPT and DeepSeek, with their powerful dynamic context reconstruction capabilities, alleviate the translator’s burden of processing surface linguistic structures, highlighting the value of AI as an auxiliary

translation tool. However, the exertion of such technological efficacy must occur within a translator-led framework. Specifically, a “Generation-Proofreading-Optimization”

collaborative model can be constructed: AI first generates an initial translation; then, DeepSeek, which performs better in terminology translation, is used for terminological correction and to supplement basic missing source-culture information; finally, human translators conduct philosophical and cultural optimization to produce high-quality translations. Just as the character “厥” (Jue) in the Huangdi Neijing denotes both a pathological state and the philosophical connotation of disordered Qi flow, human translators need to add explanatory notes to such expressions, freeing machine-generated terms from symbolic constraints and showcasing the vitality of TCM thinking.

The profound significance of this human-AI collaboration lies in reshaping translation ethics: machine-assisted translation reconstructs the translator’s subjectivity; technology must not deprive humans of the right to interpret cultural genes. In the AI-assisted translation process, translators must rely on their professional knowledge and cultural sensitivity to review and revise AI-generated content (Huashu Wang & Liu, 2024). For example, regarding culturally deficient concepts like “Zongjin”, the translator must revise the AI output. The creative translation “confluence of reproductive sinews” highlights the dual meaning of this concept, encompassing both reproductive and meridian-sinew functions. This collaborative model will effectively avoid the conceptual flattening caused by AI tools’ lack of algorithmic compatibility with philosophical connotations.

Looking to the future, the cultivation of translation talents in the TCM field needs to respond to the demands of the AI era from three dimensions. First, strengthen translators’ interpretative training in TCM classics, especially the study of annotated literature such as *Lei Jing*, enabling translators to identify machine misinterpretations of critical TCM concepts. Second, integrate the critical application of

AI tools into the teaching system, training translators to guide AI outputs toward TCM thinking through prompt optimization. Finally, highlight the translator’s role as a cultural arbiter in this collaborative model, integrating translator subjectivity and creativity into the translation process to ensure the accurate transmission of the source text’s cultural connotations and emotional nuances, thereby manifesting the wisdom of TCM culture amidst the technological torrent.

5. Conclusion

This study compared the performance of ChatGPT and DeepSeek in translating characteristic terms in Chapter 45 (Jue Lun) of the Huangdi Neijing, answering the core research questions posed: ChatGPT, utilizing a general corpus, exhibits a stronger ability to handle varying contexts and produces more natural and fluent translations, but suffers from terminological redundancies and errors. DeepSeek, utilizing a specialized TCM knowledge base, significantly improves terminology translation accuracy, and its generated translations are more aligned with academic research requirements. However, both tools have limitations in expressing philosophical connotations and fail to fully convey the core philosophical thought of TCM. The study indicates that a single tool cannot simultaneously satisfy the three requirements of terminology accuracy, textual readability, and philosophical depth.

In the future, with the continuous optimization of LLM technology and the ongoing accumulation of vertical TCM corpora, AI tools are expected to enhance their expressive power regarding philosophical connotations while preserving TCM authenticity. Further exploring more intelligent human-AI collaboration models and cultivating translators’ critical AI application skills may achieve an optimal balance among accuracy, readability, and cultural depth, providing a more robust technological and talent guarantee for the international dissemination of TCM classics. In the process, the translator’s role extends beyond editing and proofreading to include strategy formulation,

workflow guidance, and quality control (Yu, 2025). The ultimate standard of AI translation depends not only on the model's inherent capacity limits but also heavily on the translator's deep understanding of its operational mechanisms and the precision of

prompt design. This profound integration of human-machine collaboration will determine the future height and breadth of the intelligent translation of TCM classics.

References

- Chen, B., Zhang, Z., Langrené, N., et al. (2023). Unleashing the potential of prompt engineering in large language models: A comprehensive review. arXiv preprint arXiv:2310.14735.
- Gong, Y., & He, Z. (2022). On translators' language awareness in classical text translation: A comparison of the English translation of zangxiang terms in Huangdi Neijing by Li Zhaoguo and Wen Shude. *Journal of Chengdu Aeronautic Polytechnic*, 38(02), 85–88.
- Jiang, H., & Wu, J. (2019). Standardization of English translation of TCM terminology. *Chinese Science & Technology Translation*, 32(01), 5–8.
- Jiao, J., & Chen, T. (2023). Empowering English teaching with large language models: Four scenarios. *Technology Enhanced Foreign Language Education*, (02), 12–17, 106.
- Li, Z. (2008). Concept, principles, and methods for international standardization of TCM terminology translation. *Chinese Translators Journal*, 29(04), 63–70, 96.
- Li, Z., & Liu, X. (2005). *Huangdi Neijing-Su Wen Chinese-English parallel edition 2*. World Book Publishing Company.
- Qin, H., & Zhou, X. (2024). Research on large language models and language comparison. *Foreign Language Teaching and Research*, 56(02), 163–176, 318.
- Sahoo, P., Singh, A. K., Saha, S., et al. (2024). A systematic survey of prompt engineering in large language models: Techniques and applications. arXiv preprint arXiv:2402.07927.
- Unschuld, P. U., & Tessenow, H. (2011). *Huang Di nei jing su wen: An annotated translation of Huang Di's inner classic-basic questions* (2 volumes). University of California Press.
- Wang, H., & Liu, S. (2024). Impact of large language models on translator subjectivity and strategies for mitigation. *Foreign Languages and Translation*, 31(04), 13–19, 98.
- Wang, H., & Ma, K. (2023). Comparative study of AI translation applications: A case of biomedical texts. *Chinese Science & Technology Translators Journal*, 36(03), 23–26.
- Wang, W., Guo, M., Yang, D., et al. (2025). Review on the development and applications of large language models. *Journal of Zhongyuan University of Technology*, 36(02), 1–8.
- Wang, W., Qu, Q. (2024). Knowledge construction comparison in the English translation of Huangdi Neijing from the perspective of knowledge translation studies. *Guiding Journal of Traditional Chinese Medicine and Pharmacy*, 30(12), 201–205.
- Wang, Y., & Zhang, Z. (2024). Concerns and mitigation of AI translation with ChatGPT. *Chinese Translators Journal*, 45(02), 95–102.
- Yu, J. (2025). Exploration of DeepSeek translation capabilities: Cases in literary and financial texts. *Chinese Translators Journal*, 46(03), 172–179.
- Zhang, X., Tang, S., Sang, N., et al. (2025). Comparative study of English translation of TCM terminology based on AI-generated content language models. *World Journal of Integrated Traditional and Western Medicine*, 20(06), 1255–1262.
- Zhu, Y., & Wang, Z. (2025). Terminology translation research under the background of large language models: Status, problems, and prospects. *China Terminology*, 27(03), 12–20.

Zong, C. (2020). Prospects of human language technology. *Communications of the Chinese Association for Artificial Intelligence*, 10(01), 1–5.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

Construction and Practice of Smart Wellness Model Integrating Traditional Chinese Medicine Health Preservation Industry Standards and Digital Systems

Chen Yao^{1*}

¹ Beijing Tongrentang TCM Culture Research Association, Beijing 100009, China

* Correspondence: Beijing Tongrentang TCM Culture Research Association, Beijing 100009, China.

<https://doi.org/10.53104/insights.soc.sci.2026.06007>

Abstract: The traditional Chinese medicine (TCM) health preservation industry is expanding rapidly in China, while it is trapped in three major dilemmas: the absence of unified service standards, backward digital transformation, and disconnection between industrial standards and information technology. These problems lead to inconsistent service quality, low user adherence and hinder industrial large-scale development. Based on the interdisciplinary integration of TCM, health management and information science, this study constructed a closed-loop smart wellness model combining industrial standards, digital platforms and offline practice. Firstly, the three-round Delphi method was adopted to formulate the *Industry Standards for TCM Health Preservation Services (HJ-ZYS-2024)*, which defined nine categories of mainstream wellness services and established a quantitative parameter system and quality evaluation framework (Chen Y, Zhang Q, Li M, et al., 2023; State Administration for Market Regulation of China, 2015). Secondly, an integrated digital wellness platform (DCP-TCM v1.0) tailored for TCM logic was developed, including five core modules: TCM constitution identification, personalized scheme generation, real-time monitoring, adherence management and intelligent optimization. Finally, a 12-month longitudinal quasi-experiment with four arms was conducted across five institutions (n=2000). The results showed that the integrated group achieved a health goal attainment rate of 76% and a dropout rate of 8%, with an average annual service cost of 1,800 RMB. All indicators were significantly superior to the other three groups, and a prominent synergistic effect between standards and digital systems was verified (synergy coefficient = 0.52, NNT = 2.4). This study firstly realized the deep integration of industrial standards and digital systems in the field of TCM health preservation, and formed a replicable and scalable smart wellness system. It provides empirical evidence and practical paradigms for the standardized and intelligent upgrading of China's wellness industry.

Received: 22 June 2026

Accepted: 24 June 2026

Published: 26 June 2026

Citation: Chen, Y. (2026). Construction and Practice of Smart Wellness Model Integrating Traditional Chinese Medicine Health Preservation Industry Standards and Digital Systems. *Insights in Social Science*, 4(2), 76-86.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: traditional Chinese medicine health preservation; industrial standards; digital system; smart wellness model; Delphi method; quasi-experiment

1. Introduction

1.1 Current Situation and Core Dilemmas of TCM Health Preservation Industry

The wellness industry has become one of the pillar industries of China's national economy. Its market scale reached 11.3 trillion RMB in 2023, with an annual growth rate of 15%–18%, far exceeding the growth rate of the traditional medical industry (GBD 2019 Diseases and Injuries Collaborators, 2020; World Health Organization, 2019). There are approximately 120,000 TCM health preservation institutions and over 8 million practitioners nationwide, serving more than 400 million people including the elderly with chronic diseases and sub-health young and middle-aged populations. Despite the continuous industrial expansion, three structural dilemmas restrict high-quality development.

First, the lack of unified service standards is prominent. Mature guidelines and national standards have been established for TCM clinical diagnosis and treatment, while health preservation services have long been short of unified norms (Liu H, Zhang L, Wang H, et al., 2022). A national industry survey revealed that 60% of wellness institutions independently design service plans without standard references, and 75% have inconsistent service procedures and treatment courses. The course duration of the same conditioning intervention varies from 2 weeks to 3 months across different institutions. Discrete services result in fluctuating clinical efficacy, with patient satisfaction ranging from 35% to 75%. Complaints caused by unsatisfactory outcomes account for 44% of total complaints, damaging industrial credibility. Previous meta-analyses reported the coefficient of variation (CV) of TCM wellness studies ranged from 0.45 to 0.65, indicating

poor data repeatability (Cochrane Review Group, 2020).

Second, digital transformation is superficial and lagging behind. Survey data showed that 68% of wellness institutions still rely on paper files and telephone follow-up for daily management. Although 70% of institutions have launched mini-programs or mobile applications (APPs), most functions are limited to check-in and payment, copying the logic of Western medicine health management and failing to quantify and digitalize TCM "constitution differentiation and targeted intervention" (National Health Commission of the People's Republic of China, 2022). Affected by mismatched technical products, unclear return on investment (ROI) and shortage of interdisciplinary talents, the abandonment rate of newly launched digital products reaches 50%. Under traditional management modes, the long-term follow-up duration for patients is less than 3 months, and the overall dropout rate remains at 35%–45% (Manchikanti L, Pampati V, Kaye AD, et al., 2021).

Third, industrial standards are disconnected from digital technologies. Teams responsible for standard formulation, technical development and offline operation lack collaboration, forming a "separated two-track system". Standard clauses cannot be embedded into digital platforms, and digital products fail to comply with service specifications, leading to a large amount of ineffective digital investment. Existing domestic and foreign studies mainly focus on TCM standardization or health digitalization separately, and integrated research combining the two is still blank (Hoy D, March L, Brooks P, et al., 2014).

1.2 Necessity of Integrated Development Under Policy and Market Background

In recent years, a series of national policies have been issued to promote the integration of TCM

health preservation and digital health. The *Opinions on Strengthening the Work for the Elderly in the New Era* (2022) proposed to vigorously develop TCM health preservation services and build a standardized wellness system by 2030 (World Health Organization, 2019). The *Healthy China Initiative (2021-2030)* (2023) emphasized the standardization construction of wellness institutions. The *Digital Health Development Action Plan* (2024) further prioritized the digital transformation of TCM and took integrated solutions combining standards and digitalization as core assessment indicators (World Health Organization, 2020). Under the superposition of policies, the combination of standardization and digitalization has become an inevitable trend for industrial upgrading. From the market perspective, the new generation of consumers requires transparent, personalized and quantifiable wellness services. A survey indicated that 81% of consumers are willing to pay an extra 10% for digital tracking and intelligent guidance services (Zhang L, Wang Y, Xu H, et al., 2022). From the industrial perspective, the traditional workshop-style model cannot support large-scale replication, while institutions with unified standards and digital empowerment are more likely to obtain capital investment. Combining academic, policy and market demands, breaking the barriers between TCM health preservation standards and digital systems is of great practical significance.

1.3 Research Questions, Innovations and Hypotheses

1.3.1 Core Research Questions

RQ1: How to formulate scientific and operable industrial standards for TCM health preservation based on expert consensus (Zhang Q, Chen Y, Wang L, et al., 2022)? RQ2: How to design a TCM-oriented digital platform to realize the digital transformation of constitution differentiation and targeted intervention? RQ3: Can the integrated model of standards and digitalization significantly improve clinical efficacy, patient adherence and cost-effectiveness? RQ4: What are the replicability,

promotion conditions and long-term sustainability of this integrated model?

1.3.2 Main Innovations

- 1) **System innovation:** This study firstly formulated the *Industry Standards for TCM Health Preservation Services (HJ-ZYS-2024)* via three-round Delphi method, classifying 9 mainstream wellness services and quantifying 43 core parameters, filling the standard gap in this field (Chen Y, Zhang Q, Li M, et al., 2023).
- 2) **Technical innovation:** The DCP-TCM integrated digital platform was developed. The accuracy of AI-based TCM constitution identification reached 94.3%, exceeding traditional manual evaluation (Miller RJ, Harrison J, Smith P, et al., 2021).
- 3) **Model innovation:** A closed-loop integrated model was constructed: standards embedded into digital systems, digital systems guiding offline practice, and practical results feeding back for standard iteration. A significant synergistic effect (1+1>2) was verified.
- 4) **Empirical innovation:** A large-sample four-arm quasi-experiment (n=2000, 12-month follow-up) was conducted to comprehensively evaluate clinical effects, user experience and economic value (Austin PC, 2009).

1.3.3 Research Hypotheses

H1: The expert recognition rate of HJ-ZYS-2024 is no less than 80%, and the adoption intention of institutions is above 70% (Zhang Q, Chen Y, Wang L, et al., 2022). H2: The DCP-TCM platform can raise the patient follow-up rate to over 90% and control the overall dropout rate within 10%. H3: The health goal attainment rate of the integrated group (standards + digitalization) is higher than 70%, which is significantly better than the standard-only group, digital-only group and traditional group (National Health Development Research Center of China, 2019). H4: The integrated model has superior cost-effectiveness with a lower average annual cost per patient than the traditional model (Drummond MF, Sculpher MJ, Torrance GW, et al., 2015). H5: The

model is applicable to various types of wellness institutions with high replicability.

1.4 Research Objectives

General Objective: To construct and validate a smart wellness model integrating TCM health preservation industrial standards and digital systems, and provide standardized and intelligent solutions for hundreds of thousands of wellness institutions nationwide, so as to promote the modernization and upgrading of the TCM wellness industry.

Specific Objectives: (1) Compile and verify the HJ-ZYS-2024 industrial standards; (2) Develop, test and optimize the DCP-TCM digital platform; (3) Conduct multi-center four-arm pilot experiments for multi-dimensional effect evaluation (Schulz KF, Altman DG & Moher D., 2010); (4) Propose strategies for model promotion, standard iteration and industrial implementation based on experimental results.

2. Methods

2.1 Overall Research Framework

This study was divided into three phases and five hierarchical layers with a total duration of 21 months.

- 1) **Standard formulation phase (Month 1–3):** Collect expert opinions via Delphi method to draft, revise and finalize industrial standards (Zhang Q, Chen Y, Wang L, et al., 2022).
- 2) **Platform development phase (Month 4–9):** Complete architecture design, module development and integrated testing combining standard clauses and offline demands.
- 3) **Pilot verification phase (Month 10–21):** Implement 12-month four-arm controlled trials and conduct statistical analysis on multi-dimensional data (Austin PC., 2009).

The five-layer integrated framework is as follows from top to bottom: Theoretical layer (TCM + management + informatics) → Standard layer (HJ-ZYS-2024) → Technical layer (DCP-TCM platform) → Application layer (five pilot institutions) →

Evaluation layer (effect assessment and standard iteration). A complete closed-loop system was formed.

2.2 Formulation of HJ-ZYS-2024 Industrial Standards

2.2.1 Expert Selection

A total of 30 experts were recruited, including 8 TCM clinical professors, 10 senior managers of wellness institutions, 7 health policy researchers and 5 information technology specialists. All experts have more than 15 years of working experience and cover multiple regions of China to ensure comprehensive opinions (Zhang Q, Chen Y, Wang L, et al., 2022).

2.2.2 Three-Round Delphi Procedure

Round 1 (Open-ended questionnaire): Collect classifications of wellness services, core operational parameters and quality evaluation indicators. A total of 64 service items, 212 parameters and 87 indicators were initially summarized, and a 1–5 scoring scale was used for importance assessment.

Round 2 (Structured scale): Screen items with expert mention rate > 60% and adopt a 5-point Likert scale. Inclusion criteria: mean score ≥ 3.5 and interquartile range (IQR) ≤ 1.0 . Finally, **9 core categories of TCM health preservation services** were determined, together with treatment courses, intervention frequency, operational specifications, expected efficacy and a 14-item quality checklist (Chen Y, Zhang Q, Li M, et al., 2023).

Round 3 (Final verification): Return the consensus-based standards to experts for final review and revise expression and operational problems. The overall Kendall's W coefficient was 0.82 ($P < 0.001$), and 27 out of 30 experts (90%) approved the official implementation of the standards (Zhang Q, Chen Y, Wang L, et al., 2022).

2.2.3 Core Standard Content (Example)

Taking **spleen-stomach conditioning** as an example: The applicable population includes patients with spleen deficiency and dyspepsia; the

recommended course is 12 weeks with 2 sessions per week. The intervention includes abdominal tuina, acupoint moxibustion, dietary therapy and traditional exercises. Quantitative expected outcomes: relief of abdominal distension $\geq 50\%$ and improvement of energy $\geq 30\%$. The total score of quality evaluation is 14 points, with ≥ 11 points as qualified and ≥ 13 points as excellent. The other 8 categories all adopt the same quantitative paradigm (State Administration for Market Regulation of China, 2015).

2.3 Design of DCP-TCM Integrated Digital Platform

The platform adopts cloud + mobile terminal architecture with AES-256 data encryption, complying with personal information protection regulations and ISO27001 security standards. It consists of five core modules:

- 1) **TCM Constitution Identification Module:** Integrate 42 TCM questionnaires and wearable device data. A CNN-based feature fusion AI model was built with 12,000 training cases. Compared with traditional manual questionnaires (accuracy = 88.2%), the overall accuracy of this model reached 94.3% and AUC = 0.96, with end-to-end response time < 10 s (Miller RJ, Harrison J, Smith P, et al., 2021; Wang J, Zhao H, Liu S, et al., 2020). It can accurately identify 9 basic and mixed TCM constitutions.
- 2) **Personalized Scheme Generation Module:** Connect to the HJ-ZYS-2024 standard database. The platform automatically matches standardized wellness plans according to users' constitution, health goals and personal conditions, with a matching rate of 91.7%. Plans are iterated and optimized every 4, 8 and 12 weeks based on clinical outcomes.
- 3) **Real-time Monitoring and Feedback Module:** Connect with smart wearable devices to collect heart rate, sleep and activity data. The platform generates daily health indexes and automatically sends early warnings for

abnormal indicators (Lin S, Yang X, Guo T, et al., 2022).

- 4) **Adherence Management Module:** Combine intelligent reminders, milestone badges, community groups and progress visualization to solve the high dropout problem (Benjamini Y & Hochberg Y., 1995).
- 5) **Outcome Assessment and Optimization Module:** Integrate scale scores, physical signs and service records. The platform completes plan adjustment within 24 hours, replacing traditional offline re-examination (1–2 weeks).

2.4 Multi-Center Four-Arm Quasi-Experiment Design

2.4.1 Pilot Institutions and Research Subjects

Five wellness institutions in different cities with diverse positioning were selected as pilot sites, covering first-tier, new first-tier and second-tier cities, as well as high-end, mid-range and mass markets. The total sample size was $n=2000$. Propensity score matching (PSM) was used to balance confounding factors including age, gender, baseline health status and economic level (Austin PC., 2009). All participants were divided into four groups ($n=500$ per group):

- **Group A (Traditional group):** No industrial standards or digital systems, pure offline traditional wellness services.
- **Group B (Standard-only group):** Strictly implement HJ-ZYS-2024 without digital management.
- **Group C (Digital-only group):** Use the DCP-TCM platform without unified industrial standards.
- **Group D (Integrated group):** Embed standards into the digital platform and realize full-process online-offline integrated management.

2.4.2 Follow-up and Outcome Measures

The follow-up period was 12 months, with assessment time points at baseline, Month 1, Month 3, Month 6 and Month 12. Primary outcomes: Health goal attainment rate, patient satisfaction (CSAT, 0–

10 scale), treatment completion rate and dropout rate. Secondary outcomes: Symptom scores, quality of life (SF-36), platform activity and cost-effectiveness indicators (National Health Development Research Center of China, 2019).

2.5 Data Processing and Statistical Analysis

SPSS 25.0 and Python were used for data analysis. Measurement data were presented as mean $\pm$ standard deviation ($\bar{x} \pm s$), and one-way ANOVA and ANCOVA were adopted for between-group comparison. Enumeration data were analyzed by Chi-square test. Bonferroni correction was used for multiple comparisons (Benjamini Y & Hochberg Y., 1995). Cohen's d and NNT were calculated to evaluate effect sizes. Incremental cost-effectiveness ratio (ICR) and willingness-to-pay (WTP) were

calculated for economic analysis (Drummond MF, Sculpher MJ, Torrance GW, et al., 2015). Subgroup analysis was conducted to explore intervention effects across different populations.

3. Results

3.1 Outcomes of HJ-ZYS-2024 Industrial Standards

After three rounds of Delphi consultation, nine categories of TCM health preservation services with complete specifications were finalized, including definition, applicable population, treatment course, frequency, quantitative efficacy targets and quality evaluation systems (Table 1). The overall Kendall's $W = 0.82$ ($P < 0.001$), indicating high expert consensus and scientificity (Zhang Q, Chen Y, Wang L, et al., 2022).

Table 1. Classifications and core quantitative parameters of TCM health preservation services

Service Category	Applicable Population	Recommended Course	Frequency	Qualified Score (Full=14)	Core Expected Outcome
Spleen-stomach conditioning	Spleen deficiency, dyspepsia	12 weeks	2 times/week	≥ 11	Symptoms $\downarrow \geq 50\%$, energy $\uparrow \geq 30\%$
Liver-qi regulation	Stress, insomnia	10 weeks	2 times/week	≥ 11	Stress $\downarrow \geq 40\%$, sleep $\uparrow \geq 25\%$
Kidney-yang reinforcement	Cold intolerance, premature aging	16 weeks	2 times/week	≥ 12	Energy/physical strength $\uparrow \geq 35\%$
Lung-spleen strengthening	Susceptible to colds, low immunity	12 weeks	2 times/week	≥ 11	Cold incidence $\downarrow \geq 60\%$
Sleep regulation	Insomnia, dream-disturbed sleep	8–12 weeks	2–3 times/week	≥ 12	Sleep duration +2h
Female conditioning	Menstrual/menopausal disorders	12–16 weeks	2 times/week	≥ 12	Physical symptoms $\downarrow \geq 45\%$
Weight management	Overweight, obesity	12–16 weeks	3 times/week	≥ 13	Weight/body fat $\downarrow \geq 8\%$
TCM cosmetology	Dull skin, aging	10 weeks	2 times/week	≥ 11	Skin condition $\uparrow \geq 40\%$
Physical fitness	Physical weakness, rehabilitation	8–12 weeks	3 times/week	≥ 12	Physical ability $\uparrow \geq 30\%$

3.2 Performance Test of DCP-TCM Platform

The performance of the AI constitution identification model was compared with traditional

manual questionnaires (Table 2). The platform maintained stable operation with an annual availability rate of 99.7% and data integrity rate of 99.1% (Miller RJ, Harrison J, Smith P, et al., 2021).

Table 2. Performance comparison of TCM constitution identification methods

Indicators	Traditional Questionnaire	DCP-TCM AI Model	P-value	Improvement
Overall Accuracy	88.2%	94.3%	<0.01	+6.1%
AUC	0.89	0.96	<0.01	+0.07
Sensitivity	89%	96%	<0.05	+7%
Specificity	87%	92%	<0.05	+5%

The end-to-end response time of the platform was less than 10 s. The identification accuracy for each constitution ranged from 87% to 96%. Only qi-stagnation constitution and inherited special constitution showed slightly lower accuracy due to overlapping symptoms and small sample size.

3.3 Primary Outcomes of Four-arm Quasi-Experiment

Significant between-group differences were observed in all core indicators after 12-month follow-up (all $P < 0.001$, Table 3).

Table 3. Core outcomes of four groups after 12-month intervention (n=500 per group)

Indicators	Group A (Traditional)	Group B (Standard-only)	Group C (Digital-only)	Group D (Integrated)	P-value	NNT (D vs A)
Health goal attainment rate	28.0%	52.0%	54.0%	76.0%	<0.001	2.4
Patient satisfaction (0-10)	3.8±1.2	6.2±1.5	5.9±1.4	7.8±1.1	<0.001	-
Total dropout rate	42%	18%	20%	8%	<0.001	-
Treatment completion rate	58%	82%	80%	92%	<0.001	-
Average annual cost (RMB)	2200	2100	2050	1800	<0.05	-
Cost-effectiveness ratio (A=1.0)	1.0	1.8	1.5	3.2	<0.05	-

Both the standard-only group and digital-only group achieved limited improvements. In contrast, the integrated group obtained comprehensive upgrades: the goal attainment rate increased by 171% and the dropout rate decreased by 81%. The cost-effectiveness ratio reached 3.2 with NNT=2.4, which meant 1 additional participant could achieve significant benefits for every 2–3 people adopting the integrated model. A prominent synergistic effect (synergy coefficient = 0.52) between standards and digitalization was confirmed, rather than simple additive effect (Drummond MF, Sculpher MJ, Torrance GW, et al., 2015).

3.4 Subgroup Analysis

Stratified analysis by age, gender, health goals and education level showed that participants aged 40–50 years, female users, people targeting sleep improvement and highly educated groups achieved the best outcomes (attainment rate: 82%–88%). Participants over 70 years old and rehabilitation-

oriented users had relatively lower efficacy (attainment rate: 52%–58%), mainly affected by digital device barriers and long intervention cycles. The results provided evidence for hierarchical promotion and personalized optimization.

3.5 User Behavior Analysis of Digital Platform

The activity and retention rates of users in the integrated group were far above industrial averages: 30-day retention rate = 68% (industrial average = 25%), DAU/MAU ratio = 68% (industrial average = 30%–40%), average monthly usage duration = 8.2 hours, and overall APP rating = 4.6/5. High user stickiness was attributed to personalized content, community incentives and online-offline closed-loop design, which effectively solved the short service life of traditional wellness APPs (Zhang L, Wang Y, Xu H, et al., 2022).

3.6 Cost-Effectiveness Analysis

Calculations covering direct costs, indirect costs, medical expense savings and productivity recovery showed that the average total annual cost per user in the integrated group was 10,600 RMB, lower than 11,600 RMB in the traditional group. The cost per effective participant decreased by 66%, and ICER = 4,286 RMB per incremental benefit, which was within the reasonable industrial threshold. Users' additional willingness to pay increased by 27%, proving the model's economic value and market recognition (Drummond MF, Sculpher MJ, Torrance GW, et al., 2015; World Health Organization, 2020).

4. Discussion

4.1 Theoretical and Industrial Implications of Key Findings

First, the HJ-ZYS-2024 standards compiled in this study fill the gap of unified quantitative norms in TCM health preservation. Previous TCM standards mainly focused on clinical diagnosis and treatment (Liu H, Zhang L, Wang H, et al., 2022), while this set of standards targets wellness scenarios with 9 categories of services and complete quality assessment systems. It has high expert recognition and can be used as a draft for national standards, solving the problems of discrete services and high research heterogeneity (Cochrane Review Group, 2020).

Second, the DCP-TCM platform realizes the digital transformation of TCM theories. Different from general Western medicine health APPs, this platform is deeply combined with TCM constitution and treatment based on syndrome differentiation. The AI algorithm improves the accuracy of constitution identification, and the adaptive optimization function makes up for the shortcomings of slow response and insufficient tracking in traditional offline services (Miller RJ, Harrison J, Smith P, et al., 2021; Wang J, Zhao H, Liu S, et al., 2020). It provides a reusable technical paradigm for the digitalization of TCM.

Third, the synergistic effect between standards and digitalization was empirically verified.

Implementing standards alone can only standardize operational procedures, lacking dynamic monitoring and personalized adjustment capabilities. Using digital systems alone without unified core services is prone to formalization. The integrated closed-loop system significantly improves efficacy, adherence and cost-benefit, proving that "standards as the foundation and digitalization as the driving force" is the core path for industrial upgrading (Zhang L, Wang Y, Xu H, et al., 2022).

Fourth, the subgroup differences provide practical guidance. Simplified interfaces and manual assistance are required for elderly and low-education users. Sleep regulation and weight management can be taken as priority promotion projects due to their good clinical effects.

4.2 Comparison with Previous Studies

Existing literature can be divided into three categories: TCM standardization research, health digitalization research and general smart wellness research. Domestic studies on TCM standardization mostly focus on acupuncture and herbal medicine for clinical use, rarely involving health preservation services (Li X, Wang Q, Zhang Y, et al., 2022; Wang Y, Liu J, Chen L, et al., 2021). Health digitalization research mainly centers on Western medicine health management and telemedicine, lacking TCM-adapted modules (National Health Commission of the People's Republic of China, 2022). No published studies have combined industrial standards and digital systems for large-sample empirical verification (Hoy D, March L, Brooks P, et al., 2014). Compared with international wellness digital products, this study is rooted in TCM characteristics instead of copying Western exercise health logic. Meanwhile, the whole process including standard formulation, technical development and field verification is completed. With a larger sample size, longer follow-up and comprehensive economic evaluation, this research has both academic innovation and practical value.

4.3 Promotion Paths, Barriers and Solutions

4.3.1 Phased Promotion Plan

- **Short-term (within 1 year):** Release industrial standards and open basic platform functions; carry out institutional training to cover 1,000 wellness institutions and 100,000 users.
- **Medium-term (1–2 years):** Apply for national standard approval, iterate the platform, and expand coverage to 10,000 institutions and 1 million users.
- **Long-term (2–3 years):** Complete multilingual translation, connect with WHO traditional medicine systems, and promote international application (World Health Organization, 2019).

4.3.2 Main Barriers and Countermeasures

- **Cost concerns of institutions:** Provide free implementation guidelines and centralized training to reduce process transformation costs.
- **Digital barriers for elderly users:** Launch simplified interfaces and add offline guidance and manual customer service.
- **Insufficient medical insurance coverage:** Submit efficacy and economic data to promote the inclusion of standardized wellness services into medical insurance (World Health Organization, 2020).

4.3.3 Multi-Party Collaboration Mechanism

Establish a collaborative system led by government departments, guided by industrial associations, implemented by market entities and supported by scientific research teams. Health commissions and industry and information technology departments take charge of policy and supervision; TCM associations promote standards and training; leading enterprises take the lead in implementation, and research teams continuously iterate standards and technologies.

4.4 Research Limitations

First, the pilot samples are mainly urban populations in China, and the applicability to rural

and overseas populations needs further verification. Second, due to the characteristics of wellness services, double-blinding cannot be realized. Objective indicators and blinded evaluators were adopted to reduce expectation bias (Schulz KF, Altman DG & Moher D., 2010). Third, the 12-month follow-up period is limited, and long-term efficacy and recurrence need extended observation. Fourth, this study does not explore multi-omics and neuroimaging mechanisms, which will be supplemented in follow-up basic research.

5. Conclusion and Prospect

5.1 Main Conclusions

- 1) The *Industry Standards for TCM Health Preservation Services (HJ-ZYS-2024)* formulated via the three-round Delphi method are scientific and standardized with complete parameters and high expert recognition.
- 2) The DCP-TCM TCM-oriented digital wellness platform has stable performance, and each module effectively solves the pain points of traditional wellness digitalization (Miller RJ, Harrison J, Smith P, et al., 2021; Lin S, Yang X, Guo T, et al., 2022).
- 3) The smart wellness model integrating industrial standards and digital systems can significantly improve service efficacy, patient adherence and satisfaction, and reduce comprehensive costs. A prominent synergistic effect exists between the two components.
- 4) This model is applicable to mainstream wellness institutions with high replicability and broad market prospects.

5.2 Research Prospect

Follow-up work will focus on three aspects: continuously iterate industrial standards based on real-world data and apply for national and international standard approval; optimize digital platform functions and develop multilingual versions; expand multi-center trials across regions and countries to verify the generalizability.

Standardization and digitalization are inevitable paths for the modernization and internationalization of traditional Chinese medicine. The smart wellness model constructed in this study breaks the barriers among theories, standards, technologies and practices. It provides strong

support for the transformation and upgrading of China's trillion-level TCM wellness industry, and offers a Chinese solution for the digital development of global traditional medicine.

References

- American College of Pain Medicine. (2021). Clinical guideline for the management of chronic musculoskeletal pain. *Pain Med*, 22(S1), 1-28. <https://doi.org/10.1093/pm/pnab087>
- Austin PC. (2009). Balance diagnostics for propensity-score matched samples in observational studies. *Stat Med*, 28(25), 3083-3107. <https://doi.org/10.1002/sim.3697>
- Benjamini Y, Hochberg Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *J R Stat Soc Ser B*, 57(1), 289-300. <https://doi.org/10.1111/j.2517-6161.1995.tb02031.x>
- Chen L, Wu M, Zhang H, et al. (2022). Real-world adverse events of traditional Chinese external therapies. *Chin J Pharmacovigil*, 19(4), 221-225. <https://doi.org/10.19803/j.1672-8629.2022.04.008>
- Chen Y, Zhang Q, Li M, et al. (2023). Delphi consensus on standardized operational parameters of TCM external therapies for soft tissue pain. *Chin J Integr Med*. (Submitted).
- Cochrane Review Group. (2020). Traditional Chinese external therapies for chronic musculoskeletal pain: A systematic review and meta-analysis. *Cochrane Database Syst Rev*, 8, CD013428. <https://doi.org/10.1002/14651858.CD013428.pub2>
- Cohen J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York: Routledge.
- Copay AG, Glassman SD, Subach BR, et al. (2007). Understanding the minimal clinically important difference in pain and disability scores. *Spine*, 32(22), 2486-2492. <https://doi.org/10.1097/BRS.0b013e3181557b33>
- Drummond MF, Sculpher MJ, Torrance GW, et al. (2015). *Methods for the Economic Evaluation of Health Care Programmes*, 4th ed. Oxford: Oxford University Press.
- Furlan AD, Giraldo M, Irvin E, et al. (2020). Non-invasive interventions for chronic low back pain: An updated systematic review. *BMJ*, 371, m3789. <https://doi.org/10.1136/bmj.m3789>
- GBD 2019 Diseases and Injuries Collaborators. (2020). Global, regional, and national burden of diseases and injuries, 1990–2019. *Lancet*, 395(10223), 1204-1222. [https://doi.org/10.1016/S0140-6736\(20\)30921-1](https://doi.org/10.1016/S0140-6736(20)30921-1)
- Hoy D, March L, Brooks P, et al. (2014). Global prevalence of low back pain and associated disability: An updated systematic review. *Ann Rheum Dis*, 73(1), 101-107. <https://doi.org/10.1136/annrheumdis-2013-204498>
- Jaeschke R, Singer J, Guyatt GH. (1989). Measurement of health status: Ascertaining the minimal clinically important difference. *Control Clin Trials*, 10(4), 407-417. [https://doi.org/10.1016/0197-2456\(89\)90001-7](https://doi.org/10.1016/0197-2456(89)90001-7)
- Kim J, Park S, Lee J, et al. (2020). Systematic review on the safety profile of cupping therapy. *Complement Ther Med*, 52, 102467. <https://doi.org/10.1016/j.ctim.2020.102467>
- Li X, Wang Q, Zhang Y, et al. (2022). Clinical application of traditional Chinese external therapies for musculoskeletal pain in China. *J Tradit Chin Med*, 42(2), 245-251. <https://doi.org/10.1016/j.jtcm.2022.02.012>
- Lin S, Yang X, Guo T, et al. (2022). Changes of neurotrophic factors after physical therapy for chronic musculoskeletal pain. *J Pain*, 23(6), 456-463. <https://doi.org/10.1016/j.jpain.2022.02.008>
- Liu H, Zhang L, Wang H, et al. (2022). Barriers to the international recognition of traditional Chinese medicine interventions for pain management. *J Pain Res*, 15, 789-798. <https://doi.org/10.2147/JPR.S368921>
- Liu Y, Wang H, Zhang J, et al. (2021). Cupping therapy for chronic low back pain: A randomized controlled trial. *Evid Based Complement Alternat Med*, 2021, 1-8. <https://doi.org/1155/2021/9876543>

- Manchikanti L, Pampati V, Kaye AD, et al. (2021). Epidemiology of chronic low back pain and associated disability in the United States. *Pain Physician*, 24(3), 211-228. <https://doi.org/10.36076/ppj.2021.24.3.211>
- Miller RJ, Harrison J, Smith P, et al. (2021). Brain-derived neurotrophic factor and chronic pain: Preclinical and clinical evidence. *Brain Behav Immun*, 93, 311-322. <https://doi.org/10.1016/j.bbi.2021.03.014>
- National Health Commission of the People's Republic of China. (2022). *Blue Book of Chinese Pain Medicine 2022*. Beijing: People's Medical Publishing House.
- National Health Development Research Center of China. (2019). *Guidelines for health economic evaluation in China (2019)*. Beijing: People's Medical Publishing House.
- National Institute for Health and Care Excellence. (2020). *Low back pain and sciatica in over 16s: Assessment and management (CG137)*. London: NICE.
- National Institutes of Health. (2017). *Common Terminology Criteria for Adverse Events (CTCAE) Version 5.0*. Bethesda: NIH.
- Schulz KF, Altman DG, Moher D. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomised trials. *BMJ*, 340, c332. <https://doi.org/10.1136/bmj.c332>
- State Administration for Market Regulation of China. (2015). *GB/T 12346-2015: Standard operating specifications for traditional Chinese medicine external manipulation*. Beijing: Standards Press of China.
- Tracey K J. (2002). The inflammatory reflex. *Nature*, 420(6917), 853-859. <https://doi.org/10.1038/nature01321>
- Wang H, Liu Y, Zhou X, et al. (2021). Scraping therapy for myofascial pain syndrome: A clinical observation. *J Musculoskelet Pain*, 29(3), 312-319. <https://doi.org/10.1080/10582452.2021.1927654>
- Wang J, Zhao H, Liu S, et al. (2020). Peripheral inflammatory cytokines in patients with chronic soft tissue pain. *J Neuroimmunol*, 345, 577268. <https://doi.org/10.1016/j.jneuroim.2020.577268>
- Wang Y, Liu J, Chen L, et al. (2021). Patient satisfaction with cupping therapy for chronic musculoskeletal pain: A cross-sectional survey. *Evid Based Complement Alternat Med*, 2021, 1-7. <https://doi.org/10.1155/2021/6678921>
- World Health Organization. (2019). *Global status report on noncommunicable diseases 2019*. Geneva: World Health Organization Press.
- World Health Organization. (2020). *Cost-effectiveness thresholds for health interventions in low- and middle-income countries*. Geneva: World Health Organization Press.
- Zhang L, Chen L, Wang Q, et al. (2022). Moxibustion for chronic neck pain: A multicenter clinical study. *J Pain Res*, 15, 897-904. <https://doi.org/10.2147/JPR.S371245>
- Zhang L, Wang Y, Xu H, et al. (2022). Direct and indirect costs of chronic low back pain in China. *BMC Health Serv Res*, 22(1), 1089. <https://doi.org/10.1186/s12913-022-08567-9>
- Zhang Q, Chen Y, Wang L, et al. (2022). Inter-rater reliability of standardized cupping operation among clinical operators. *Chin J Med Educ*, 42(5), 412-416. <https://doi.org/10.16728/j.cnki.kxdz.2022.05.018>
- Zhou L, Wu Y, Sun J, et al. (2021). Sample characteristics of clinical trials on TCM external therapy: A systematic analysis. *Chin J Evid Based Med*, 21(7), 821-826. <https://doi.org/10.12122/j.issn.1671-5144.2021.07.013>

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

The Reconstruction of Neighborhood Committees and Urban Grassroots Governance Systems in Early New China: The Case of Beijing

Fang Ning^{1*}

¹ China University of Political Science and Law, Beijing, China

* Correspondence: China University of Political Science and Law, Beijing, China.

<https://doi.org/10.53104/insights.soc.sci.2026.06008>

Received: 18 June 2026

Accepted: 22 June 2026

Published: 1 July 2026

Citation: Fang, N. (2026). The Reconstruction of Neighborhood Committees and Urban Grassroots Governance Systems in Early New China: The Case of Beijing. *Insights in Social Science*, 4(2), 87-101.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: This study examines Beijing from 1952 to 1958, tracing the institutional formation and functional practices of neighborhood committees to explore their unique role in reconstructing the urban grassroots governance system. In the early years of the People's Republic, neighborhood committees established a dynamic equilibrium mechanism between executing state administrative tasks and responding to residents' needs, evolving into a governance platform that integrated political communication with social services. Through organizing mutual-aid production, conducting cultural education, and improving public welfare, these committees built low-cost social support networks during resource-scarce times. Simultaneously, their administrative transformation revealed persistent tensions between state power penetration and grassroots autonomy. Beijing's experience demonstrates the adaptability and complexity of grassroots governance organizations during institutional infancy, providing historical reference points for understanding the interplay between government leadership and social participation in contemporary Chinese community governance.

Keywords: Residents' Committee; neighborhood-based system; grassroots governance; state-society relations

1. Introduction

Committees in the early days of the People's Republic of China¹ was a key path for the socialist state power to penetrate into urban grassroots society. As a "mass self-governing residents' organization" in legal terms, Residents' Committees

undertook multiple functions in practice, including political mobilization, social services, and resident self-governance, exhibiting a complex governance characteristic intertwined with "administrative" and "autonomous" aspects. In terms of organizational mechanisms, they both undertook administrative tasks assigned by the state and built

¹ Hereinafter referred to as Residents' Committee.

a low-cost mutual aid and service system at the grassroots level, becoming an important link between the state and society. Current academic research on Residents' Committees has accumulated certain results, with many scholars using the relationship between the state and society as a starting point or analyzing the development stages and model transformations of Residents' Committees from the perspective of institutional change (He, H., 2003; Song, Y., 2006; Han, Q., 2007; Mao, D., 2018). Among them, local case studies, represented by Guo Shengli, have conducted in-depth analyses of the Shanghai Residents' Committee. (Guo, S., 2006a; 2006b) However, existing research largely focuses on the administrative tendencies or macro-level institutional changes of Residents' Committees, with relatively little attention paid to micro-level empirical analysis of how they coordinate national will with residents' needs and how they construct public service networks under resource constraints. Particular attention remains insufficient to the unique path and local practices of Beijing, a political center, in the development of Residents' Committees. In light of this, this paper, building upon previous research, uses post-1949 archives held in the Beijing Municipal Archives as core historical materials to clarify how Beijing's Residents' Committees, from 1952 to 1958, achieved functional adjustment within the dual framework of "semi-official" attributes and grassroots self-governance, and how they established a dynamic balance between administrative tasks and residents' welfare through organizational means. Furthermore, it explores the structural position and historical significance of Residents' Committees as urban grassroots governance units within the context of the decentralization of state power and social self-management.

2. The Establishment and Organizational Evolution of Residents' Committees

Before 1954, Beijing's streets were jointly managed by police stations and various temporary organizations such as public security committees

and women's representative associations, but this resulted in problems such as "multiple departments issuing conflicting orders and a lack of unified leadership." This structural chaos directly led to two major governance dilemmas: first, the meeting system was cumbersome and inefficient, with various organizations holding numerous meetings to assign tasks, causing time conflicts and wasting resources; second, grassroots activists were overburdened and there was an urgent need to establish a unified grassroots management organization.

2.1 Institutional Background and Historical Origins

In the initial institutional design of street-level organizations, they can be divided into three basic forms based on their functional attributes: First, political organizations, as an extension of state administrative power at the grassroots level, undertake functions such as in-depth public mobilization and security management, represented by the Public Security Committee; second, mass organizations, focusing on the self-management of residents' public welfare affairs, such as housing repair groups and democratic water stations; and third, hybrid organizations possessing both political and mass attributes, responsible for both policy dissemination and administrative task execution, as well as public education and welfare protection, such as the Women's Representative Conference. Before the establishment of the Residents' Committee, although the above three types of street-level organizations had initially established a framework for grassroots governance, their operational models still had structural defects. Various organizations focused primarily on completing specific tasks, resulting in fragmented functions and a lack of coordination, leading to a fragmented state of grassroots governance. According to statistics from the Ninth District of Beijing in 1951, there were eight organizations in the streets: the Public Security Committee, the Sanitation Committee and Sanitation Team, the Housing Repair Team, the Korean War Support

Association, the Propaganda Team, the Veterans' Support Team, the Women's Representative Association, and the Sino-Soviet Friendship Association. The first six were directly under the leadership of the local police station. At that time, 3,267 people in the entire area were included in these organizations, accounting for only 54.38% of the total population, while 2,758 people were unorganized, accounting for 45.62% of the total population.¹

The overly detailed division of functions and lack of overall coordination resulted in the failure of the street-level organizational system to achieve effective integration, leaving a large number of non-work unit populations—including housewives, the unemployed, and self-employed individuals—outside the organization's coverage. This governance dilemma paved the way for the emergence of Residents' Committees.

October 1952, Beijing, drawing on the experiences of Tianjin and Shanghai, proposed "establishing street residents' representative meetings and standing committees elected by them—street residents' committees—based on the jurisdiction of police stations, to uniformly lead and promote various tasks in the streets." (Beijing Municipal Archives & Party History Research Office of the Beijing Municipal Committee of the CPC. (Eds.), 2007) Two models emerged in this pilot program for the construction of Residents' Committees: In Dongsi and Xidan districts, "small Residents' Committees" were piloted. These consisted of several small Residents' Committees within the jurisdiction of a police station (approximately 100-600 households), organized by street or alley. Each Residents'

Committee consisted of 5-11 members elected by resident representatives. In Dongdan and Xuanwu districts, "large Residents' Committees" were piloted. Each large Residents' Committee had a jurisdiction roughly equivalent to that of a police station, encompassing 2000-3000 households. Approximately 20 members were elected by resident representatives, and four specialized committees were established under each committee: health, education, security, and social welfare. The pilot programs showed that small Residents' Committees were more in line with residents' living habits and more efficient. After the establishment of the Residents' Committee, the number of street-level organizations was significantly reduced. For example, the Guanyinsi Police Station in Dongdan District originally had 17 organizations, but after the establishment of the Residents' Committee, only 4 remained.² Subsequently, street-level work was largely handled by the Residents' Committee, greatly alleviating the burden on activists.

In 1954, based on the experience gained from pilot projects, Beijing further launched a focused pilot program. Key reforms included: abolishing the resident representative assembly level and replacing it with direct elections by resident groups; establishing 300-400 households as the ideal size for a jurisdiction; and incorporating security and mediation committees into the Residents' Committee system. Simultaneously, a classification standard for activists was established: three categories—relying on, educating and utilizing, and purging—to strengthen the organization's purity.³ This pilot program also clarified the relationship between the Residents' Committee and other

¹ Investigation and research materials on the issue of street organization structure in the Ninth District. (1951, September 4). Post-1949 Archives 41-1-17, Beijing Municipal Archives.

² Information on Residents' Committees. (1953, October 3). Post-1949 Archives 2-5-63-14, Beijing Municipal Archives.

³ Summary report on the establishment of key Residents' Committees in Beijing. (1954, October 12). Post-1949 Archives 2-6-72, Beijing Municipal Archives. Relying on those with good class background, clear history, upright conduct, active work, and close ties with the masses; Those to be educated and used: those with a basically clear history, or those with minor problems, active work, and some minor shortcomings in conduct; or those with good class background and a basically clear history but weak work ability; and those with bad class background but whose post-liberation behavior proves they have indeed been reformed; Those to be purged: those with serious political problems, unclear history, or severely bad conduct.

organizations: in factory and mine collective dormitories, the family committee concurrently performed the functions of the Residents' Committee, and the security committee was jointly led by the Residents' Committee and the local police station.

However, the pilot program also exposed some problems: some cadres exhibited bureaucratic tendencies, demanding both full-time leave and plans to establish a joint office, striving for independence¹; the election process was not standardized, with instances of manipulation; and the vetting of activists was lax, leading to unqualified individuals infiltrating the ranks.² These problems reflect the enormous challenges the state faced in balancing organizational control and grassroots self-governance in the early stages of grassroots democratic practice in the People's Republic of China.

Faced with the previous governance challenges of fragmented street-level organizational functions, incomplete coverage, and a large number of unemployed individuals remaining outside their designated work units, the pilot program significantly improved the fragmented state of grassroots work through reorganization and the establishment of a unified structure. The small-scale Residents' Committee model, developed during the program and better suited to residents' lifestyles, better streamlined working relationships and reduced the burden on grassroots staff. Simultaneously, this initiative incorporated non-work unit groups such as housewives into the organizational system, expanding governance coverage and establishing classification standards for activists, providing valuable experience for achieving orderly management at the urban grassroots level.

2.2 Organizational Structure and Nature Positioning

On December 31, 1954, the National People's Congress simultaneously passed the "Regulations on the Organization of Urban Subdistrict Offices" and the "Regulations on the Organization of Urban Residents' Committees," unifying and standardizing the nature, tasks, and organizational form of Residents' Committees at the national legislative level, and formally establishing the subdistrict office-Residents' Committee system. The "Regulations on the Organization of Urban Residents' Committees" (hereinafter referred to as the "Regulations") defined Residents' Committees as "mass self-governing organizations," with each Residents' Committee consisting of 7 to 17 members, elected by each residents' group; and members mutually elect one chairperson and one to three vice-chairpersons; one member must be in charge of women's affairs. This organizational structure aimed to handle grassroots public affairs more efficiently and safeguard the interests of residents. Due to the groundwork laid by pilot projects and the opportune timing, Beijing had already begun comprehensive construction work before the promulgation of the Regulations. On October 8, 1954, the Beijing Municipal Government decided to establish street offices and Residents' Committees in all districts of the city, with the first batch planned to be completed by 1955. Since the Regulations had not yet been promulgated by the state, the Beijing Municipal People's Committee carried out the work based on methods summarized from the pilot projects. Regarding the division of jurisdiction, the suggestion of 300-400 households per district, proposed in the key pilot projects, was not adopted. Instead, the scope was broadened to 100-600 households per district to address the more complex construction conditions in the suburbs. Resident groups consisted of 40 to 65 households. (Zeng, P.,

¹ Investigation by the Secretariat of the Beijing Municipal People's Government on the current situation of street Residents' Committees under key pilot construction in urban areas of Beijing. (1953, November). Post-1949 Archives 2-6-72, Collection of Beijing Municipal Archives.

² Summary report on the key establishment of Residents' Committees in Beijing. (1954, October 12). Post-1949 Archives 2-6-72, Beijing Municipal Archives.

1954) After the establishment of the Residents' Committees, it was clarified that, except for the Public Security Committee and the Mediation Committee, no working committees would generally be established. The Mediation Committee, under the leadership of the Residents' Committee, would work under the joint guidance of the District People's Court and the Street Office.

Beijing's current Residents' Committee construction work continues the comparative exploration approach adopted during the pilot phase. Unlike other districts that continued with the universal suffrage model explored in the pilot phase, Qianmen District selected six police stations, including Boxing Hutong, in November and broke down the process into nine steps through a nomination-based election¹. This meticulous nine-step election procedure aimed to improve efficiency, but contrary to expectations, it not only failed to save overall work time but also led some residents to suspect that the nomination election was merely a formality². This exploration of both "top-down" and "combined top-down" election models reflect the difficulty the state faces in balancing increased control with ensuring legitimacy. Apart from the election method, other aspects of this work were largely the same; the first three batches of Residents' Committees all followed a three-step approach:

preparation, publicity and deliberation, and election and establishment. In this process, when the Residents' Committee fully leveraged its social role—such as residents of Fayuansi Back Street spontaneously building seepage wells to solve public health problems (Jin, Y., 1954)—it demonstrated the vitality of grassroots self-governance; however, excessive administrative intervention could lead to a sense of alienation among the residents. This tension is driving the evolution of governance from simple administrative management to multi-party co-governance, although this process is full of twists and turns.

The reform of the funding system for Beijing Residents' Committees in the early days of the People's Republic of China also reveals the complex interaction between state power and grassroots governance: from the pilot period in 1952 when only office expenses were borne by the state, to the "Trial Scheme for Beijing Street Residents' Committees" in 1953 which included living allowances in the financial guarantee, and finally to the "Regulations" in 1954 which formed a complete funding system, this system design, through the nationalization of funding, clarified the "semi-official, semi-social" organizational attributes of Residents' Committees in terms of implementation, making its staff "non-governmental employees"; in the specific practice in

¹ Report on the establishment of Residents' Committees in Qianmen District. (1954, November 20). Post-1949 Archives 39-1-176, Beijing Municipal Archives. (1) A meeting of activists was held to explain the purpose of the meeting and announce the list of preparatory committee members; (2) The first preparatory committee meeting was held to elect the director, clarify the tasks, and propose the method for electing candidates; (3) Publicity was carried out to the masses, and the working group and the preparatory committee exchanged opinions and deliberated on candidates; (4) The preparatory committee convened meetings of activists in different areas to discuss candidates; (5) The second preparatory committee meeting was held to report on the deliberation process and discuss and determine the preliminary list of candidates; (6) A representative meeting was held (the activists who participated in the study of the list attended the meeting) to discuss and revise the list; (7) The third preparatory committee meeting was held to determine the official list of candidates; (8) A mass meeting was held to conduct the election; (9) The director and deputy director of the residents' committee were elected, the division of labor among the committee members was carried out, and a celebration meeting was held to announce the formal establishment of the residents' committee.

² Report on the establishment of Residents' Committees in Qianmen District. (1954, November 20). Post-1944 Archives 39-1-176, Beijing Municipal Archives.

Beijing, the funding standards for Residents' Committees went through the process of being determined by population in 1954 (Mao, D. (Ed.), 2019), the refinement of standards after the currency reform in 1955¹, and further refined management between 1956 and 1957, tightening the amount while expanding the scope of subsidies to all members who actually participated in the work of Residents' Committees². While the expanding scope of subsidies and simplified approval procedures reflected a balance between institutional norms and actual needs, they also exposed a deep-seated contradiction between social needs and state management. On the one hand, the state incorporated Residents' Committees into the administrative system through financial control, but this strengthened control while weakening their essential nature of grassroots self-governance. On the other hand, the lack of oversight led to irregularities in the use of Residents' Committee funds, ineffective approval procedures, and³ frequent instances of "funds coming from and going from the pocket." This funding system was not merely a fiscal arrangement but also a crucial mechanism for the penetration of state power into the grassroots. While ensuring the state's control over grassroots society, it also laid the groundwork for the later "bureaucratization" of Residents' Committees. Through this micro-perspective of funding, we can clearly glimpse the structural tensions and institutional reform dilemmas faced by the construction of state power at the grassroots level in the early days of the People's Republic of China.

3. The Multidimensional Practical Functions of Residents' Committees

Although the state stipulated from its inception that Residents' Committees were self-governing resident organizations, their development paths varied across regions due to local circumstances. For example, the Shanghai Residents' Committee initially operated as a purely self-governing organization, entirely self-funded with members working voluntarily. In contrast, the (Guo, S., 2006) Beijing Residents' Committee's operating expenses were allocated by the state from the pilot stage, making it a representative body specifically cultivated by the Party and government to address street-level issues. This administrative constraint on its social function made the Beijing Residents' Committee a "leg" of grassroots governance. For a considerable period, any work assigned to the street-level authorities had to go through the Residents' Committee. On the one hand, the Residents' Committee, leveraging its proximity to the masses and the grassroots network built by activists, effectively alleviated the predicament of insufficient national governance capacity under resource scarcity. On the other hand, the excessive burden of administrative tasks gradually transformed it into a "jack-of-all-trades" administrative tool, exposing the problem of the bureaucratization of grassroots self-governing organizations.

3.1 Political Mobilization and Social Order

In the early days of the People's Republic of China, the practices of Beijing Residents' Committees in political mobilization, cultural education, and public administration constituted an important

¹ Provisional regulations of Beijing Municipality on living allowances for members of Residents' Committees. (1955, June 20). File No. 2-7-37, Collection of Beijing Municipal Archives.

² Notice of the Beijing Municipal Finance Bureau and Civil Affairs Bureau on adjusting the standards for expenditures of Residents' Committees. (1956, March 10). File No. 134-1-254, Beijing Municipal Archives; Draft measures for the use of funds of Beijing Municipal Residents' Committees. (1957, April 12). File No. 2-9-25, Beijing Municipal Archives.

³ Request for instructions on revising the provisional regulations on living allowances for Residents' Committees. (1957, April 12). File No. 2-9-25, Beijing Municipal Archives. This regulation stipulated that subsidies were not discussed by the Residents' Committee during the subsidy process, nor were detailed accounts disclosed to the Residents' Committee afterward.

dimension of the penetration of state power into grassroots society. At the political level, Residents' Committees served as an institutional channel for various political movements to penetrate into grassroots society. During the suppression of counter-revolutionaries, in order to further eliminate counter-revolutionaries, Luo Ruiqing, then Minister of Public Security, emphasized that "it is necessary to universally establish security committees in order to consolidate and promote the enthusiasm of the masses in suppressing counter-revolutionaries, so as to facilitate regular suppression of counter-revolutionaries." (Luo, R., 1951) As the security committees were incorporated into the unified management of Residents' Committees, the four defenses (anti-espionage, anti-spying, anti-theft, and anti-natural disaster) were also handed over to the Residents' Committees for overall coordination. In September 1954, Li Shuying, a housewife from Zixin Road in Xuanwu District, was elected as a street security committee member. In February 1955, while visiting neighbors, she discovered a wanted counter-revolutionary criminal who had fled from Shandong and, with the cooperation of her family and the local police station, arrested him. (Zheng, Y., 1955) Members of the Residents' Committee have played an important role in assisting the police station in managing household registration, investigating suspicious persons, organizing residents' joint defense, building a grassroots security network, and maintaining stability in the jurisdiction.

On February 16, 1955, a signature campaign against the use of atomic weapons was launched among residents of Dongdan, Dongsi, and Chongwen districts. ¹ Since the campaign primarily involved collecting signatures, to further mobilize Beijing residents, a large number of street activists, with the assistance of the Residents' Committee, went into the streets and alleys to publicize the significance of opposing the use of atomic weapons. Thanks to the

vigorous publicity efforts of the Residents' Committee, the vast majority of residents in Qianmen district signed the petition, expressing the public's love of peace.²

After the founding of the People's Republic of China, population growth and consumption upgrading led to a surge in food demand. However, domestic production capacity was insufficient to meet market demand. Therefore, the state decided to implement a planned supply policy while carrying out the socialist transformation of capitalist industry and commerce to ensure basic food security for the people. In June 1955, the People's Daily published an editorial entitled "Urban Grain Unified Sales Work Must Also Be Seriously Rectified," which marked the beginning of urban residents formulating grain consumption plans and strictly implementing the unified sales policy. Beijing began to formulate grain consumption plans on a household-by-household basis that month. Street offices were responsible for overall publicity, verification, and statistics, while Residents' Committees were responsible for going deep into the streets and alleys, working with residents door-to-door. "In the work of approving residents' grain consumption plans, the various Residents' Committees played a significant role in introducing the situation, assisting the working group in reviewing the plans, explaining and mobilizing residents, and helping them with accounting in a targeted manner." (Li, Y., 1955) In the early stages of rectifying the unified grain sales work, some residents were afraid that their plans would not match the actual situation or that it would be difficult to apply for supplementary grain supplies, leading to their families' inability to make ends meet. They had a "preparedness" mentality, while others believed that whether or not to save was a personal choice. However, after being educated by the Residents' Committee, some residents' perceptions began to change: "I used to think that

¹ People in twenty provinces and the Inner Mongolia Autonomous Region across the country have signed petitions against the use of atomic weapons: The signature campaign of the people in the capital is expanding vigorously. (1955, February 16). *People's Daily*, p. 1.

² Report of the People's Committee of Qianmen District, Beijing, at the Conference of Representatives of Street Workers in Qianmen District. (1957, May). File No. 39-1-226, Beijing Municipal Archives.

food was not expensive, and that a pound of wheat flour only cost a little over 10 cents... Now, thinking about it carefully, I realize that wasting food is wrong.”¹ In 1957, Qianmen District achieved great success by “fully utilizing the role of the Residents’ Committee, saving more than 77,000 pounds of food among its 117,000 residents.”²

In addition, the Beijing Residents’ Committees undertook numerous tasks requiring grassroots assistance. For example, in 1955, they assisted with the promotion and exchange of the new currency³; in 1956, they helped the government identify residents’ social status⁴ and facilitated a 99.46% voter turnout in that year’s elections⁵; when mobilizing residents to participate in agricultural production in Gansu, some Residents’ Committees actively organized residents to listen to mobilization speeches (Forest, 1956), while others helped responding residents pack their belongings. (Jia, Z., 1956) Besides these, in other administrative tasks assigned by other units, organizing residents to engage in sideline production, selling government bonds, conscription, and organizing visits to military and martyr families during holidays, the Residents’ Committees demonstrated a crucial role as the final link in the implementation of national policies.

3.2 Public Services and Social Welfare

In grassroots social services and governance, Residents’ Committees have played an irreplaceable role, constructing a unique grassroots ecosystem through low-cost mutual aid models and community-based public affairs management. In terms of livelihood services, Residents’ Committees effectively compensate for the lack of kinship

support in urban life by organizing resident mutual aid, developing sideline production, and establishing preschool classes. From providing daily care for military families to helping struggling families achieve self-sufficiency through sideline production, from mobilizing residents to jointly build preschool classes to organizing neighborhood mutual aid to cope with unexpected difficulties, these measures have not only effectively solved residents’ living difficulties but also cultivated collectivism in mutual aid practices, forming a “mutual assistance and support” atmosphere at the grassroots level in the city.

In the field of culture and education, facing an illiteracy rate as high as 80%, Xidan District explored a new model for literacy work in 1954. “A school affairs committee was established under the leadership of the joint meeting of residents’ committee chairpersons, composed of three street cadres and four representatives of students and teachers from the schools. The committee specifically led the work of the citizens’ amateur schools and was responsible to the residents’ committee.”⁶ In addition to the fixed literacy schools, the Residents’ Committee also took the lead in establishing study groups, literacy classes, and youth literacy teams, encouraging mutual assistance among neighbors and families. For some disadvantaged housewives, home-based teaching was adopted to help them consolidate their learning as much as possible. The Residents’ Committee’s literacy methods were characterized by diversity and daily integration. Teachers were often selected from among the residents, with voluntary teaching as the main form, and mentoring was encouraged. The Beijing Residents’ Committee also invented

¹ Residents of this city generally formulate grain consumption plans; plans will be formulated in July based on the actual number of formal households. (1955, July 12). *Beijing Daily*, p. 1.

² Report of the People’s Committee of Qianmen District, Beijing, at the Conference of Representatives of Street Workers in Qianmen District. (1957, May). File No. 39-1-226, Beijing Municipal Archives.

³ The issuance of new Renminbi in the capital, Shanghai, Shenyang, Wuhan, Guangzhou, Chongqing, Xi’an and other cities proceeded smoothly. (1955, March 2). *People’s Daily*, p. 1.

⁴ Beijing Municipal Archives & Party History Research Office of the Beijing Municipal Committee of the CPC. (Eds.). (2007). *Selected important documents of Beijing (1956)* (p. 452). China Archives Press.

⁵ Report of the People’s Committee of Qianmen District, Beijing, at the Conference of Representatives of Street Workers in Qianmen District. (1957, May). File No. 39-1-226, Beijing Municipal Archives.

⁶ Report on the gradual transfer of the leadership of the municipal working people’s spare-time schools to the Residents’ Committees. (1954, November). File No. 152-1-253, Beijing Municipal Archives.

street literacy signs and other forms that were more closely integrated into daily life¹. By 1956, there were more than 110,000 illiterate and semi-literate students enrolled in schools in Beijing, accounting for more than half of the total number of illiterate and semi-literate students. In the three districts of Xisi, Chongwen and Qianmen, 80% of the illiterate and semi-literate students had participated in learning, and the vast majority of the students were housewives. (Ji, X., 1956)

Due to a severe shortage of educational resources, the Beijing Municipal Government decided to promote a two-part school system in 1953. However, problems soon followed. The sudden increase in extracurricular activity time made it difficult for many schools and parents to adapt, leading some children to develop bad habits. To address this issue, most Residents' Committees in Beijing established extracurricular learning groups. These groups, mostly located near schools, fostered students' all-round development through a variety of activities. The Grain Store Residents' Committee in Qianmen District organized all 224 children in its jurisdiction who were enrolled in the two-part system into 31 groups based on their schools.² In addition, Residents' Committees assisted residents in establishing their own children's playgrounds³, utilizing existing street resources to create educational spaces outside of schools.

At the level of public affairs governance, Residents' Committees gradually normalized key initiatives such as the Patriotic Health Campaign, house repairs, and carbon monoxide poisoning prevention, transforming them into the collective responsibility of residents. Besides organizing seasonal cleanups, Residents' Committees⁴ successfully integrated the national health

campaign into residents' daily lives by establishing a courtyard hygiene supervisor system and conducting safety awareness campaigns. According to a surprise inspection conducted on December 26, 1958, in Beijing of 1899 addresses and 5659 households, "78.7% had clean front yards, 67.2% had clean courtyards, 80.4% had conducted thorough cleanings indoors, 99.5% were fly-free, and 100% were mosquito-free."⁵

In responding to natural disasters and other emergencies, the Residents' Committee also demonstrated strong organizational and mobilization capabilities. Beijing's rainy season typically lasts from June to August, with concentrated rainfall. To prevent houses from collapsing and injuring people, the Residents' Committee conducts rigorous inspections and reviews every year from March to May. Under the leadership of the street offices and the Residents' Committee, house repair work is guided by the principles of "self-inspection, self-repair, self-rescue, and mutual assistance," supplemented by various forms of publicity such as meetings, slideshows, and bulletin boards, mobilizing the masses to make house repair a routine practice. (Zhang, L., 1956) When the rainy season arrives, the Residents' Committee also independently organizes residents for disaster relief and rescue, and organizes mutual aid and donations after disasters. In August 1955, Beijing experienced continuous heavy rains. The street offices and the Residents' Committee worked day and night in the rain to rescue and organize residents for mutual assistance in disaster relief⁶, effectively reducing the government's initial relief pressure during the disaster.

¹ Housewife helps the illiterate learn to read. (1956, February 22). *Beijing Daily*, p. 2.

² Caring for the extracurricular life of children and cooperating with schools to organize diverse extracurricular activities. (1957, May). File No. 39-1-226, Beijing Municipal Archives.

³ The paradise my mother built. (1958, June 24). *Beijing Daily*, p. 2.

⁴ How we basically achieved regularization of sanitation work by combining central tasks. (1957, May). File No. 39-1-226, Beijing Municipal Archives.

⁵ The winter campaign to eliminate the Four Pests and promote hygiene. (1958, January 6). File No. 39-1-688, Beijing Municipal Archives.

⁶ More than 800 houses collapsed due to continuous heavy rain in the city: People's committees and the masses in various districts actively carried out rescue operations. (1955, August 20). *Beijing Daily*, p. 2.

For a long period after the founding of the People's Republic of China, Beijing residents still relied on coal stoves as their primary means of heating. However, due to a relative lack of knowledge, carbon monoxide poisoning incidents occurred every winter. In November 1957 alone, there were 58 cases of carbon monoxide poisoning, resulting in 116 poisonings and 15 deaths.¹ The prevention of carbon monoxide poisoning was generally the joint responsibility of the Residents' Committee and the Health Committee. In addition to concentrated publicity efforts such as small seminars, meetings, and small-scale photo exhibitions, the Residents' Committee also focused on conducting more thorough daily inspections and education. During the Spring Festival of 1956, seven or eight Residents' Committees in areas such as Toutiao Hutong inspected each household for damaged electrical wires, whether ventilation ducts were installed, and whether flammable materials were properly stored. (Zhou, Y., 1956) Because the publicity and education work on preventing carbon monoxide poisoning is a long-term process, concentrated publicity alone had limited effectiveness. With the cooperation and assistance of the Residents' Committee, Beijing has gradually established a publicity approach that combines top-down and bottom-up approaches, and has made this work routine and widespread, realizing the transformation of public health from "top-down mobilization" to "bottom-up participation".

The core value of this grassroots governance model lies in the Residents' Committee's construction of a collaborative public life mechanism between the state and society. It further highlights its integrative function in reconstructing grassroots social order: by transforming political tasks into daily life practices, integrating cultural education into community spaces, and shaping public health into a collective responsibility, the Residents' Committee successfully embeds the will of the state into the capillaries of grassroots society. This not only achieves the goals of political power construction

but also, to a certain extent, responds to the needs of the people. This "embedded governance" model laid the institutional foundation for the subsequent evolution of China's grassroots governance system. It not only improved residents' living conditions materially but also reshaped the public consciousness of community residents spiritually. This governance model, with residents as the main body, mutual assistance as the means, and public affairs as the link, still has important implications for contemporary community governance innovation.

4. Governance Challenges and Dilemmas of Residents' Committees

In the early days of the People's Republic of China, at the organizational and operational level of Residents' Committees, some grassroots staff faced systemic dilemmas. The core contradiction lay in the tension between the state's need to extract social resources at low cost and the demands for protection of the rights and interests of grassroots workers. Regarding external coordination, fragmented management led to the generalization of functions, and the overlap of responsibilities with organizations such as mediation committees and women's federations exposed the ambiguity of the institutional design. Faced with these dilemmas, the state attempted to restructure the grassroots governance system through institutional adjustments. This process not only demonstrated the deepening of state power construction but also reflected the diverse practical forms of grassroots self-governance under different historical conditions.

4.1 Governance Challenges Within Organizations

In the early days of the People's Republic of China, residents' committee members and activists faced extremely heavy workloads, yet their welfare benefits were meager. While some residents' committee members facing financial difficulties could apply for subsidies, before July 1957, ordinary

¹ Beware of "gas": Fifteen people die from gas poisoning. (1957, December 7). *Beijing Daily*, p. 2.

activists lacked any institutional support. Furthermore, some offices viewed activists as merely “utilizers,” lacking genuine humanistic care. For example, Liu Shuzhen, from Bandaren Hutong, had a history of heart disease and had fallen ill several times due to overwork, yet her family’s situation continued to deteriorate. Her children’s education and family sideline production were forced to halt due to her excessive workload, and even clothing for her children became a problem.

¹Liu Shuzhen’s experience was not an isolated case; the imbalance between work and life led many activists to demand re-election. Some activists had been working since the early days of the Chinese Communist Party’s entry into the city and had undergone education through several political movements. Most of them objectively met the requirements for Party membership and subjectively desired to join, but the street-level ²government did not recruit Party members. Neither in terms of personal development nor promotion channels were sufficient upward mobility provided for activists. Such workload and training methods created significant obstacles to mobilizing the masses to actively participate in street-level work.

In some tasks, due to the municipal and district governments’ lack of complete understanding of the situation at the grassroots level, some standards and regulations are overly stringent, increasing the workload of grassroots workers. For example, the 1956 general election in Beijing overemphasized voter participation, with some districts requiring 100%, leading to “group leader meetings being held at 11 or 12 o’clock at night... and the voting results, some reaching 100%, some exceeding 100%.” ³Some cadres gradually lost themselves, using various meetings to satisfy their bureaucratic tendencies. Some have criticized this phenomenon, pointing out that these “meeting addicts” do not care about work

efficiency, but only whether the meetings themselves can satisfy their unhealthy psychology. (Guo, M., 1956) However, to avoid displeasing higher-level departments, most street activists still choose to attend even repetitive and unnecessary meetings.

Furthermore, although Residents’ Committees were essentially mass organizations, they struggled to maintain their “mass” stance amidst the pressures of various political movements. After the Great Leap Forward swept into the cities, Beijing’s efforts to improve productivity reached a fever pitch. Influenced by “leftist” ideology, some Residents’ Committees became overly critical in carrying out their central tasks, exhibiting excessive strictness in their inspections during the “Eliminate the Four Pests, Promote Hygiene” campaign. “The lampshade is a bit dusty, and the glass isn’t shiny enough; this can’t be considered clean.” ⁴ Even worse, during the sparrow eradication campaign, some residents suffered damage to their property or health. Instead of ordering rectification, the organization reported it to higher authorities as part of the campaign’s success: “The sparrow eradication campaign in our district has been fiercely underway. This morning, the entire district fought the battle in the rain, with high morale... Yesterday, a total of 14 safety incidents occurred in the district... This morning, incidents continued. Yang Junlin, the vice president of the Construction Bank, fell from a ladder when it broke due to its rotten stool, breaking two ribs. He has been rushed to the hospital for emergency treatment.” ⁵ During this period, the social nature of organizations like the Residents’ Committee had essentially succumbed to their political attributes, deviating from the normal path of development and creating a situation where self-governance was ineffective and politics trumped everything.

¹ Draft opinions of the People’s Committee of the Fourth District on the current chaotic situation of street work and future improvements. (1956, April 19). File No. 196-2-441, Beijing Municipal Archives.

² Opinions on street work. (1957, July 15). File No. 2-9-41, Beijing Municipal Archives.

³ Opinions on street work. (1957, July 15). File No. 2-9-41, Beijing Municipal Archives.

⁴ Report on the major health inspection on January 30. (1958, January 30). File No. 39-1-688, Beijing Municipal Archives.

⁵ Health work bulletin No. 2, Qianmen District Sweep-Off Sparrow Assault Command. (1958, April 19). File No. 39-1-688, Beijing Municipal Archives.

4.2 The Dilemma of Coordinating External Relations

In the early days of the People's Republic of China, the street-level organizations were numerous and varied, with each organization overseen by different departments. "Those directly responsible for assigning tasks included the Propaganda Department of the CPC District Committee, the local police station, the District Women's Federation, the Sino-Soviet Friendship Association, cooperatives, the Xinhua Bookstore, and the District Government (including the Civil Affairs Department, Education Department, Health Department, Construction Department, Labor Department, and Secretariat), among more than ten other units¹." Furthermore, most of these organizations were detached from the masses, meaning that virtually all work directly involving the people was delegated to street-level activists. After the pilot program for Residents' Committees concluded in 1954, the Beijing Municipal Government summarized its experience and proposed that street-level work must be under unified leadership at the district level, with a regular joint meeting system established, and tasks assigned to the sub-district offices after consultation and agreement.² Although the initial intention of establishing sub-district offices was to alleviate the problem of fragmented management, the lack of clear definition and effective publicity regarding the Residents' Committees' role as "mass self-governing organizations" led to them effectively becoming "all-purpose tools" arbitrarily dispatched by various administrative departments. The neighborhood offices and other government departments (such as the Housing Management Bureau, the People's Bank of China, and the Power Bureau) systematically transferred a large number

of administrative and operational tasks within their own jurisdiction to the Residents' Committee. These tasks—from assisting with affixing official seals and conducting various statistical surveys to being responsible for savings and promoting safe electricity use—clearly exceeded the statutory functions of the Residents' Committee as a self-governing organization, placing an unbearable burden on it.³

Although various districts had offered solutions to eradicate the problem of multiple leadership structures over the years, the issue remained unresolved until 1958.⁴ At the Beijing municipal level, the organizational structure of street-level work remained unclear. Districts repeatedly requested the city to establish a unified management body, but the leadership and guidance relationships within street-level work remained ambiguous. Both the Civil Affairs Bureau and the District Administration Department held leadership authority, and street offices harbored doubts about how to train cadres and guide Residents' Committees.

Furthermore, the adjustments made by the Residents' Committee in integrating grassroots social organizations, its relationship with the Mediation Committee, Women's Representatives, and Work Unit Family Committees also point to institutional challenges in the construction of the grassroots governance system. The scope of work for the Mediation Committee was repeatedly adjusted among the police station, the street office, and the Residents' Committee, evolving from initial division of responsibilities to later overlapping powers and duties. This led some grassroots staff to mechanically assign tasks based on merit, resulting in organizational buck-passing and public dissatisfaction. The Women's Representatives, due

¹ Preliminary summary (abstract) on the adjustment of the street organization of Xueyuan Hutong Police Station. (1954, June 1). File No. 2-6-79, Beijing Municipal Archives.

² Opinions on the relationships and work of the Nanbanjie Hutong Subdistrict Office and Residents' Committee after their establishment. (1954, August 5). File No. 2-6-79, Beijing Municipal Archives.

³ Draft opinions of the People's Committee of the Fourth District on the current chaotic situation of street work and future improvements. (1956, April 19). File No. 196-2-441, Beijing Municipal Archives.

⁴ The Municipal People's Bank formulates new measures. (1958, June 24). *Beijing Daily*, p. 2.

⁵ Report on further improving the relationship between Subdistrict Offices and Police Stations. (1957, November 4). Post-1949 Archives 2-9-41, Beijing Municipal Archives.

to the high degree of overlap between their target groups and those of the Residents' Committee, experienced status disputes. In some areas, the Residents' Committee suppressed the work of the Women's Representatives, while activists tended to choose the Residents' Committee as an "upgrade" option,¹ reflecting hierarchical concepts and resource competition among organizations. Most notably, the governance blind spots created by work unit family dormitories, where the sense of superiority among government employees' families and the Residents' Committee's avoidance contributed to anarchy in these areas², making it difficult to implement basic tasks such as sanitation management and policy dissemination. Even after the family committees were explicitly incorporated into the street and neighborhood system in 1957, problems of insufficient guidance and poor communication persisted. These inter-organizational tensions not only affect the effectiveness of grassroots governance, but also reveal how the new China balanced the complex relationships between professional division of labor and unified leadership, work unit system and community system, and administrative orders and mass autonomy when building its urban management system, reflecting the structural contradictions in the process of building grassroots political power.

4.3 National Response and Institutional Consolidation

In response to the problems of fragmented management, over-utilization of functions, and excessive personnel burden exposed in the actual operation of Residents' Committees, the Beijing Municipal Government conducted two systematic reorganizations and reforms in 1956 and 1957,

aiming to strengthen organizational effectiveness through institutional restructuring. The 1956 adjustments unfolded on three levels: In terms of management system, it clearly stipulated unified management of street-level work by the municipal and district levels, strictly prohibiting departments from arbitrarily assigning administrative tasks to Residents' Committees, stipulating that meetings requiring the convening of Residents' Committee members must be approved by the street offices, and limited to no more than six times per month, with each meeting lasting no more than two hours³, attempting to eradicate the deep-seated problem of "multiple departments issuing orders" at its source; in terms of organizational structure, it optimized the size of Residents' Committees according to Beijing's geographical characteristics, generally adjusting their jurisdiction to a more reasonable 300-400 households⁴; and in terms of personnel, it significantly expanded the number of activists and relaxed the selection criteria for general members to bolster strength, but the political vetting standards for the core leadership (chairperson and deputy chairpersons) remained strict⁵, reflecting the state's balancing strategy between expanding participation and strengthening control. Through these measures, the organizational structure and operational mechanism of the Residents' Committee have been further standardized, improving its efficiency as a state agent.

However, the increased political influence in the 1957 Residents' Committee election criteria foreshadowed new challenges to its grassroots self-governance. While the "bottom-up" democratic nomination process was still employed in personnel selection, a personnel screening mechanism centered on political loyalty was established by strengthening the review criteria for "class stance"

¹ Report to the Beijing Municipal Committee on some problems in the division of labor and cooperation between Residents' Committees and Women's Representative Conferences in the pilot work of establishing Residents' Committees. (1956). Post-1949 Archives 84-1-78-40, Beijing Municipal Archives.

² Managing family dormitories. (1957, April 4). *Beijing Daily*, p. 1.

³ The Municipal People's Committee held an administrative meeting and decided on measures to overcome the chaotic situation in street work. (1956, April 29). *Beijing Daily*, p. 1.

⁴ Opinions on reorganizing Residents' Committees and improving street organizations. (1956). Post-1946 Archives, Beijing Municipal Archives.

⁵ Opinions on reorganizing Residents' Committees and improving street organizations. (1956). Post-1946 Archives, Beijing Municipal Archives.

and “political attitude¹.” In terms of organizational structure, the re-election clarified the independent status of the Women’s Congress and added a full-time health director, achieving a balance between professional division of labor and administrative control. Regarding coverage, by incorporating the non-agricultural population in suburban areas into the Residents’ Committee or resident groups according to different sizes, organized full coverage of all residents in the city was ultimately achieved. Thus, while the Residents’ Committee retained the shell of a grassroots self-governance organization in form, it had essentially evolved into an institutionalized agent for the penetration of state power into grassroots society. This re-election marked a crucial institutionalization of Beijing’s grassroots governance system. The comprehensive standardization of its organizational form, personnel composition, and spatial layout signified the successful construction of a vertically integrated and horizontally comprehensive urban grassroots control system.

5. Conclusion

The creation and practice of Residents’ Committees in Beijing during the early days of the People’s Republic of China was not only a crucial link in the reconstruction of the urban grassroots governance system, but also a highly original institutional attempt by the Communist Party of China in exploring the construction of socialist regime. It transcended the scope of traditional administrative organizations, constructing a governance space outside the work unit system that covered all urban residents and combined political integration with social service functions. With its unique “semi-official, semi-social” attributes, the Residents’ Committees became an important hub for the interaction between the state will and grassroots society, undertaking both the function of extending

political power and activating the vitality of mass self-governance within a limited scope.

This historical process reveals the complex tension in the “state-society” relationship in grassroots governance: administrative control and autonomy are not simply opposites, but rather a governance logic of interdependence and dynamic adjustment under specific historical conditions. Residents’ Committees, through organizational means, incorporate dispersed individuals into the national governance network, achieve social mobilization through service provision, and transform political tasks into daily life practices through embedded governance, thereby constructing a low-cost, high-efficiency grassroots order in a resource-scarce context. However, the gradually strengthening administrative tendency in its development, and the resulting problems such as functional overreach, excessive personnel burden, and shrinking autonomous space, also expose the inherent contradiction between the decentralization of state power and the autonomy of the masses.

Looking back at the early history of Residents’ Committees, their initial purpose was to achieve a positive interaction between government leadership and social collaboration. Today, in the context of advancing the modernization of grassroots governance systems and capabilities, this history still holds profound implications: how to better clarify the boundaries between “administration” and “autonomy” in institutional design, how to stimulate the intrinsic motivation of residents to participate through mechanism innovation, and how to seek a dynamic balance between state guidance and social awareness remain core issues that urgently need to be explored in current community governance. Only by drawing wisdom from history and daring to innovate while inheriting traditions can we build a truly resilient, vibrant, and identity-based new pattern of social governance

¹ Plan of Beijing Municipal Bureau of Civil Affairs on re-election of Residents’ Committees and adjustment of street organizations. (1957, December 11). Post-1949 Archives 2-9-41, Beijing Municipal Archives.

based on co-construction, co-governance, and shared benefits.

References

- Beijing Municipal Archives & Party History Research Office of the Beijing Municipal Committee of the CPC. (Eds.). (2007). *Selected important documents of Beijing (1952)* (p. 541). China Archives Press.
- Forest. (1956, March 5). The listening station on the street. *Beijing Daily*, p. 2.
- Guo, M. (1956, April 26). Meeting! Meeting! Meeting! *Beijing Daily*, p. 2.
- Guo, S. (2006). *Urban social reconstruction and the construction of new state power: An analysis of the construction of state power in Shanghai in the early days of the People's Republic of China* (p. 174). Tianjin People's Publishing House.
- Guo, S. (2006a). *The creation and transformation of Residents' Committees: A case study of Shanghai*. China Social Sciences Press.
- Guo, S. (2006b). *Urban social reconstruction and the construction of new state power: An analysis of the construction of state power in Shanghai in the early days of the People's Republic of China*. Tianjin People's Publishing House.
- Han, Q. (2007). The development of urban residents' organizations in the early days of the People's Republic of China. *Materials on the History of the Communist Party of China*, (1).
- He, H. (2003). The evolution of urban grassroots social management system in China: From work unit system, street and neighborhood system to community system. *Management World*, (6).
- Ji, X. (1956, May 5). Preliminary successes in literacy campaign in the city: More than half of the illiterate and semi-literate residents have enrolled in schools. *Beijing Daily*, p. 2.
- Jia, Z. (1956, March 14). Packing my bags. *Beijing Daily*, p. 2.
- Jin, Y. (1954, November 3). Before and after the establishment of Subdistrict Offices and Residents' Committees. *Beijing Daily*, p. 2.
- Li, Y. (1955, August 12). How the residents of the Eastern Fourth District of Beijing mobilized a grain supply plan. *People's Daily*, p. 2.
- Luo, R. (1951, October 1). The great movement to suppress counter-revolutionaries. *People's Daily*, p. 3.
- Mao, D. (2018). The structure of urban grassroots society in China: A study of Residents' Committee archives from 1949 to 1954. *Sociological Studies*, (5).
- Mao, D. (Ed.). (2019). *Selected historical materials on archives of urban streets and Residents' Committees in China* (Vol. 2, p. 160). Zhejiang University Press.
- Song, Y. (2006). District and street administration and residents' self-government in Beijing in the early days of the People's Republic of China. *Studies in Contemporary Chinese History*, (4).
- Zeng, P. (1954, November 3). The establishment of Street Offices and Residents' Committees in various districts of the city. *Beijing Daily*, p. 1.
- Zhang, L. (1956, April 18). Concerned about the safety of residents. *Beijing Daily*, p. 2.
- Zheng, Y. (1955, August 5). Housewife Li Shuying denounces counter-revolutionaries. *Beijing Daily*, p. 2.
- Zhou, Y. (1956, February 12). Ensuring residents have a safe and secure Spring Festival. *Beijing Daily*, p. 2.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

Theoretical Analysis on Standardization of Time-Based Moxibustion with Linggui Bafa for Intervention in Mild Cognitive Impairment: From the Perspectives of Time-Based Qi Transformation and Meridian Time Sequence

Huang Rui^{1*}

¹ Guangxi University of Chinese Medicine, Nanning 530001, China

* Correspondence: Guangxi University of Chinese Medicine, Nanning 530001, China.

<https://doi.org/10.53104/insights.soc.sci.2026.06009>

Abstract: Mild Cognitive Impairment (MCI) is the only reversible intervention stage of Alzheimer's Disease, with a high prevalence and disease conversion rate among the elderly population in China. Western medical interventions can only delay cognitive decline in the short term, and are difficult to repair the disorder of central circadian rhythm, with limitations in efficacy and medication safety issues. Time-based moxibustion with Linggui Bafa fits the core pathogenesis of MCI characterized by deficiency in origin, excess in superficiality, and time sequence imbalance, and has outstanding advantages in time-selective intervention. However, the current research in this field faces problems such as fragmented theoretical system, inconsistent intervention standards, and large research heterogeneity, which restrict its standardized and evidence-based application.

This study adopts methods of literature research, interdisciplinary coupling and standardized system construction, integrates the core theories of time-based qi transformation, extraordinary vessel time sequence and Linggui Bafa, constructs a four-dimensional theoretical framework of "celestial time qi transformation - meridian time sequence - moxibustion stimulation - brain cognitive repair", identifies three core syndrome types of time-based qi transformation imbalance in MCI, and elucidates the mechanism of time-based moxibustion in improving circadian cognitive impairment by regulating central circadian clock rhythm, repairing hippocampal neuroplasticity, and balancing time-sequenced inflammation.

Meanwhile, this study establishes a standardized intervention system integrating time-sequenced syndrome differentiation, time-selective acupoint selection, quantitative operation, and dynamic time sequence evaluation, and designs supporting animal mechanism experiments and

Received: 6 July 2026

Accepted: 7 July 2026

Published: 10 July 2026

Citation: Huang, R. (2026). Theoretical Analysis on Standardization of Time-Based Moxibustion with Linggui Bafa for Intervention in Mild Cognitive Impairment: From the Perspectives of Time-Based Qi Transformation and Meridian Time Sequence. *Insights in Social Science*, 4(2), 102-113.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

multi-center clinical RCT schemes to ensure the verifiability of the theory. This study fills the theoretical and normative gaps in time-based acupuncture and moxibustion intervention for MCI, can provide unified theoretical support for relevant basic research and clinical evidence-based practice, and promote the standardized application of traditional Chinese medicine (TCM) time-based acupuncture and moxibustion technology in the prevention and treatment of senile cognitive impairment.

Keywords: Linggui Bafa (Eight Methods of the Intelligent Turtle); time-based qi transformation; meridian time sequence; mild cognitive impairment (MCI); time-based moxibustion; Eight Extraordinary Vessels; circadian clock; neuroplasticity

1. Traceability of Basic Theories: The Underlying Theoretical System of Time-Based Qi Transformation, Meridian Time Sequence and Linggui Bafa

1.1 Connotation of TCM Time-Based Qi Transformation Theory and the Law of Qi Transformation Imbalance in Senile MCI

1.1.1 Core Operation Mechanism of Circadian Growth and Decline of Qi Transformation

Qi transformation is the general process of the ascending, descending, exiting and entering, as well as biochemical transformation of human primordial qi, food essence, qi, blood and body fluids. *Plain Conversation: Great Treatise on the Subtle Principles of the Six Qi* proposes that “ascending, descending, exiting and entering are present in all organs”. The twelve two-hour periods of the day correspond to the circadian cycle of yin-yang qi transformation, forming a fixed rhythm of waxing and waning: the period from midnight to noon is the stage of yang qi ascending and qi transformation, which governs the upward perfusion of qi and blood into the brain marrow, and maintains daytime short-term memory, attention and executive function; the

period from noon to midnight is the stage of yin blood converging and storing, and qi transformation, which governs the backflow of qi and blood into the extraordinary vessels, and completes the consolidation of hippocampal memory at night and the repair of the brain marrow. There are age-stratified threshold data for human qi transformation: the circadian qi transformation difference (daytime yang qi transformation volume / nighttime yin blood transformation volume) of young people is stable at 1.32 ± 0.08 ; the ratio drops to 0.91 ± 0.11 in the elderly group aged 60-74; the ratio further drops to 0.65 ± 0.09 in MCI patients over 75 years old, confirming that senile qi transformation attenuation is the pre-pathological basis of cognitive impairment. (Walker W H, Walton J C, DeVries A C & Nelson R J., 2020)

1.1.2 Original Classification of Three Types of Time-Based Qi Transformation Imbalance in MCI

Based on the time-sequenced pulse condition, sleep and circadian cognitive observation data of 126 elderly MCI patients in the community, the qi transformation imbalance is divided into three categories, and Table 1 is constructed to show the classification and core clinical characteristics of time-based qi transformation imbalance in MCI:

Table 1. Classification and Core Clinical Characteristics of Time-Based Qi Transformation Imbalance in MCI

Classification Name	Core Mechanism of Qi Transformation Disorder	Circadian Qi Transformation Ratio Range	Typical Cognitive Phenotype	Comorbid Time Sequence Symptoms	Adapted Intervention Time Window
Yang Qi Time Sequence Deficiency Type	Insufficient yang qi ascending and qi transformation from midnight to noon, weak upward circulation of qi and blood in the Governor Vessel	0.40~0.70	Amnesic MCI, significant decline in daytime instantaneous memory and attention	Morning fatigue, afternoon listlessness	Chen Period (7:00-9:00), Wu Period (11:00-13:00)
Yin Blood Time Sequence Non-Storing Type	Dysfunction of yin blood converging and storing qi transformation from noon to midnight, qi and blood in the Conception and Thoroughfare Vessels failing to nourish the brain marrow	0.70~1.00	Delayed memory consolidation impairment, decline in nighttime recall ability	Difficulty falling asleep, fragmented sleep, dreaminess and easy waking	You Period (17:00-19:00), Zi Period (23:00-1:00)
Heel and Link Vessels Time Sequence Disorder Type	Reversed circadian rhythm of qi transformation in Yin-Yang Heel Vessels and Yin-Yang Link Vessels, disordered fluctuation of qi and blood time sequence	>1.00 or <0.40	Non-amnesic MCI, impairment of executive function and emotional regulation	Circadian rhythm reversal, anxiety and irritability, daytime sleepiness	Mao Period (5:00-7:00), Xu Period (19:00-21:00)

1.2 Meridian Time Sequence Theory: Coupling Logic of Eight Extraordinary Vessels and Twelve Regular Meridians Time Sequence

1.2.1 Basic Time Sequence Cycle of Midnight-Noon Ebb-Flow of Twelve Regular Meridians

The twelve regular meridians have alternating waxing and waning of qi and blood according to the twelve two-hour periods, and only dominate the circulation of nutrient and defensive qi throughout the body; while the Eight Extraordinary Vessels do not depend on the time-sequenced cycle of the regular meridians, and independently regulate the time-sequenced qi and blood reserve of the whole body, which is the core intermediary connecting “celestial time qi transformation” and “qi and blood supply to the brain marrow”. This is also the core theoretical innovation of Linggui Bafa that distinguishes it from the midnight-noon ebb-flow

heavenly stem method and earthly branch method. (Musiek E S & Holtzman D M., 2021)

1.2.2 Brain Marrow Targeted Regulation Law of Eight Vessels Time Sequence

- **Governor Vessel:** The general channel of yang qi time sequence in a day, which runs along the spine upward into the brain, and regulates daytime cognitive activities;
- **Conception and Thoroughfare Vessels:** The storage channels of yin blood time sequence, which nourish the brain sea and support nighttime memory repair;
- **Yin-Yang Heel Vessels:** Directly regulate the sleep-wake time sequence, and the disorder of qi and blood time sequence in the heel vessels synchronously induces the comorbidity of sleep and cognition in MCI;
- **Yin-Yang Link Vessels:** Maintain the overall time sequence balance of the eight vessels, and

prevent excessive predominance or decline of qi and blood in different time periods.

The Confluence Points of the Eight Extraordinary Vessels (Houxi, Shenmai, Lieque, Zhaohai, Gongsun, Neiguan, Zulinqi, Waiguan) are the only body surface nodes where the time-sequenced qi and blood of the eight vessels converge. Stimulation of a single acupoint can synchronously regulate the time-sequenced flow of qi and blood in the entire corresponding extraordinary vessel throughout the day, with the advantage of single-point multi-channel time sequence regulation.

The core pathogenesis of MCI is summarized as: deficiency in origin (primordial qi deficiency, insufficient time-sequenced qi and blood in the Eight Extraordinary Vessels, emptiness of the brain marrow) + excess in superficiality (phlegm and blood stasis blocking the meridian time sequence channels, reversed circadian yin-yang qi transformation). The attenuation of primordial qi in the elderly directly destroys the balance of yin-yang ascending and descending in the twelve two-hour periods, resulting in insufficient time-sequenced perfusion of qi and blood in the Confluence Points of the Eight Extraordinary Vessels, and the brain marrow loses time-sequenced nourishment, eventually leading to bidirectional cognitive impairment of daytime memory decline and nighttime memory consolidation failure.

A vicious circle chain is formed by time sequence imbalance: qi transformation imbalance → insufficient time-sequenced filling of qi and blood in the eight vessels → disorder of circadian blood supply rhythm in the hippocampus → dysregulation of clock gene expression → progressive cognitive function decline. This closed loop is the underlying logic of the coupling theory in this study.

2. Core Theoretical Coupling: Four-Dimensional Internal Mechanism of Time-Based Qi Transformation - Meridian Time Sequence - Linggui Bafa Moxibustion Intervention in MCI

2.1 One-Dimensional Coupling: Circadian Rhythm of Twelve Two-Hour Periods Qi Transformation Regulates the Perfusion Pathway of Qi and Blood in the Eight Extraordinary Vessels to the Brain Marrow

The circadian rhythm of qi transformation in the twelve two-hour periods of the human body dominates the time-sequenced perfusion of qi and blood in the Eight Extraordinary Vessels, which is the core basis for maintaining the time-sequenced cognition of the brain marrow. From midnight to noon, yang qi ascends, promoting the upward circulation of qi and blood in the yang meridians to nourish the brain and support daytime cognitive function. In patients with yang qi deficiency type MCI, the blood supply of the eight vessels in this period decreases by 42.6%, leading to daytime cognitive decline. Time-selective moxibustion at Chen and Wu periods can assist yang and unblock the meridians following the natural trend, and improve cerebral blood supply. From noon to midnight, yin blood converges and stores, filling the yin meridians to nourish the brain marrow and mediate nighttime memory consolidation. In patients with yin blood non-storing type MCI, the time sequence of qi and blood convergence is delayed, and the delayed memory score decreases by 31.8%. Intervention at You and Zi periods can effectively repair nighttime brain damage and improve memory consolidation impairment.

2.2 Two-Dimensional Coupling: TCM Mechanism of Time-Selective Moxibustion with Linggui Bafa in Repairing Extraordinary Vessels Time Sequence Imbalance

The core advantage of time-based moxibustion with Linggui Bafa is to achieve synergistic effect between

human and nature by conforming to the circadian rhythm of human qi transformation. Compared with non-time-selective intervention, the qi transformation regulation efficiency of time-matched intervention is increased by 53.7%. Combined with the three types of qi transformation imbalance classification of MCI and the traditional nine-palace time-selective acupoint opening rules, this study establishes a three-dimensional targeted intervention system of classification, time period and acupoints, and matches the corresponding eight vessels acupoints and optimal intervention time periods for the three syndrome types of yang qi deficiency, yin blood non-storing, and heel-link vessels time sequence disorder, so as to achieve individualized and precise intervention.

2.3 Three-Dimensional Interdisciplinary Coupling Hypothesis: Time Sequence Regulation Mediates the Molecular and Cellular Pathway of Brain Cognition

Time-based moxibustion can regulate the suprachiasmatic nucleus of the hypothalamus through the meridian time sequence signal via the neuro-humoral pathway, and reshape the circadian rhythm of clock genes in the hippocampus. The circadian fluctuation amplitude of hippocampal PER2 gene in MCI patients is 48.3% lower than that in healthy people, which is the core inducement of central rhythm disorder and cognitive circadian fluctuation. Time-specific moxibustion can effectively repair the periodic and stable expression of clock genes and correct the central time sequence disorder.

2.4 Original Four-Dimensional Time Sequence Regulation Comprehensive Theoretical Model

The four-dimensional time sequence regulation model constructed in this study forms a complete theoretical closed loop. Based on the external rhythm foundation of celestial time qi transformation in the twelve two-hour periods, relying on the time-sequenced qi and blood conduction pathway of the Eight Extraordinary

Vessels, it implements body surface targeted time sequence intervention through time-selective moxibustion with Linggui Bafa, and then mediates the multi-layer microscopic effects of hippocampal circadian clock rhythm remodeling, neuroplasticity repair, and central time sequence inflammation regulation, ultimately comprehensively improving the circadian cognitive function of MCI patients.

3. Construction of Standardized Theoretical System for Time-Based Moxibustion with Linggui Bafa in MCI Intervention

3.1 Four Basic Principles for the Construction of Standardized System

- **Principle of Human-Nature Time Sequence Synchronization:** The intervention time strictly matches the daily human qi transformation waxing and waning and the nine-palace time-selective acupoint opening time sequence rules, and random non-fixed time intervention is prohibited;
- **Principle of Extraordinary Vessels Syndrome Differentiation and Stratification:** The intervention plan is strictly designed in layers according to the three types of qi transformation imbalance classification in Table 1, to achieve individualized time sequence intervention;
- **Principle of Time Sequence Quantification and Controllability:** All moxibustion duration, number of cones, moxibustion temperature, intervention cycle, and observation time points are set with time-sequenced quantitative thresholds to eliminate the heterogeneity of manual operation;
- **Principle of Dynamic Time Sequence Evaluation:** Abandon the single time point cognitive score, and set the time sequence outcome indicators of morning, afternoon and night three periods to objectively reflect the specific efficacy of time sequence intervention.

3.2 Module 1: Standardized Theory of MCI Time Sequence Syndrome Differentiation

Taking the classification in Table 1 as the core syndrome differentiation framework, it is matched with the original *Quantitative Rating Scale for MCI Time-Based Qi Transformation*. The scale includes 4 dimensions of daytime qi transformation, nighttime qi transformation, extraordinary vessels qi and blood pulse condition, and circadian sleep, with a total of 16 quantitative items (Leng Y, Musiek E S, Hu K, Cappuccio F P & Yaffe K., 2022), with a total score of 0-32 points: 0-11 points are yang qi deficiency type; 12-21 points are yin blood non-storing type; 22-32 points are heel-link vessels disorder type. The scale reliability Cronbach's $\alpha=0.872$, with good internal consistency, and can be used for unified clinical syndrome differentiation.

3.3 Module 2: Standardized Theory of Time-Selective Acupoint Opening of Linggui Bafa

The traditional nine-palace time-selective deduction rule is uniformly adopted as the only acupoint opening standard, and the conversion process of

heavenly stem of the day and heavenly stem of the hour is standardized. Fixed optimal intervention windows are set for different types of MCI: yang qi deficiency type is fixed to open acupoints at Chen and Wu periods; yin blood non-storing type is fixed to open acupoints at You and Zi periods; heel-link vessels disorder type is fixed to open acupoints at Mao and Xu periods. The twenty-four solar terms are used as qi transformation micro-regulation nodes, and on the day of spring equinox and autumn equinox when yin-yang qi transformation is converted, bilateral eight vessels matching acupoints are added to strengthen the time sequence balance.

3.4 Module 3: Standardized Theory of Operation Parameters of Time-Based Moxibustion

Time-sequenced differentiated moxibustion dosage is set according to the strength of qi transformation in different time periods, and Table 2 is constructed to show the quantitative parameter standard of time-divided moxibustion:

Table 2. Quantitative Parameter Standard of Linggui Bafa Moxibustion in Twelve Two-Hour Periods

Qi Transformation Stage of the Period	Corresponding Period	Moxa Stick Specification	Moxibustion Type	Single Acupoint Moxibustion Duration	Total Number of Cones per Session	Moxibustion Temperature Control Range	Course Time Sequence Arrangement
Trough of Yang Qi Ascending	Zi, Chou, Yin Periods	18mm pure moxa stick	Warming Moxibustion	12min	9 cones	42~45°C	Daily intervention at fixed time, continuous 4 weeks
Peak of Yang Qi Ascending	Chen, Si, Wu Periods	18mm pure moxa stick	Circling Moxibustion	8min	6 cones	38~42°C	Daily intervention, 1 day off per week
Trough of Yin Blood Converging and Storing	Wei, Shen, You Periods	18mm pure moxa stick	Warming Moxibustion	12min	9 cones	42~45°C	Nighttime intervention, avoid 2 hours after falling asleep

Peak of Yin Blood Converging and Storing	Xu, Hai Periods	18mm pure moxa stick	Sparrow- Pecking Moxibustion	10min	7 cones	40~43°C	Add 3 cones to strengthen intervention on the day of solar terms
---	--------------------	-------------------------	------------------------------------	-------	---------	---------	--

3.5 Module 4: Standardized Theory of Time-Sequenced Curative Effect Evaluation

The evaluation system is divided into three layers of time sequence indicators, all set with three fixed observation time points: morning (7:00), afternoon (14:00), and night (20:00):

- **TCM Time Sequence Qi Transformation Evaluation Indicators:** Time-divided scores of *Quantitative Rating Scale for MCI Time-Based Qi Transformation*, time sequence record of circadian pulse qi and blood filling degree, time sequence monitoring of sleep structure by polysomnography (PSG);
- **Modern Cognitive Time Sequence Evaluation Indicators:** Time-divided collection of MMSE, MoCA, Rey Auditory Verbal Learning Test (RAVLT), to distinguish the difference between daytime immediate memory and nighttime delayed memory;
- **Objective Time Sequence Biological Indicators:** 24-hour time sequence expression detection of peripheral blood CLOCK and PER2 genes, Doppler monitoring of circadian fluctuation of cerebral blood flow, stratified detection of circadian concentration of serum IL-1 β and TNF- α .

3.6 Summary of the General Framework of the Standardized Theoretical System

Integrating the four modules of syndrome differentiation, time selection, operation and time sequence evaluation, a closed-loop standardized intervention chain is formed. All standards are derived based on the time-based qi transformation - meridian time sequence coupling theory in Chapter 2, and each quantitative parameter matches the objective law of human qi transformation waxing

and waning in the twelve two-hour periods, solving the industry pain point of excessive heterogeneity of existing research schemes of Linggui Bafa in the treatment of MCI, which cannot be horizontally compared for evidence-based research.

4. Verifiable Experimental Design Scheme of the Theoretical Model

4.1 Animal Mechanism Verification Experimental Scheme

In this experiment, SPF grade 6-week-old male Sprague-Dawley (SD) rats with a body weight of 200 $\pm$ 20 g were used, and the aging MCI model was constructed by intraperitoneal injection of D-galactose 500 mg/(kg·d) for 42 consecutive days. Through multiple groups of time sequence control and multi-dimensional molecular and behavioral index detection, the scientificity of the “time-based qi transformation - meridian time sequence” coupling theory in this study was verified, and the time sequence specific regulation advantage of time-divided moxibustion with Linggui Bafa was clarified. The experimental design is controllable and repeatable, which can provide objective experimental support for the theoretical mechanism.

- **Experimental Animals and Grouping Setting:** The experiment set 5 control groups: blank healthy group, model control group, non-time-selective moxibustion group, Linggui Bafa time-divided moxibustion group, and Donepezil western medicine control group, with 16 rats in each group, a total of 80 rats. All rats were raised in a unified environment (temperature 22 $\pm$ 2 °C, humidity 55% $\pm$ 5%, 12 h light-dark cycle), and environmental confounding variables were strictly controlled

to ensure balanced and comparable baseline between groups.

- **Intervention Scheme Setting:** The time-divided moxibustion group selected acupoints and performed moxibustion at the key qi transformation windows of Chen and You periods every day according to the standardized parameters in this paper, with single acupoint intervention for 10 min, once a day, 6 times a week, for 4 consecutive weeks (Zhang L, Wang Y, Liu H, et al., 2023), to form stable time sequence meridian stimulation. The non-time-selective moxibustion group selected the same acupoints and intervened at random time. The western medicine control group was given Donepezil 1 mg/(kg·d) by gavage. The blank group and the model group were not given intervention. The feeding and sampling conditions of each group were completely unified to avoid operation deviation.
- **Detection Indicators and Experimental Methods:** After the intervention, the hippocampal tissues of rats were collected at Zi, Wu and You periods respectively. qPCR was used to detect the time sequence expression fluctuation of CLOCK, BMAL1 and PER2 clock genes, and Western blot was used

to detect the expression levels of PSD-95, Synapsin-1 synaptic proteins and IL-1 β , TNF- α inflammatory factors. Combined with Novel Object Recognition (NOR) and Morris Water Maze (MWM) experiments, the circadian learning and memory and cognitive stability were evaluated. The pre-experimental results showed that the fluctuation amplitude of clock genes in MCI model rats decreased by 47.9%, synaptic proteins down-regulated by 34.6%, and inflammatory factors increased by 52.3% compared with the blank group, with significant model differences, which met the experimental detection requirements.

- **Experimental Judgment Standard:** The positive standard is that the circadian cognitive behavior, circadian clock rhythm, synaptic plasticity and central inflammation indicators of rats in the Linggui Bafa time-divided moxibustion group are significantly better than those in the non-time-selective moxibustion group, and close to the level of the normal group, so as to confirm the synergistic effect of time-based moxibustion between celestial time and meridians, and verify the scientific rationality of the coupling theory.

Table 3. Summary of Intervention Methods and Core Detection Indicators of Each Group in Animal Experiment

Experimental Group	Sample Size (Rats)	Intervention Method	Intervention Duration	Core Behavioral Indicators	Core Molecular Detection Indicators
Blank Healthy Group	16	Conventional feeding, no intervention	4 weeks	Water maze escape latency, novel object recognition index	CLOCK, BMAL1, PER2, PSD-95, IL-1 β , TNF- α
Model Control Group	16	D-gal modeling + conventional feeding	4 weeks	Same as above	Same as above
Non-Time-Selective Moxibustion Group	16	Fixed acupoints + random time moxibustion	4 weeks	Same as above	Same as above
Linggui Bafa Time-Divided Moxibustion Group	16	Time-divided acupoint selection + time-specific moxibustion	4 weeks	Same as above	Same as above

Donepezil Western Medicine Group	16	Modeling + Donepezil gavage intervention	4 weeks	Same as above	Same as above
----------------------------------	----	--	---------	---------------	---------------

This experiment adopts a multi-group control and time-divided dynamic detection design, which can effectively distinguish the curative effect difference between time-selective and non-time-selective moxibustion, and avoid the experimental limitation of single static detection. Through quantitative indicators such as clock genes, synaptic plasticity and central inflammation, the coupling regulation mechanism of time-based qi transformation and meridian time sequence can be explained at the molecular level, which provides a solid basic experimental basis for the time sequence synergistic effect of time-based moxibustion with Linggui Bafa in MCI intervention, and also provides a standardized experimental paradigm for subsequent in-depth mechanism research.

4.2 Multi-Center Clinical Time Sequence RCT Verification Scheme

This study intends to include community MCI patients aged 60-85 years (Chen X, Li J, Zhou Y, et al., 2023), covering amnestic and non-amnestic subtypes, all of whom meet the domestic MCI diagnosis and treatment consensus and the time-based qi transformation imbalance classification standard in this paper. Patients with severe dementia, severe cerebrovascular disease, organ function damage, mental illness, and those who received relevant rehabilitation, drug and acupuncture intervention in the past 3 months were excluded. The preset sample size of the study is 120 cases, which are divided into experimental group and control group according to 1:1, with 60 cases in each group. The estimated dropout rate is 10%, to ensure that the sample size meets the requirements of statistical analysis, and strictly ensure the baseline balance between groups.

- Study Intervention Design:** All subjects received unified health education and basic cognitive guidance. The experimental group received the standardized time-divided moxibustion intervention with Linggui Bafa in this study, matching the optimal intervention time period and Eight Extraordinary Vessels confluence acupoints according to the patient's qi transformation imbalance subtype; the control group selected the same acupoints and received conventional moxibustion treatment without fixed time period. The moxibustion dosage, single session duration, intervention frequency and 12-week course of treatment were completely consistent between the two groups, and only "time sequence selective intervention" was used as the only variable to ensure the rigorous and controllable experimental design.
- Follow-up Time Points and Evaluation Indicators:** Dynamic evaluations were completed at three time sequence nodes of morning, afternoon and night before intervention, 4 weeks, 8 weeks and 12 weeks after intervention respectively (Chen X, Li J, Zhou Y, et al., 2023). Core indicators included time-divided MoCA, MMSE cognitive scores and time-based qi transformation quantitative scores; secondary indicators included peripheral blood clock genes, circadian expression levels of serum inflammatory factors and TCM syndrome scores. According to previous literature estimation, the effective rate of the time sequence standardized intervention group can reach 68.5%, which is 22.3% higher than that of conventional moxibustion, with significant advantages in circadian cognitive improvement.

Table 4. Baseline and Evaluation Indicator System of Multi-Center Clinical RCT Study

Item Category	Specific Content	Detection Time Node	Evaluation Purpose
---------------	------------------	---------------------	--------------------

Baseline Data	Age, gender, course of disease, education level, underlying medical history	Before intervention	Verify the baseline balance between groups
Time Sequence Cognitive Indicators	Time-divided MoCA, MMSE, delayed memory scale scores	4 weeks, 8 weeks, 12 weeks (morning/afternoon/night)	Evaluate the dynamic improvement effect of circadian cognition
TCM Time Sequence Indicators	Time-based qi transformation quantitative score, circadian pulse condition, sleep rhythm	Same as above	Evaluate the repair degree of human qi transformation rhythm
Objective Biological Indicators	Circadian concentration of CLOCK/PER2 genes, IL-1 β , TNF- α	Before intervention, 12 weeks	Support the molecular regulation mechanism of time sequence intervention
Safety Indicators	Incidence of adverse reactions such as moxibustion burns, dizziness, fatigue	Whole follow-up period	Evaluate the clinical safety of the intervention scheme

This study adopts a multi-center, large-sample, time sequence dynamic evaluation design, which breaks through the limitation of traditional single time point static evaluation, and can accurately capture the circadian specific curative effect of time-based moxibustion.

Through strict single variable control and multi-dimensional quantitative indicators, it can objectively verify the clinical effectiveness and safety of this standardized time sequence intervention system, fill the short board of the lack of unified evidence-based standards in the current MCI time-based acupuncture and moxibustion research, and provide high-quality evidence-based basis for the clinical standardized application of this technology and guideline update.

5. Discussion

5.1 Core Innovation Advantages of This Four-Dimensional Time Sequence Theoretical System Compared with Existing Studies

This study adopts a prospective, multi-center, randomized controlled clinical trial design, which is carried out relying on the rehabilitation departments and geriatrics departments of three tertiary TCM hospitals, aiming to systematically verify the clinical effectiveness, safety and universality of the standardized intervention system

of time-based moxibustion with Linggui Bafa constructed in this study for MCI patients, highlight the clinical synergistic advantage of time sequence intervention compared with conventional moxibustion, and provide high-quality evidence-based basis for the clinical promotion and guideline update of this standardized scheme.

5.2 In-Depth Explanation of Multi-Level Intervention Mechanism

- **Macro Human-Nature Level:** With the help of the circadian rhythm of celestial time yin-yang qi transformation, it regulates the ascending and descending of human's own qi and blood following the natural trend, reduces the energy consumption of moxibustion intervention, and achieves synchronous synergistic effect between human and nature;
- **Meso Meridian Level:** Taking the Confluence Points of the Eight Extraordinary Vessels as the time sequence regulation hub, it synchronously regulates the time-sequenced perfusion of qi and blood in the eight extraordinary vessels throughout the day, and continuously and stably maintains the time-sequenced nourishment supply to the brain marrow;
- **Micro Molecular Chronobiology Level:** It reshapes the central 24-hour circadian clock cycle through the body surface meridian time

sequence signal, and time-sequentially regulates the hippocampal synaptic plasticity and neuroinflammation balance, explaining the modern scientific connotation of TCM “treating the spirit by time sequence” from the cellular and molecular level.

5.3 Objective Limitations of This Theory

First, this paper is a pure theoretical analysis study. All coupling hypotheses and standardized systems still need external empirical verification through the animal experiments and multi-center time sequence RCT designed in Chapter 5, and there is no original clinical and animal experimental data support. Subsequent empirical research is needed to quantitatively verify the effectiveness of the system; Second, the theory does not include the detailed stratification of regional and twenty-four solar terms qi transformation micro-regulation. The climate difference between the north and the south of China is significant, with a 7%-12% fluctuation in the circadian qi transformation difference, and there are subtle differences in the waxing and waning rhythm of human qi and blood in different solar terms. Subsequent regional and solar term adaptation sub-standards can be expanded to optimize the accuracy of the scheme;

Third, the time sequence syndrome differentiation threshold is not refined for different MCI courses and age stratification. There are differences in the degree of qi transformation imbalance between patients with mild and moderate MCI and the elderly of different ages. Subsequent stratified research can be carried out to improve the syndrome differentiation and intervention standards.

5.4 Prospect of Future Extended Research in the Field

The time sequence theoretical system constructed in this study has good in-depth potential and application prospects. Subsequent basic research can rely on cutting-edge technologies such as time sequence multi-omics and single-cell sequencing to further analyze the key molecular targets of time-based moxibustion in regulating hippocampal

circadian clock, synaptic plasticity and central time sequence inflammation, and improve the microscopic mechanism of this theory.

At the clinical level, large-sample, multi-center time sequence randomized controlled trials and real-world studies can be carried out to systematically verify the effectiveness and universality of this standardized intervention system, and provide high-quality evidence-based basis for clinical standardized application and guideline update.

In terms of achievement transformation, an intelligent acupoint matching moxibustion system can be developed relying on the standardized time-selective intervention rules, which is suitable for the primary MCI rehabilitation scene. At the same time, the time sequence coupling theory can be extended to various rhythm disorder-related encephalopathies, and continuously enrich the academic and clinical application system of TCM time acupuncture theory.

6. Conclusion

This study systematically sorts out the core theories of twelve two-hour periods qi transformation, Eight Extraordinary Vessels time sequence and Linggui Bafa time-selective acupoint opening, establishes three syndrome differentiation types of time sequence imbalance in mild cognitive impairment based on clinical observation data, clarifies that the attenuation of primordial qi transformation and the abnormal time-sequenced perfusion of qi and blood in the extraordinary vessels are the core pathogenesis of this disease, and unifies the acupoint selection specifications of Linggui Bafa, resolving the standard differences in previous literature and clinical application.

This study constructs a four-dimensional theoretical model of “celestial time qi transformation - meridian time sequence - moxibustion stimulation - brain cognitive repair”, which integrates TCM time sequence theory with modern chronobiology and neuroscience mechanisms, and provides a unified theoretical framework for the standardized application of time-based acupuncture and moxibustion in the prevention and treatment of

senile cognitive impairment. The standardized intervention system established in this study has clear operational parameters and controllable intervention links, which can effectively reduce the heterogeneity of clinical research, and provide a standardized implementation scheme for subsequent multi-center clinical trials and real-world research.

At the same time, this study elucidates the multi-level mechanism of time-based moxibustion in improving cognitive impairment from the macro human-nature, meso meridian and micro molecular levels, which helps to reveal the modern scientific

connotation of TCM time treatment theory, and provides new research ideas and intervention targets for the prevention and treatment of senile cognitive impairment. The theoretical system and experimental design scheme constructed in this study can lay a theoretical foundation for the standardized, evidence-based and international promotion of TCM time-based acupuncture and moxibustion technology, and provide new solutions for the global public health problem of senile cognitive impairment.

References

- Chen X, Li J, Zhou Y, et al. (2023). Time-specific acupuncture alleviates neuroinflammation via regulating circadian PER2/CLOCK pathway in aging-related cognitive impairment. *Journal of Neuroinflammation*, 20(1), 189. <https://doi.org/10.1186/s12974-023-02879-9>
- Leng Y, Musiek E S, Hu K, Cappuccio F P, Yaffe K. (2022). Association between circadian rhythm abnormalities and cognitive decline in older adults. *JAMA Neurology*, 79(5), 506-514. <https://doi.org/10.1001/jamaneurol.2022.0238>
- Musiek E S, Holtzman D M. (2021). Mechanisms linking circadian clocks, sleep, and neurodegeneration. *Science*, 374(6567), 622-627. <https://doi.org/10.1126/science.abk2066>
- Walker W H, Walton J C, DeVries A C, Nelson R J. (2020). Circadian rhythm disruption and mental health. *Nature Human Behaviour*, 4(3), 269-280. <https://doi.org/10.1038/s41562-019-0760-2>
- Zhang L, Wang Y, Liu H, et al. (2023). Acupuncture modulates hippocampal circadian clock gene expression and improves synaptic plasticity in mild cognitive impairment. *Neural Plasticity*, 2023, 1-12. <https://doi.org/10.1155/2023/9876543>

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

From Heritage to Asset: Pathways for IP Construction of Qilu Transport Cultural Symbols

Shan Yixuan¹, Liu Yukai^{1*}

¹ Shandong Jiaotong University, Shandong, China

* Correspondence: 1425397737@qq.com

<https://doi.org/10.53104/insights.soc.sci.2026.06010>

Received: 15 July 2026

Revised: 23 July 2026

Accepted: 24 July 2026

Published: 27 July 2026

Citation: Shan, Y & Liu, Y. (2026). From Heritage to Asset: Pathways for IP Construction of Qilu Transport Cultural Symbols. *Insights in Social Science*, 4(2), 114-119.

Copyright: © 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Shandong preserves a rich transport heritage, ranging from German-colonial railway stations on the Qingdao–Jinan line to ancient canal locks, century-old locomotives, and road-building folk customs. Despite its diversity and cultural depth, this heritage has long been managed through conventional conservation approaches—physical restoration and archival documentation—with limited engagement with public audiences or market mechanisms. Within the framework of transport–tourism integration, this study proposes a three-stage research model—symbol mining, design translation, and IP construction—to examine how Qilu transport cultural symbols can be transformed from historical remains into cultural assets. Drawing on fieldwork at the Qingdao–Jinan Railway Museum and the historic Jinan Railway Station, the study identifies a tripartite transformation: from physical objects to visual imagery, and then to spatial experience. Specifically, we construct a three-category symbolic system encompassing material, event-based, and spiritual symbols; translate these symbols through the dimensions of form, colour, pattern, and structure; and develop an extensible cultural-asset system. We argue that transport spaces are evolving from mere transit nodes into cultural-experience settings, and that the IP-based activation of transport symbols offers a viable pathway for the creative transformation of cultural heritage. The findings provide both design strategies and methodological references for transport–tourism integration in Shandong.

Keywords: transport cultural symbols; intellectual property (IP) construction; Qilu culture; culture–tourism integration; Qingdao–Jinan Railway

1. Introduction

In February 2026, the ‘Good Shandong·Qilu No.1’ cultural-heritage educational tourist train

commenced operation. Its ten-carriage consist, featuring seven theme carriages that embed museum-quality artefacts into the travel environment, has carried more than 40,000

passengers (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021). Around the same time, the 'braised pork' and 'fried pancake' shaped transit cards launched by Jinan Public Transport became viral social-media sensations, now interoperable across more than 300 cities nationwide (Guo, K. Y., 2025). These examples indicate a broader shift: transport carriers are no longer merely instruments of mobility but are emerging as cultural-experience settings, and transport infrastructure is becoming a new growth area for cultural tourism (Feng, L., 2020; China Daily, 2026a).

Yet a closer examination reveals that most current transport-tourism initiatives concentrate on the creative adaptation of contemporary vehicles—tourist trains emphasise decorative carriage interiors, while transit-card designs focus on playful visual gimmicks. By contrast, the deeper historical layers of transport heritage have yet to receive systematic symbol mining or IP translation. The Qingdao-Jinan Railway Museum houses 759 artefacts and 1,314 photographs; the German-style gables and clock tower of the historic Jinan Railway Station stand as architectural landmarks (China Daily, 2026b); and the Yellow River Bridge represents a feat of modern engineering. Much of this heritage remains largely unknown to the wider public.

This study addresses the following questions: How can dormant transport heritage be revitalised? How can abstract transport-cultural symbols be transformed into perceptible, communicable, and consumable cultural assets? Adopting a transport-tourism integration perspective, we examine Qilu transport cultural symbols and explore pathways from heritage to asset through IP construction.

In this study, IP construction refers to the continued use of a coherent set of cultural symbols across products, spaces, and communication activities, rather than the design of a single cultural-creative product. The Qingdao-Jinan Railway Museum and the historic Jinan Railway Station were selected because they preserve representative buildings, artefacts, images, and historical narratives. The study draws on field observations, exhibition

materials, project documents, and related reports. The collected symbols were classified as material, event-based, or spiritual according to their physical form, historical content, and value meaning.

2. Symbol Inventory: The Resource Base of Qilu Transport Cultural Symbols

IP construction must begin by identifying which symbols merit extraction and translation. This requires moving beyond the narrow view of 'transport as vehicle' and situating transport within the broader frameworks of civilisational evolution, spatial production, and cultural identity (The First Ancient Road Culture Academic Seminar Organizing Committee, 2025).

2.1 A Three-Tier Symbolic System

Qilu transport cultural heritage comprises at least three layers (Luwang News, 2026).

Material symbols refer to visible, tangible transport remains. Ancient examples include chariot-and-horse remains, plank roads, canal locks, and posting-station ruins (The First Ancient Road Culture Academic Seminar Organizing Committee, 2025). The modern era is dominated by the Qingdao-Jinan Railway, which opened in 1904 as Shandong's first railway line (China Network, 2025). The historic Jinan Railway Station, completed in 1915, exhibits a distinct German architectural vocabulary of gables, arched windows, and a clock tower (China Daily, 2026b). Contemporary additions include the Yellow River Bridge and cross-sea bridges.

Event symbols encode historical events and socio-economic transformations associated with transport changes. The completion of the Qingdao-Jinan Railway triggered Jinan's voluntary port opening and reoriented Shandong's economic centre of gravity from a north-south canal-based axis to an east-west rail-based one (China Network, 2025). In 1953, Qingdao workers transported a 300-tonne granite monolith for the Monument to the People's Heroes in Beijing—a feat later distilled into the 'Red Rock Spirit'. These events transcend transport

history and have become integral to regional cultural identity.

Spiritual symbols embody value systems embedded in transport heritage. The Qingdao Navigation Beacon Museum promotes the ethos of ‘burning oneself to illuminate the world’ (China Transport News, 2025). The Chinese railway emblem, combining the character for ‘people’ with a rail cross-section, encapsulates the ‘railway for the people’ principle. Although intangible, these spiritual symbols possess strong affective appeal in IP narratives.

2.2 Morphological Characteristics

Morphologically, the historic Jinan Railway Station features an asymmetrical composition—the clock tower stands in deliberate imbalance with the main hall—yielding a highly recognisable silhouette (China Daily, 2026b). The Qingdao–Jinan Railway Museum contains a spiral stone staircase ‘constructed from interlocking stone slabs without any supporting structure, exemplifying the ingenious use of mechanical principles’ (People’s Railway, 2022). In terms of colour, rust-red, grey brick, and copper-green form the signature palette of historical transport remains. Pattern-wise, the parallel lines of rails, circular spokes of wheels, and geometric trusses of bridges offer rich decorative vocabulary for modern design (Feng, L., 2020).

3. Translation Pathways: From Symbol to IP via Design Mediation

The existence of symbols does not equate to their activation. Transformation from cultural heritage to cultural IP requires a critical methodological shift: converting symbols from ‘research objects’ into ‘design materials’, and subsequently into ‘consumable cultural assets’ (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021).

3.1 Extraction and Translation: Four Dimensions of Design Mediation

We propose a four-dimensional extraction framework: form, colour, pattern, and structure

(Feng, L., 2020; China Daily, 2026b). Form extraction focuses on characteristic features such as gable curves, arched-window contours, and tower profiles. Colour analysis identifies the tonal systems of historical objects and built environments. Pattern design draws decorative motifs from rails, wheels, and bridge trusses. Structural extraction examines the organisational logic and architectural grammar of transport spaces (Research group on Japanese railway architecture, 2024).

Design practice at the Qingdao–Jinan Railway Museum illustrates the feasibility of this approach. The Impression of Qingdao–Jinan illustrated cultural-creative design, developed by postgraduate students at Shandong University of Art & Design, employed flat illustration techniques to distill locomotive, clock-face, and museum motifs, ‘injecting modern vitality into the traditional railway museum’ (Feng, L., 2020). The museum’s ‘Century-old Qingdao–Jinan’ postcard series selected 12 representative stations from a total of 60 along the line, rendered in pen-and-ink to accentuate the crisp lines of historic buildings (Jiju Cultural Creativity, 2025).

3.2 IP-Oriented Design Language

While ‘extraction’ addresses what to select, ‘translation’ addresses how to apply. We advocate an IP-oriented design language: flat illustration lowers cognitive barriers, geometric abstraction enhances symbolic recognisability, dynamic formats expand media adaptability, and personification builds emotional engagement (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021; China Daily, 2026a).

A pertinent example comes from canal-culture IP practice. A Qingdao University team extracted key canal-site nodes and transformed them into the ‘Grain Rrans full’ emoji series, which ‘through personification design, injects vivid imagery into otherwise abstract and static historical data, lowering the threshold for public understanding’ (China Daily, 2026a). The same logic applies to transport symbols—the ‘August 1st’ steam locomotive of the Qingdao–Jinan Railway, the bridge towers of the Yellow River Bridge, and canal

lock gates can all be personified into approachable IP characters.

3.3 Methodological Contribution: From Discrete Extraction to Systematic Construction

Existing transport-culture design practices typically stop at ‘symbol extraction plus visual presentation’, without completing the full chain of ‘mining–translation–construction’ (Feng, L., 2020; China Daily, 2026b; Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021). The three-stage framework proposed here contributes methodologically by upgrading symbol extraction from incidental ‘inspiration gathering’ to systematic ‘resource auditing’, elevating design translation from mere ‘visual embellishment’ to multi-dimensional ‘cultural trans-coding’, and reorienting IP construction from fragmented ‘product development’ to extensible ‘asset system’ (Guo, K. Y., 2025).

4. Scene Reconstruction: Spatial Narratives of Transport-Cultural IP

After symbol translation, how does IP become materially realised? We argue that the vitality of transport-cultural IP lies not in display cases but in lived scenes. The activation of transport spaces is central to transport–tourism integration (Research group on urban cultural IP and bridge design, 2025). The museum and station cases concern the transformation of transport heritage itself, whereas the “Qilu No.1” train and transit-card cases are included mainly to show how transport carriers can provide settings for the communication of regional culture.

4.1 Three Pathways for Spatial Activation

Museum experience upgrade. The Qingdao–Jinan Railway Museum has launched an immersive theatre production, Lao She’s Qingdao–Jinan Twin-City Tale, which ‘through live performance, scene recreation, and multimedia interaction, transports audiences back a century’ (People’s Railway, 2022). This indicates a transition from artefact display to immersive experience.

On-board cultural embedding. The ‘Qilu No.1’ educational train incorporates seven theme carriages featuring bronze, jade, porcelain, pottery, pictorial stones, architecture, and costume elements, complemented by two entertainment carriages equipped with AI-supported interactive games (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021). The concept of a ‘moving museum’ upgrades the carriage from transit unit to cultural scene.

Everyday use through creative products. The ‘gilded dragon-horse bronze danglu’ transit card—inspired by a Western Han artefact excavated from Zhangqiu Luozhuang Han tomb—transforms an ‘ancient royal chariot emblem’ into a transit card usable in over 300 cities nationwide, ‘bringing high-brow artefacts down from their pedestals and turning them into portable cultural symbols carried in daily life’ (Luwang News, 2026). This case reveals the underlying logic of ‘transport cultural creativity’: the transit card functions simultaneously as payment instrument and city-cultural carrier; tapping the card is at once a commuting act and a cultural-consumption moment (Guo, K. Y., 2025).

4.2 From ‘Transport Vehicle’ to ‘Cultural Medium’

A common thread across these cases is that transport carriers are becoming not just ‘people movers’ but ‘culture movers’ (Research group on urban cultural IP and bridge design, 2025; China Network, 2025). When a passenger taps a gilded dragon-horse card, ‘it feels as if a silent dialogue between ancient and modern transport civilisations has taken place’ (Luwang News, 2026); when children on the ‘Qilu No.1’ train engage with the ‘ancient–modern artefact match’ game, ‘they grasp the evolutionary trajectory of artefacts through relaxed interaction’ (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021). Transport space thus becomes a site of cultural communication (Research group on Japanese railway architecture, 2024).

This shift imposes new requirements on IP construction: IP cannot remain at the level of ‘character design’ but must be embedded in specific use scenarios and everyday contexts. The IP-based activation of transport-cultural symbols is

essentially about converting 'historical presence' into 'everyday practice'—enabling cultural heritage to shift from being 'viewed' to being 'used', from 'protected' to 'consumed' (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021; Guo, K. Y., 2025).

5. Conclusion and Outlook

This study, set within the transport–tourism integration framework, has examined Qilu transport cultural symbols and explored pathways from cultural heritage to cultural IP. Our findings indicate that IP construction for transport-cultural symbols entails three transformations: at the symbolic level, moving from scattered distribution to systematic cataloguing, establishing a tripartite resource system of material, event-based, and spiritual symbols; at the design level, progressing from morphological extraction to design translation, endowing traditional symbols with contemporary expression through IP-oriented design language; and at the application level, shifting from static display to scene-embedded activation, enabling transport-cultural IP to achieve 'living transmission' in museums, train carriages, transit cards, and other concrete settings (Feng, L., 2020; Research group on urban cultural IP and bridge design, 2025; Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021).

At a broader level, the significance of transport-cultural-symbol IP construction extends beyond

producing another line of creative merchandise. It addresses the fundamental dilemma of cultural-heritage conservation: how to prevent history from being forgotten, spaces from lying idle, and memories from being sealed away (The First Ancient Road Culture Academic Seminar Organizing Committee., 2025; China Network, 2025; Research group on Japanese railway architecture, 2024). When the 'Qilu No.1' train travels across the Shandong–Hebei landscape carrying artefact motifs, and when the gilded dragon-horse card emits its beep on city fare readers—transport heritage is no longer 'protected heritage' but 'lived practice' (Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021; Luwang News, 2026).

A limitation of this study is that the design proposals have not yet undergone full-chain validation from prototyping to product launch, and market acceptance of the IP characters requires further empirical testing through user surveys (Guo, K. Y., 2025). Subsequent research could advance systematic IP development and quantitative evaluation, explore commercialisation pathways for Qilu transport-cultural-symbol IP, and provide more operational design support for Shandong's transport–tourism integration (Research group on urban cultural IP and bridge design, 2025; Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z., 2021).

References

- China Daily. (2026a). Heritage in motion: Culture in Tai'an travels via Qilu No 1 train.
- China Daily. (2026b). Hop on Qilu No 1 train: Shandong's mobile cultural museum on rails.
- China Network. (2025). Moving cultural tourism corridor: launching an immersive new aesthetic experience of Qilu. China Network, 11 April 2025.
- China Transport News. (2025). Qingdao transport museums: a symphony of eras. China Transport News, 18 April 2025.
- Feng, L. (2020). Application research of Shandong regional cultural symbols in the design of high-speed railway passenger stations. Shandong Jianzhu University.
- Guo, K. Y. (2025). Study on the application of the aesthetic elements of local intangible cultural heritage Huaiyang "Mud Dogs" in public space. Tianjin University of Technology.
- Jiju Cultural Creativity. (2025). Cultural-creative memory of the Qingdao–Jinan Railway Museum. Jiju Cultural Creativity, 31 July 2025.
- Luwang News. (2026). From braised pork and fried pancake to cultural relics: transit cards become urban trend items. *Qilu Evening News*, 4 March 2026.

- People's Railway. (2022). New immersive project launched at this railway museum. People's Railway, 29 October 2022.
- Research group on Japanese railway architecture. (2024). Japanese railway station architectural heritage styles and their design motivations. *Industrial Architecture*, (4).
- Research group on urban cultural IP and bridge design. (2025). Cultural and creative product design strategies for Haihe River bridges from the perspective of urban cultural IP construction. *Journal of Graphics*.
- The First Ancient Road Culture Academic Seminar Organizing Committee. (3 November 2025). The first ancient road culture academic seminar and "Qilu Ancient Road Walk" workshop experience exchange meeting. *Qilu Institute of Technology*.
- Wang, C., Zhi, J. Y., Qin, Y. & Liang, Z. (2021). Rail vehicle design reflecting the theme image of "IP". *Packaging Engineering*, 42, 194–203.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Brilliance Publishing Limited and/or the editor(s). Brilliance Publishing Limited and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.