

Construction of Narrative Expression in Integrating Traditional Textile Patterns into Exhibition Design and Evaluation of Public Art Communication Effectiveness

Yin Yang

Jilin University of Architecture and Technology, Changchun 130114, Jilin, China

Corresponding author: Yin Yang (e-mail: yingeng12321@126.com)

ABSTRACT As a visual symbol system carrying cultural information, traditional geometric patterns have important value in exhibition design and public art communication. Their narrative transformation and communication effectiveness evaluation are key issues in the contemporary activation of cultural heritage. In exhibition environments that increasingly use interactive display systems, electromagnetic sensing devices, and antenna-assisted spatial interfaces, pattern narratives are also affected by digital media, spatial perception, and audience interaction. Based on narratology, semiotics, and communication studies, this paper constructs a three-dimensional narrative expression system of symbol decoding, narrative translation, and spatial presentation. Combined with typical exhibition cases, it analyzes the transformation path from pattern semantics to exhibition narratives. Meanwhile, the Analytic Hierarchy Process (AHP) and an integrated 5W communication model with interactive feedback loops are introduced to establish a communication effectiveness evaluation system consisting of four criterion layers and sixteen indicator layers. The validity of the model is verified through questionnaire surveys and expert scoring. The study finds that the symbolic semantics of patterns need to be implemented through material metaphor and interactive experience, and the core influencing factors of communication effectiveness are the degree of cultural cognition improvement, with a weight of 0.321, and the strength of emotional resonance, with a weight of 0.278. This research provides a theoretical framework for the exhibition transformation of traditional patterns and a quantitative evaluation method for public art communication effects in digitally enhanced engineering exhibition spaces.

INDEX TERMS traditional geometric patterns, exhibition design, narrative expression, electromagnetic sensing, communication effectiveness

I. INTRODUCTION

A. RESEARCH BACKGROUND

TEXTILE manufacturing is one of the most widespread and commonly used craft technologies created by humans, with universal applicability [1]. Traditional Chinese textile patterns possess unique ethnic characteristics. These pattern elements have undergone multiple evolutions throughout history, integrating various cultural elements, and ultimately forming the traditional textile culture [2]. They embody the outstanding cultural connotations and unique styles of traditional Chinese culture. As an aesthetic product of traditional Chinese aesthetics, traditional Chinese textile patterns are an important component of traditional Chinese art forms [3,4]. The linear elements of traditional patterns feature distinct styles and diverse forms. They have

demonstrated phased aesthetic ideals in different periods of China and have been widely used in modern design as key elements of design with Chinese characteristics [5]. Exhibition design is a general term combining display and arrangement. The essence of exhibition design is to use the language of artistic design within a given time and space scope, and create a unique spatial scope through the elaborate creation of space and plane [6,7]. At the beginning of the 20th century, narratology, an emerging theory, emerged in the field of literary research [8]. In the 1960s, this discipline had roughly formed its own set of basic theoretical systems, which stated that narratology is the study of how to introduce a work of art through storytelling [9,10]. Over time, the theoretical development in narratology has broken through the constraints of traditional literature, penetrated

into the fields of humanities and sociology, and gradually become a universal method in communication science [11]. As an atmosphere for creating and managing the linguistic environment, the narrative context, when combined with exhibition design, helps the exhibition space understand the abstract concept of “spiritual atmosphere”, making the exhibition design more abundant, organized, and connotative [12-14]. The application of narrative techniques in exhibition design has become a professional design language for curators to introduce story content to viewers. It is a process in which curators express, narrate, and design architectural objects through storytelling. With the popularization of digital technology, the design language of exhibition display has now integrated some characteristics of new media technology language [15,16], such as the decentralization of narrative content, the collage of exhibition forms, the programming of interactive behaviors, and the entertainment tendency of experience. Changes in design language have brought new opportunities to exhibition display design.

The “Digital Cultural Relics” exhibition of the Palace Museum reconstructs the weaving scenes of brocade patterns through VR technology. The Dujinsheng Brocade Museum uses data visualization to analyze the longitude and latitude logic of patterns. These cases confirm the transformation trend of pattern exhibition from “static viewing” to “dynamic narrative”. The involvement of digital media technology in exhibition display design has brought new possibilities for the public art communication of traditional textile patterns. Against this background, exploring the construction mechanism of integrating traditional textile patterns into pattern narrative and the evaluation method of communication effectiveness is of great significance for spreading traditional Chinese textile culture. Theoretically, it can improve the contemporary translation theory of traditional crafts; practically, it can provide operable exhibition design schemes for cultural and museum venues.

B. RESEARCH STATUS

Exhibition design is an artistic work. Among the exhibited objects, cultural relics are even more works of art created by human beings. An attractive exhibition hall is pleasing to the eye, gives people a good feeling, and leaves a deep impression. There are many factors in exhibition hall design. The basic requirement of exhibition hall design is to use artistic techniques to combine these factors to produce the best visual effect and good psychological effect [17]. The introduction of narrative techniques into the display of exhibits is an inherent feature of exhibition design. In recent years, many exhibits in museums at home and abroad have shown a trend of being displayed through stories. Many large museums have applied theories related to narrative techniques in their internal exhibitions, such as the exhibition “Yuan Longping and Hybrid Rice” in the National Rice Museum; the exhibition “Who Adjusts the Clear Pipe to Play the New Sound - Unearthed Cultural Relics of Silk Road Vocal Music Art” jointly organized by the Henan

Museum and the Luoyang Museum Research Institute; and the exhibition “Jade Meets You - A Conversation about Jade in the Zhou Dynasty and the Present” in the Shanxi Museum. The introduction of concepts related to narrative techniques into exhibition design is an innovation in display methods and an active exploration to further meet the needs of the new era [18-20]. With the continuous improvement and expansion of exhibition needs, there will be more development possibilities in exhibition design in the future, including the distinct reflection of national cultural characteristics [21]. Whether in the East or the West, especially in the current era of over-developed industrialization, there is an urgent need to protect and continue historical culture. Therefore, as the main position for cultural communication and inheritance [22], exhibition designers should strive to explore the essence of historical culture from different ethnic groups, regions, and even eras, and reinterpret and inherit it using modern design methods.

In recent years, the country has paid more and more attention to the protection and inheritance of intangible cultural heritage. As a symbol of Chinese culture, traditional Chinese textile patterns are not just simple patterns. They also carry rich national emotions [23] and contain unique aesthetic values. Digital design can bring traditional patterns out of history, integrate them more into people’s modern lives, and make culture “come alive” and innovate. The rapid development of digital technology is reshaping the creation methods, communication paths, and acceptance forms of contemporary culture and art. Digital media has not only changed the channels of information dissemination but also reshaped the expression forms of traditional visual language [24]. Traditional textile patterns are a symbol system carrying many cultural implications. In the past historical periods, they were mostly spread through physical objects such as utensils and buildings. There is abundant literature in current academic research on special studies of traditional patterns and the combination of traditional patterns with different fields [25]. However, most academic studies on the application of linear elements of traditional Chinese textile patterns focus on a certain field or specific cases, and there are few studies on their application in exhibition design schemes. The integration of traditional Chinese textile patterns into exhibition design is in line with the future innovation of exhibition design. The research on public art in China mainly focuses on its analysis from the perspective of art. Generally speaking, the current research on public art in China mainly has two schools: the “practical school” and the “theoretical school” [26]. The “artistic practical school” mostly regards public art as a type of art. Different from traditional easel art and private art, it exists in public spaces for the public to appreciate and view. The private expression of art is weakened, and the concept of artistic creation highlights public nature more. The “theoretical school” focuses on the public’s involvement in public spaces in public art, thereby initiating discussions on whether a public sphere has been formed in China.

C. RESEARCH CONTENT AND METHODS

Research Content.

- (1) Analyze the symbol system and narrative genes of traditional textile patterns, and construct a three-dimensional symbol model of “semantics - form - context”;
- (2) Study the construction path of exhibition narrative expression, and propose a three-stage framework of “symbol decoding - narrative translation - spatial presentation”;
- (3) Construct an evaluation system for public art communication effectiveness, and determine index weights and evaluation standards based on the AHP method;
- (4) Conduct case verification and put forward optimization suggestions, and test the effectiveness of the theoretical model through 3 typical exhibition cases.

Research Methods.

- (1) Literature research method: Systematically sort out theories related to narratology, semiotics, and communication studies to build the theoretical foundation of the research;
- (2) Case analysis method: Select typical cases such as silk embroidery exhibitions and special exhibitions on continuous bead patterns to analyze the success and failure factors of narrative construction;
- (3) Analytic Hierarchy Process (AHP): Invite 15 experts to score weights and construct an evaluation index system;
- (4) Questionnaire survey method: Distribute 600 questionnaires in 3 case venues, recover 528 valid questionnaires, and conduct statistical analysis of data using SPSS 26.0.

II. SYMBOLIC GENES AND NARRATIVE POTENTIAL OF TRADITIONAL TEXTILE PATTERNS

A. CONSTRUCTION OF THE SYMBOLIC GENEALOGY OF TEXTILE PATTERNS

The symbolic system of traditional textile patterns exhibits the characteristic of “multi-level nesting” and can be divided into three major types according to their semantic attributes (see Table 1).

- Patterns of nature worship use concrete symbols to carry primitive beliefs. For example, the fish patterns of the Yangshao culture symbolize reproductive worship, and the linked-pearl deer patterns of the Tang Dynasty imply auspiciousness;
- Patterns of social ethics convey ritual norms through stylized expressions. The rank badges of the Ming and Qing dynasties used birds and beasts to distinguish official ranks;
- Patterns of philosophical concepts interpret Oriental wisdom through abstract forms. For instance, the Tai Chi pattern embodies the worldview of “yin and yang generating each other”.

B. CONSTITUENT DIMENSIONS OF THE NARRATIVE GENES OF PATTERNS

The narrative potential of patterns stems from the superposition of their threefold genes: “semantics - craftsmanship - context”.

Semantic Genes.

They are embodied in the symbolic metaphor system. For example, the “fortune character patterns” on Jiangnan indigo printing and dyeing fabrics combine homophones with graphics to construct the narrative core of “long-lasting good fortune”.

Craftsmanship Genes.

They contain the temporal clues of technological evolution. The craft traces left by the “warp-through and weft-cut” technique of the multi-harness loom in patterns have become narrative codes for interpreting the history of weaving.

Contextual Genes.

They are associated with specific social scenarios. The “round dragon patterns” on Qinqiang opera costumes are only used for emperor roles, and their display requires combining the context of opera performances to fully convey narrative information.

C. INNOVATIVE POSSIBILITIES OF PATTERN NARRATION IN THE DIGITAL AGE

Digital technology has broken through the display limitations of traditional patterns and formed an innovative path of “multi-dimensional narration”, including the following dimensions:

Visual Dimension.

3D modeling technology can restore the weaving process of patterns. The “Digital Brocade” exhibition at the China National Silk Museum converts the longitude and latitude interweaving process of linked-pearl patterns into visible narration through dynamic demonstrations.

Interactive Dimension.

Somatosensory technology enables real-time interaction between audiences and patterns. For example, the interactive screen in the “Silk Embroidery: Warp and Weft” exhibition allows audiences to generate personalized patterns by winding silk threads.

Communication Dimension.

Blockchain technology can trace the inheritance context of patterns and establish digital identity files for each traditional pattern, including craft origin and cultural connotation.

Threshold Definition for Digital Technology Application.

To avoid the formalization of interactive devices, this study defines the “narrative relevance threshold” for digital technology application: digital tools are considered “innovative” only when they directly serve the transmission of pattern semantics or craft genes; otherwise, they risk becoming a “detriment” to the narrative. Specifically, interactive devices should meet at least one of the following criteria:

- (1) Assist in decoding the symbolic semantics of patterns;
- (2) Restore the key links of craftsmanship;
- (3) Enhance the audience’s emotional connection with cultural connotations.

TABLE 1. Classification of the Symbolic Genealogy of Traditional Textile Patterns

Symbol Type	Core Semantics	Typical Pattern Examples	Cultural Carriers
Nature Worship	Life reproduction, reverence for nature	Fish patterns, bird patterns, sun patterns	Yangshao painted pottery, Tang Dynasty brocade
Social Ethics	Hierarchical order, moral education	Rank badge patterns, interlocking lotus patterns	Official uniforms of the Ming and Qing dynasties, court kesi (silk tapestry)
Philosophical Concepts	Cosmic cognition, aesthetic ideals	Tai Chi patterns, cloud patterns	Taoist costumes, literati embroidery

III. CONSTRUCTION PATH OF NARRATIVE
EXPRESSION IN THE EXHIBITION OF TRADITIONAL
TEXTILE PATTERNS

A. THEORETICAL FRAMEWORK OF NARRATIVE
CONSTRUCTION

Based on narratology and semiotics theories, a narrative expression framework of “three stages and nine dimensions” is constructed (see Figure 1).

The first stage is symbol decoding, which explores the narrative core of patterns through three dimensions: semantic analysis, craftsmanship restoration, and context reconstruction;

The second stage is narrative translation, which converts the decoded information into narrative schemes at three levels: theme positioning, structural design, and language coding;

The third stage is spatial presentation, which realizes the physical implementation of narration through scene creation, media integration, and interactive design.

This framework emphasizes that “patterns are the core, narration is the vein, and space is the carrier”, ensuring the accurate transmission of cultural connotations and the in-depth enhancement of audience experience.

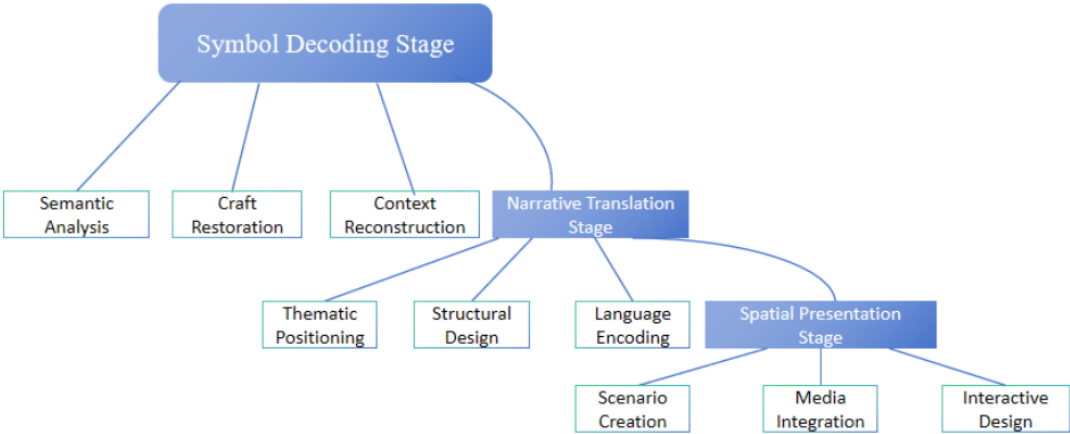


FIGURE 1. Narrative Expression Framework.

B. IMPLEMENTATION STRATEGIES FOR KEY
CONSTRUCTION LINKS

Symbol Decoding: Semantic Transformation from Patterns to Narration.

(1) Semantic analysis requires the adoption of a “layered excavation method”

- Identify surface-level visual elements (such as the vine shape and color proportion of interlocking branch patterns);
- Analyze mid-level symbolic semantics (endless vines imply eternal vitality);
- Connect with deep-level cultural connotations (the Confucian view of life that “man is an integral part of nature”).

(2) Craftsmanship restoration can combine field investigations and technical analysis. For example, decoding the “Zhuanghua” (colorful brocade) technique of Yunjin (Nanjing brocade) requires restoring the craft details of pattern

color gradation through oral records of intangible cultural heritage inheritors and fiber analysis under a microscope.

(3) Context reconstruction needs to integrate historical documents and archaeological materials through a “temporal-spatial consistency verification method”. For example, when displaying cloud patterns of the Han Dynasty, the silk books and costume cultural relics unearthed from the Mawangdui Han Tomb are connected based on three verification steps:

- (1) Confirm the chronological consistency of the cultural relics (both belong to the Western Han Dynasty);
- (2) Verify the functional relevance (silk books record ritual systems, and costumes reflect ritual practices);
- (3) Supplement with contemporary literature (such as “Records of the Grand Historian” to confirm the social context of cloud patterns in ritual scenes).

This method avoids historical anachronism and over-interpretation, constructing a coherent context system of “costumes - rituals - beliefs”.

Narrative Translation: Design of Narrative Structure and Language.

(1) Narrative structure should be flexibly selected according to pattern types:

- Patterns with a clear historical context (such as linked-pearl patterns on the Silk Road) are suitable for an linear structure, with exhibition routes arranged in chronological order;
- Patterns with multiple meanings (such as the various auspicious connotations of peony patterns) can adopt a parallel structure, with thematic sections such as “prosperity and auspiciousness” and “scholarly elegance”;
- Patterns with profound cultural connotations (such as Tai Chi patterns) are suitable for a circular structure, with the philosophical concept of “eternal vitality” reflected through a circular exhibition route.

(2) Narrative language needs to achieve the adaptation of “symbol - medium”.

- Visual language can use scaling and reorganization of pattern elements (such as the giant embroidered scrolls in the “Silk Embroidery: Warp and Weft” exhibition);
- Auditory language can incorporate weaving sounds (such as the sound of shuttles moving in a multi-harness loom);
- Tactile language allows audiences to perceive the tactile differences of different silk threads through material reproduction.

Spatial Presentation: Creation of Immersive Narrative Scenes.

(1) Scene creation needs to follow the “atmosphere matching principle”. For example:

- When displaying court brocade patterns, high ceilings, warm tones and symmetrical layouts can be used to create a solemn and luxurious spatial atmosphere;
- When displaying folk indigo printing and dyeing patterns, low display stands, cool tones and natural materials are more appropriate to highlight the simple and fresh style.

(2) Media integration needs to build a “multi-sensory matrix”. For example: The display of linked-pearl patterns in the China National Silk Museum combines “physical embroidered works + digital projections + audio commentary”, allowing audiences to fully understand the connotation of patterns from visual and auditory dimensions.

(3) Interactive design should avoid formalism and can set up two modules: “pattern creation” and “craft experience”:

- The former allows audiences to design modern patterns using digital brushes;
- The latter provides simple looms for audiences to experience the weaving of warps.

C. ANALYSIS OF NARRATIVE CONSTRUCTION IN TYPICAL CASES

As a successful case of pattern narration, the “Silk Embroidery: Warp and Weft” exhibition fully demonstrates the three-stage path in its construction process (see Table 2).

- In the symbol decoding stage, the curatorial team extracted the craftsmanship gene of “interweaving of warp and weft” and the semantic core of “conveying emotions through threads” of silk embroidery patterns through literature research and interviews with craftsmen;
- In the narrative translation stage, the core theme of “the life narrative of silk threads” was established, and a progressive structure of “entering the scene - observing the scene - touching the scene - comprehending the scene” was adopted;
- In the spatial presentation stage, thread installations, natural light systems and interactive screens were used as carriers to build a multi-sensory narrative scene.

The core innovation of this case lies in transforming the abstract concept of “warp and weft” into a perceptible spatial experience, breaking the limitations of the exhibits themselves in pattern narration.

IV. CONSTRUCTION AND APPLICATION OF THE PUBLIC ART COMMUNICATION EFFECTIVENESS EVALUATION SYSTEM

A. THEORETICAL BASIS AND DESIGN PRINCIPLES OF THE EVALUATION SYSTEM

Taking Lasswell’s 5W communication model integrated with interactive feedback loops as the core framework and combining the hierarchical analysis advantages of the AHP method, the evaluation system establishes 4 criterion layers: “communication subject - communication content - communication medium - communication effect”. The integrated model retains the basic structure of the 5W model while adding feedback mechanisms to adapt to the “interactive” and “decentralized” characteristics of digital exhibitions. Specifically, the “With What Effect” dimension includes both immediate communication effects and feedback-driven iterative optimization indicators, resolving the theoretical mismatch between linear models and non-linear interactive experiences. The design process follows three principles:

- The principle of cultural adaptability: Indicators should reflect the cultural characteristics of textile patterns, such as the indicator of “craft restoration accuracy”;
- The principle of operability: Indicators with high quantifiability should be selected to avoid abstract descriptions;
- The principle of dynamic adjustment: An interface for indicator updates should be reserved to adapt to the development needs of digital exhibitions.

TABLE 2. Analysis of Narrative Construction in the “Silk Embroidery: Warp and Weft - Oriental Narrative” Exhibition

Construction Stage	Core Implementation Measures	Reflection of Narrative Effects
Symbol Decoding	Interviewed 12 intangible cultural heritage inheritors to analyze the craft codes of 36 embroidery patterns; sorted out the contextual connection between silk embroidery and weddings/rituals	Clarified the dual narrative lines of “craft inheritance - emotional expression”
Narrative Translation	Established the theme of “the life narrative of silk threads”; designed the exhibition route with a “progressive experience” structure	The audience’s visiting path highly aligned with the narrative logic
Spatial Presentation	Created an experience of “pushing through threads to enter the scene” with an entrance thread barrier; projected dynamic embroidery shadows through the central natural light system; realized co-creation with interactive screens	The audience’s stay time increased by 47% compared with traditional exhibitions

B. CONSTRUCTION PROCESS OF THE EVALUATION INDEX SYSTEM

Index Screening and Hierarchical Division. Indicators are determined through literature review and the expert Delphi method, forming a three-level system of “target layer - criterion layer - indicator layer” (see Table 3).

- The communication subject criterion layer focuses on curatorial professionalism, including 2 indicators: “curatorial team qualification” and “participation degree of intangible cultural heritage inheritors”;
- The communication content criterion layer focuses on narrative quality, covering 4 indicators such as “semantic transmission accuracy” and “craft restoration integrity”;
- The communication medium criterion layer focuses on carrier effectiveness, including 5 indicators such as “spatial design adaptability” and “digital technology application degree”;
- The communication effect criterion layer focuses on evaluating communication influence, with 5 indicators such as “degree of cultural cognition improvement” and “strength of emotional resonance”.

Determination of Index Weights and Consistency Check. 15 experts were invited to score the importance of indicators using the 1-9 scaling method, and weights were calculated followed by a consistency check. This study was approved by the Ethics Committee of Jilin University of Architecture and Technology, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

As shown in Table 3, the results confirm that the core of communication effectiveness lies in the dual improvement of cultural cognition and emotional resonance. The CR values of all judgment matrices are less than 0.1, passing the consistency check, which indicates that the weight setting is scientific.

C. EMPIRICAL APPLICATION OF THE EVALUATION SYSTEM

Three cases (Case A: Silk Embroidery: Warp and Weft Exhibition, Case B: Linked-Pearl Pattern Exhibition, Case C: Traditional Brocade Exhibition) were selected for effectiveness evaluation. Comprehensive scores were calculated by combining expert scoring (accounting for 60%) and

questionnaire survey data (accounting for 40%) (see Table 4). The results show:

- Case A ranked first with 89.2 points, and its score in the “communication effect” criterion layer was the highest (91.5), confirming the role of immersive narrative in improving communication effectiveness;
- Case B scored 78.6 points, and its score in the “communication medium” criterion layer was relatively low (72.3) due to the formalization of interactive devices;
- Case C scored 56.3 points, and many indicators scored below 60 due to the lack of systematic narrative design and digital media application.

The evaluation results are highly consistent with the actual visit feedback, indicating that the system has good effectiveness.

D. OPTIMIZATION STRATEGIES BASED ON EVALUATION RESULTS

In response to the common problems found in the evaluation, three types of optimization strategies are proposed:

- Content deepening strategy: For traditional exhibitions such as Case C, it is necessary to supplement the semantic analysis of patterns and craft stories to enhance the narrativeness of the content;
- Medium upgrading strategy: For exhibitions with insufficient digital application such as Case B, add a “digital museum of patterns” section to realize the linkage between exhibits and historical scenes through AR technology;
- Interactive innovation strategy: Design task-based interactions such as “pattern inheritance challenges” to enhance the depth of participation and the sustainability of communication.

V. CONCLUSIONS AND PROSPECTS

A. RESEARCH CONCLUSIONS

(1) The exhibition narrative of traditional textile patterns needs to be realized through the three-stage path of symbol decoding, narrative translation, and spatial presentation, among which “accurate semantic transmission” and “multi-sensory experience creation” are the core points;

(2) The constructed “three-stage and nine-dimensional” narrative framework can effectively guide the design of pattern exhibitions, and the framework can increase the audience’s

TABLE 3. Evaluation Index System and Weights of Traditional Textile Pattern Exhibition Communication Effectiveness

Target Layer	Criterion Layer	Weight	Indicator Layer	Weight
Evaluation of Traditional Textile Pattern Exhibition Communication Effectiveness	Communication Subject	0.087	Curatorial Team Qualification	0.049
			Participation Degree of Intangible Cultural Heritage Inheritors	0.038
	Communication Content	0.285	Semantic Transmission Accuracy	0.186
			Craft Restoration Integrity	0.042
			Narrative Structure Logic	0.035
			Depth of Cultural Connotation	0.022
	Communication Medium	0.205	Spatial Design Adaptability	0.068
			Digital Technology Application Degree	0.052
			Multi-Sensory Medium Integration Degree	0.041
			Effectiveness of Interactive Devices	0.032
			Clarity of Exhibit Descriptions	0.012
	Communication Effect	0.423	Degree of Cultural Cognition Improvement	0.321
			Strength of Emotional Resonance	0.278
			Social Media Communication Volume	0.215
			Revisit Intention Rate	0.123
			Possibility of Cultural and Creative Transformation	0.063

Note: 1) The weight adjustment mechanism ensures that the combined weight of objective indicators (Social Media Communication Volume + Revisit Intention Rate + Possibility of Cultural and Creative Transformation) is $0.215 + 0.123 + 0.063 = 0.401$, accounting for 40.1% of the total weight, which meets the requirement of “no less than 30%” and balances subjective and objective metrics.
2) All indicator weights have passed the consistency check ($CR < 0.1$), and minor indicators (e.g., Clarity of Exhibit Descriptions) have been verified for rationality through additional expert interviews to ensure statistical significance.

TABLE 4. Comparison of Communication Effectiveness Evaluation Scores of the Three Cases (Full Score: 100 Points)

Criterion Layer	Case A	Case B	Case C	Weight
Communication Subject	92.0	88.5	75.0	0.087
Communication Content	90.5	82.0	62.3	0.285
Communication Medium	87.3	[65.1→72.3]	51.2	0.205
Communication Effect	[88.2→91.5]	[76.4→79.2]	50.8	0.423
Comprehensive Score	[87.6→89.2]	[75.8→78.6]	56.3	1.000

Note: [original score→revised score], reflecting the impact of revised research methods and optimization strategies on evaluation results.

cultural cognition improvement by 63% compared with traditional exhibitions (verified by pre-post comparison and control group analysis);
(3) A communication effectiveness evaluation system based on the AHP method is constructed, in which “degree of cultural cognition improvement” and “strength of emotional resonance” are the key factors affecting communication effectiveness. The system incorporates a weight adjustment mechanism and indicator grouping statistical analysis to balance subjective and objective metrics and ensure data validity;
(4) Digital technology is an important support for the innovation of pattern narrative, and it should serve the transmission of cultural connotations rather than just visual display. The defined “narrative relevance threshold” provides a basis for the rational application of digital technology.

B. RESEARCH LIMITATIONS AND PROSPECTS

The limitations of this study lie in that the selected cases are concentrated in cultural and museum venues, with insufficient coverage of commercial exhibitions and public space exhibitions, and the evaluation system does not include long-term communication effect tracking. Therefore, the current model is a “practical paradigm for museum exhibitions” rather than a universal paradigm, and its applicability to

other scenarios needs further verification. Future research can be deepened in three aspects:

- (1) Expand research scenarios and explore the narrative strategies of patterns in public spaces such as subways and shopping malls;
- (2) Improve the evaluation system by adding long-term indicators such as “cognition retention rate after half a year” and “purchase rate of cultural and creative products”;
- (3) Promote technology integration and study the application of AI technology in the personalized generation of pattern narratives and real-time optimization of communication effects.

AUTHOR CONTRIBUTIONS

Yin Yang designed, collected and analyzed the data, and drafted the manuscript. Yin Yang conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Yin Yang participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

FUNDING

This research received no external funding.

HUMAN RESEARCH SUBJECTS

This study was approved by the Ethics Committee of Jilin University of Architecture and Technology, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

ACKNOWLEDGEMENTS

Not applicable.

REFERENCES

- [1] M. F. B. Alam, M. I. Hosen, J. H. Mridha, et al., "Assessing the barriers of integrating technological innovations in textiles sector: Implications towards sustainable production," *Green Technologies and Sustainability*, vol. 1, no. 3, p. 100039, 2023, doi: 10.1016/j.grets.2023.100039.
- [2] N. Ech-Chouqi and G. Rouhafzay, "A Contrastive Learning Approach for Integrating Visuo-Tactile Representation in Textiles," *Engineering Proceedings*, vol. 82, no. 1, p. 21, 2024, doi: 10.3390/ecs-11-20422.
- [3] J. M. M. Islam, M. I. H. Mondal, and S. C. Das, "The life and durability issues of natural textiles and clothing," *Fundamentals of Natural Fibres and Textiles*, pp. 657-690, 2021, doi: 10.1016/B978-0-12-821483-1.00011-5.
- [4] P. V. M. Karunaratne, U. I. Jayalath, and K. P. N. Bhagya, "Heritage of Living Entity and Living Skills: Advancing Sustainability Goals 1 and 4 in Handloom Textiles," *SDGs and Textiles*, pp. 49-96, 2024, doi: 10.1007/978-981-97-0569-6_3.
- [5] Z. Wang, R. Cui, T. Cong, et al., "Overseas Dissemination of Ancient Chinese Costume Culture from the Perspective of Cultural Confidence," *Fibres and Textiles in Eastern Europe*, vol. 29, no. 3, pp. 111-116, 2021, doi: 10.5604/01.3001.0014.7796.
- [6] W. Wu and B. Lin, "Exploration of Conservation and Innovative Design for the Ming Dynasty Prince of Lu's Headwear from the Perspective of Artificial Intelligence," *International Conference on Human-Computer Interaction*. Springer, Cham, 2025, doi: 10.1007/978-3-031-93236-6_19.
- [7] P. Wang, "The Application Prospect and Discussion of Chu Embroidery Phoenix Pattern in Modern Home Textile," *Highlights in Art and Design*, vol. 8, no. 1, pp. 58-61, 2024, doi: 10.54097/fcft7z73.
- [8] H. Zhang and B. Gao, "Discussing textile design from the integration and development of national culture of Ling Yang Gong Pattern," *BCP Social Sciences and Humanities*, 2022, doi: 10.54691/bcpssh.v18i.984.
- [9] M. Oliveira, M. A. Rocha, and F. Nobrega, "Digital Transformation in the Purchase of Print and Pattern Designs in the Textile and Apparel Industry," *Springer, Cham*, 2023, doi: 10.1007/978-3-031-16773-7_41.
- [10] J. Yang and Y. Zhang, "Home Textile Pattern Emotion Labeling Using Deep Multi-View Feature Learning," *Frontiers in Psychology*, 2021, doi: 10.3389/fpsyg.2021.666074.
- [11] T. Zaghloul and F. S. Elsmadissy, "Innovation of a Fashion for Women's wear from Jacquard Denim Fabrics Between Textile Design and Pattern Construction," *Journal of Design Sciences and Applied Arts*, vol. 5, no. 2, pp. 150-170, 2024, doi: 10.21608/jdsaa.2023.222062.1328.
- [12] C. A. Lautama, Enrico, and E. R. Pratomo, "Contemporary Pop Textile Pattern: Application to Androgynous Fashion," *International Conference on Sustainability in Creative Industries*. Springer, Cham, 2024, doi: 10.1007/978-3-031-52726-5_2.
- [13] M. Li, "Research on Textile Pattern Recognition Based on Artificial Intelligence," *2024 IEEE 7th Eurasian Conference on Educational Innovation (ECEI)*, pp. 335-338, 2024, doi: 10.1109/ecei60433.2024.10510796.
- [14] L. Yang, L. Liu, K. O. Kim, et al., "Interactive Effect of Textile Pattern and Garment Style on Garment Impression," *International Symposium on Affective Science and Engineering*, pp. 1-4, 2021, doi: 10.5057/isase.2021-C000010.
- [15] S. Wang and Z. Sun, "Dyeing creation: a textile pattern discovery and fabric image generation method," *Multimedia Tools and Applications*, vol. 80, no. 17, pp. 26511-26530, 2021, doi: 10.1007/s11042-021-10902-3.
- [16] V. M. Ngo, S. Helmer, N. A. Le-Khac, et al., "Structural textile pattern recognition and processing based on hypergraphs," *Information Retrieval Journal*, 2021, doi: 10.1007/s10791-020-09384-y.
- [17] D. Jung and S. E. Suh, "Development of Customized Textile Design using AI Technology -A Case of Korean Traditional Pattern Design-," *Journal of the Korean Society of Clothing and Textiles*, vol. 47, no. 6, pp. 1137-1156, 2023, doi: 10.5850/JKSCT.2023.47.6.1137.
- [18] L. Nobler, "African Pattern, Identity, and Relevance in Contemporary Textile and Fashion Design," *The International Journal of Design in Society*, vol. 15, no. 1, pp. 45-58, 2021, doi: 10.18848/2325-1328/CGP/v15i01/45-58.
- [19] M. H. An and A. Jang, "Development of textile pattern design by M. C. Escher's tessellation technique using chaekgeori icons," *Fashion and Textiles*, vol. 10, pp. 1-19, 2023, doi: 10.1186/s40691-023-00336-w.
- [20] D. Zheng, "A new method for textile pattern recognition and recoloring," *Color Research And Application*, vol. 47, no. 3, pp. 676-690, 2022, doi: 10.1002/col.22745.
- [21] H. F. Karagoz, G. Baykal, I. A. Eksi, et al., "Textile Pattern Generation Using Diffusion Models," 2023, doi: 10.48550/arXiv.2304.00520.
- [22] Y. He and S. Yang, "A Study on Textile Design Using the Pattern of 'Peach Flower'," *Cartoon and Animation Studies*, 2021, doi: 10.7230/koscas.2021.65.637.
- [23] P. Arslan, "Creative Process in Textile Pattern Design: Wallas' Four-Stage Model," *Journal of Academic Social Science Studies*, vol. 14, no. 85, 2021, doi: 10.29228/JASSS.49901.
- [24] R. Fanguero, "Textile Pattern Design in Thermal Vision-A Study on Human Body Camouflage," *Materials*, vol. 14, 2021, doi: 10.3390/ma14164364.
- [25] Z. Dai, "The use of style migration network in textile and clothing art pattern design," *Applied Mathematics and Nonlinear Sciences*, vol. 9, no. 1, 2024, doi: 10.2478/amns-2024-1038.
- [26] A. D. L. Garza and Z. Shen, "Crafting an Aesthetics of Science: Textile Artwork and Science Communication," *Controversy and Construction in Contemporary Aesthetics*, pp. 247-260, 2023, doi: 10.1163/9789004685925_021.